UISPP UNION INTERNATIONALE DES SCIENCES PRÉHISTORIQUES ET PROTOHISTORIQUES
INTERNATIONAL UNION OF THE PREHISTORIC AND PROTOHISTORIC SCIENCES
EXPLORING THE WORLD'S PREHISTORY

Studies on the Palaeolithic of Western Eurasia presents the papers from Sessions XVII-4 and XVII-6 of the 18th UISPP World congress (Paris, June 2018). The geographic areas discussed in the Session 4, Central and Eastern Europe, are prehistorically strongly articulated, their cultural successions are highly similar, and they share several common archaeological issues for investigation. The papers disseminate a wealth of archaeological data from Bavaria to the Russian Plain, and discuss Aurignacian, Gravettian, Epigravettian, and Magdalenian perspectives on lithic tool kits and animal remains. The papers of Session 6 are concerned with lithic raw material procurement in the Caucasus and in three areas of the Iberian peninsula.

György Lengyel an associate professor at the Department of Prehistory and Archaeology of the University of Miskolc, Hungary, and research associate at the Institute of Systematics and Evolution of Animals of the Polish Academy of Sciences. He graduated at the University of Miskolc, and received a PhD degree from the University of Haifa, Israel. His main field of research is the Upper Palaeolithic of Central Europe. The focus of his research is hunter-gatherer subsistence strategy and the formation of the corresponding archaeological record. He conducts research projects on the Upper Palaeolithic of the Levant and Central Europe. ORCID: 0000-0002-7803-3043

Jarosław Wilczyński is head of the Department of Vertebrate Zoology of the Institute of Systematics and Evolution of Animals of the Polish Academy of Sciences. He graduated in archaeology at the Jagiellonian University in Kraków, and received his PhD in archaeozoology at the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences. His interests are two-pronged, including studying Upper Palaeolithic and Neolithic lithic inventories, as well as Pleistocene and Holocene faunal assemblages. He conducts research projects on the Gravettian and the Epigravettian of Central Europe. ORCID: 0000-0002-9786-0693.

Marta Sánchez de la Torre is currently a Beatriu de Pinós postdoctoral researcher at the *Prehistoric Studies and Research Seminar* (SERP) of the University of Barcelona. Her research has mainly focused on the analysis of lithic raw materials by Palaeolithic groups settled in the Pyrenean region by the use of traditional approaches as well as geochemical methods. She is currently directing archaeological seasons at several sites in NE Iberia and participates in different projects in France and Spain.

Xavier Mangado is a professor in prehistory at the University of Barcelona and researcher at the *Prehistoric Studies and Research Seminar* (SERP) of the University of Barcelona. He specialise in the analysis of lithic raw materials, mostly by using petrographic and micropalaeontological tools. His research is mainly focused on the study of Palaeolithic groups settled in NE Iberia and he has also participated in several international projects at Portugal, France and Jordan.

Josep Maria Fullola has been a professor in prehistory at the University of Barcelona since 1985. In 1986 he created the *Prehistoric Studies and Research Seminar* (SERP) of the University of Barcelona, a research group that promotes advanced research in prehistoric archaeology, being since its creation the main director. He has directed archaeological seasons in several Palaeolithic sites in NE Iberia, but he has also been involved in international projects in Baja California, France and Portugal.

ARCHAEOPRESS ARCHAEOLOGY www.archaeopress.com

ISBN 978-1-78969-717-9

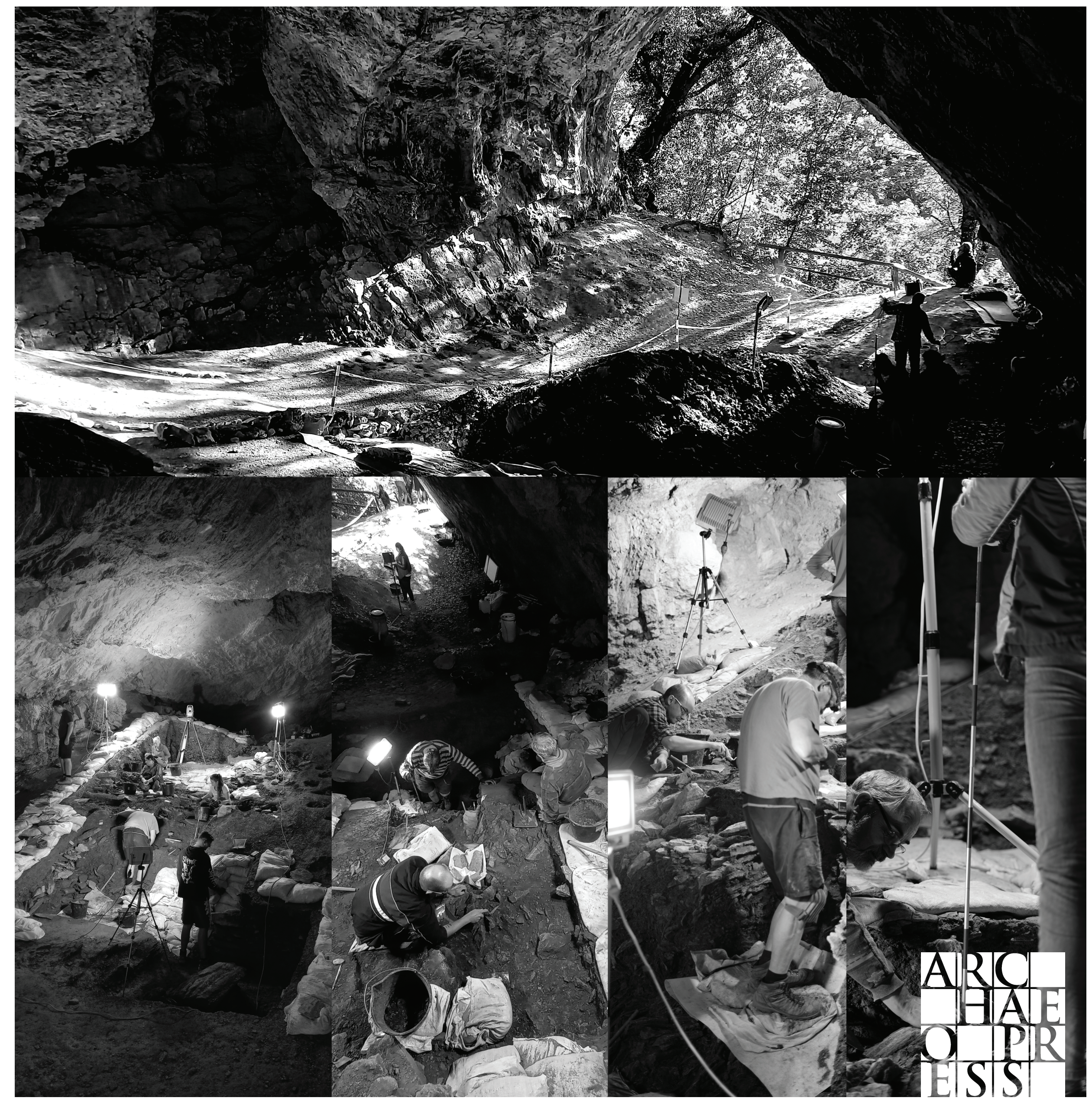
Lengyel *et al.* (eds) Studies on the Palaeolithic of Western Eurasia ARCHAEOPRESS

2018 Paris 4-9 juin uispp Union Internationale des Sciences Préhistoriques et Protohistoriques XVIII[e] Congrès

Studies on the Palaeolithic of Western Eurasia

edited by

György Lengyel, Jarosław Wilczyński, Marta Sánchez de la Torre, Xavier Mangado, Josep Maria Fullola



Raw material procurement at Abrigo do Poço Rock shelter (Central Portugal)

Telmo Pereira[1-4], Eduardo Paixão[5-6], Marina Évora[6], João Marreiros[5,6], David Nora[6], Patrícia Monteiro[6-7], Sandra Assis[8-9], Vânia Carvalho[10], Trenton Holliday[11,12]

[1] Universidade Autónoma de Lisboa, Portugal
[2] Instituto Politécnico de Tomar, Portugal
[3] CGeo – Centro de Geociências da Universidade de Coimbra, Portugal
[4] UNIARQ – Centro de Arqueologia da Universidade de Lisboa, Portugal
[5] Museu de Leiria, Câmara Municipal de Leiria, Portugal
[6] Tulane University, New Orleans, USA
?[5] TraCEr – Laboratory for Traceology and Controlled Experiments, MONREPOS – Archaeological Research Centre and Museum for Human Behavioural Evolution. RGZM. Germany
?[6] ICArHEB – Interdisciplinary Centre for Archaeology and Evolution of Human Behaviour, Universidade do Algarve, Portugal
[7] Era Arqueologia, SA
[8] CRIA – Centro em Rede de Investigação em Antropologia, Universidade Nova de Lisboa, Portugal
[9] CIAS – Centro de Investigação em Antropologia e Saúde, Universidade de Coimbra, Portugal
[10] Museu de Leiria, Câmara Municipal de Leiria, Portugal
[11] Tulane University, New Orleans, USA
[12] Centre for the Exploration of the Deep Human Journey, University of the Witwatersrand, South Africa

Abstract

Abrigo do Poço is a rock shelter located in the karstic canyon of Ribeira das Chitas in the River Lis basin (Central Portugal). The site has an Epipaleolithic occupation overlying a Solutrean occupation. Despite the multiple available resources in the vicinity, the main activity during the Upper Paleolithic occupation seems to have been the exploitation of a small chert outcrop located right above it. This outcrop extends in patches throughout the vicinity due to the combination of tectonic activity and fluvial erosion that results in multiple canyons. Interestingly, the outcrop above the site is one in which the chert is less expressive, probably due to exhaustion during the Solutrean, during which the site was used to heat-treat chert for the production of blades and, especially, bifacial points. The chert from this site has different colors, patterns and textures due to internal variability and to external agents (tectonic, patina). Here we present the macroscopic and geochemical characteristics of this outcrop throughout the valley and discuss the issue of potentially misleading interpretations when only one of these approaches is used.

Keywords: Epipalaeolithic; Solutrean; chert; River Lis basin; western Iberia

Résumé

Abrigo do Poço est un abri rocheux situé dans le canyon karstique de Ribeira das Chitas, dans le bassin de la rivière Lis (centre du Portugal). Le site a une occupation épipaléolithique qui recouvre une occupation solutréenne. Malgré les multiples ressources disponibles dans les environs, l'activité principale pendant l'occupation du Paléolithique supérieur semble avoir été l'exploitation d'un petit affleurement de chaille (chert) situé juste au-dessus. Cet affleurement s'étend en parcelles dans tout le voisinage en raison de la combinaison de l'activité tectonique et de l'érosion fluviale qui se traduit par de multiples canyons. Fait intéressant, l'affleurement au-dessus du site est celui dans lequel la chaille est moins massive, probablement en raison de l'épuisement pendant le Solutréen, période au cours de laquelle le site a été utilisé pour traiter à la chaleur la chaille pour la production de lames et, en particulier, des pointes bifaciales. La chaille de ce site a différentes couleurs, motifs et textures, en raison de la variabilité interne et des agents externes (tectonique, patine). Nous présentons ici les caractéristiques macroscopiques et géochimiques de cet affleurement dans toute la vallée et discutons de la question des interprétations potentiellement trompeuses, lorsqu'une seule de ces approches est utilisée.

Mots-clés : Epipaleolithique ; Solutreen ; chaille ; bassin de la riviere Lis ; Iberie occidentale

1. The EcoPLis Project

The behavioural ecology and ecodynamics of the Pleistocene and Early Holocene populations that lived in westernmost Iberia is a crucial paleoanthropological issue. This is because there is increased information about coastal foraging not only by modern humans, but also by pre-modern humans. In addition, this particular coast is rich in marine and brackish resources, including when climatic shifts resulted in increased upwelling (Abrantes 1988, 1990, 1991, 2000; Abrantes and Moita 1999; Abrantes *et al.* 1998; Fiuza 1982, 1983; Loureiro *et al.* 2005). Further still, far too often archaeological and paleoanthropological research projects tend to focus on a single landscape rather than the connection between them, resulting in a biased interpretation of the framework in which the human behaviour occurred.

To help contribute more relevant data, in 2015 we started the EcoPLis project (Human Occupations in the Pleistocene Ecotones of River Lis). The River Lis Basin (Leiria, Portugal) is an ecotone between different landscapes rich in multiple resources. This project focuses not only on the coast, but also on the inland and territories in between, giving special attention to the karstic canyons where multiple caves, rock shelters and open-air sites preserve long sequences with rich assemblages and organic material with great preservation. The recurrent presence of salty/brackish water shellfish in sites more than 25 km inland, as well as sites located on the shore were strong indicators that human populations have since the Middle Pleistocene been recurrently circulating between the coast and the inland through karstic canyons. Despite this, there has never been a systematic investigation focusing on the human behavioral ecology and patterns of coastal foraging in this region.

Through EcoPLis, we aim to solve the problem of coarse and dispersed information from westernmost Iberia in order to produce a more detailed understanding of human behavioural ecology and ecodynamics during the Pleistocene and Early Holocene. Among other issues, it aims to bring relevant data about coastal foraging patterns, from a diachronic perspective, and using a high-resolution approach. Surveys, tests and excavations in rock shelters, caves and open-air sites done since 2015 already cover a chronology from the Acheulean to the Chalcolithic. One of the sites tested and then subsequently excavated is Poço Rock Shelter.

2. Geological and geomorphological background

The River Lis basin has 850 km^2 of surface drainage and 945 km^2 taking into account its underwater drainage (Almeida *et al.* 1989; Dinis 1996; Gonçalves and Dinis 2007; INAG 1999), and runs between 585 and 0 m.a.s.l.. It is located in the Western Portuguese Mesocenozoic Edge (Almeida *et al.* 1989; Gonçalves and Dinis 2007). The basin sits on Mesozoic deposits, with the oldest ones associated with lagoon formations during the Hetangian-Recian. In the past, the continental environment produced the present plaster and salt deposits. With the Lusitanian there is a strong marine regression and the creation of marls, clays and sandstone deposits, frequently with associated fossils. In the beginning of the Jurassic the formation of the Leiria-Monte Real diapir began, and with volcanic activity, doleritic domes and lodges were formed (Teixeira *et al.* 1968). The Leiria-Parceiros and Monte Real diapirs, along with the Torrinhas/Reguengo do Fetal and Senhora do Monte main faults drove the N-S orientation of the Lis and Lena rivers, as well as the E-W orientation of most of the smaller streams, with the most important springs along the western face of the eastern mountains (Almeida *et al.* 1989).

Until the end of the Middle Jurassic there was a long-term transgressive phase that, especially during the Batonian and Callovian, resulted in a strong accumulation of calcareous sediments. However, between the Middle and Upper Jurassic there is a hiatus in the geological record (Azerêdo *et al.* 2003; Gonçalves and Dinis 2007) that is followed by a large marine transgression with the sea covering the entire region (Teixeira *et al.* 1968). In the last phase of the Cretaceous and beginning of the Cenozoic another marine regression with specific environmental conditions result in the silification of Turonian limestone. During the Cenomanian another marine transgression flooded the entire basin and between the Cenomanian and the Eocene there was strong erosion (Gonçalves and Dinis 2007; Teixeira *et al.* 1968). Through the Miocene the region was a continental landscape with lagoons but, by the Pliocene, several marine transgressions covered large areas, leaving a rich fossil record (Teixeira *et al.* 1968).

In higher areas during the Pleistocene, the drainage system created a network of canyons, caves and other karstic phenomena in the Jurassic and Cretacic deposits. This shaped a hilly landscape with steep cliffs but in lower areas it created fluvial and marine siliclastic deposits (quartz and quartzite gravels supported packed by sand to clay) over the Miocene and Pliocene formations (Gonçalves and Dinis 2007; Teixeira *et al.* 1968). It is possible that during the Last Glacial Maximum the sea level was 120 to 140 m below the present sea level, exposing hundreds of km^2 of the continental platform (Dias *et al.* 2000; Dias 2004) and creating a very different landscape, with much steeper talwegs, and making the present coast a deep inland territory. With the post-glacial progressive global warming, but particularly during the Holocene, the sea level rose and a thick dune was formed along with other eolian deposits, lagoons and estuaries (Dias 2004; Dinis 1996; Gonçalves and Dinis 2007; Teixeira *et al.* 1968).

3. Poço Rock Shelter (AdP)

Poço Rock Shelter (Figure 1) sits in the Chitas Valley, between 100 and 115 m.a.s.l., and ~26 km from the present sea coast. Around it are several primary chert outcrops. The 14 Stratigraphic Units thus far identified encompass Epipaleolithic and Solutrean archaeological horizons (Figure 2 and Table 1):

Epipaleolithic: Abundant sandy and brackish/salty waters species (*Scrobicularia plana, Cerastoderna edule* and *Ensis sp.*), micromammals, Leporidae, fragmented unidentifiable macromammal diaphyses and charcoal. The rich lithic assemblage has quartzite (fire cracks, flakes and chopper-like cores), quartz (prismatic and bipolar cores, chipped stones, small flakes and bladelets) but is mostly chert (small prismatic cores, burins, flakes and bladelets). AMS dates on Arbutus unedo (8208 ± 38 BP) and Cerastoderna edule (8276 ± 40 BP) point for an occupation at the Early-Middle Holocene transition and an AMS date on *Scrobicularia plana* (9205 ± 40 BP) may be inflated by the ecology of this species.

Stratigraphic unit.	Material	Result
1	*Scrobicularia plana*	9205 ± 40
1	*Arbutus unedo*	8208 ± 38
4	*Cerastoderna edule*	8276 ± 40
6-10	Bone (ind)*	19170 ± 120
6-10	*Salix/Populus*	209 ± 27
14	*Cervus elaphus***	18510 ± 100

Table 1. Poço Rock Shelter. AMS absolute dates.

Solutrean: Mostly composed of lithics with a small faunal assemblage dominated by *Cervus elaphus*. The lithic assemblage has quartzite (fire cracks, hammer stones, anvils, flakes and chopper-

Figure 1. Poço Rock Shelter. A: Location in the Iberian Peninsula from Google Earth. and location of Poço Rock Shelter (red triangle) with 5, 10 and 15 km ranges. Chert sources: 1- Picassinos, 2- Tojeira, 3- Areeiro do Aeródromo Este (AAE); 4- Boavista, 5- Opeia, 6- Martinela, 7- Epígrafe, 8- Bancada das Chitas (BChitas), 9- Curvachia, 10- Arroteia.

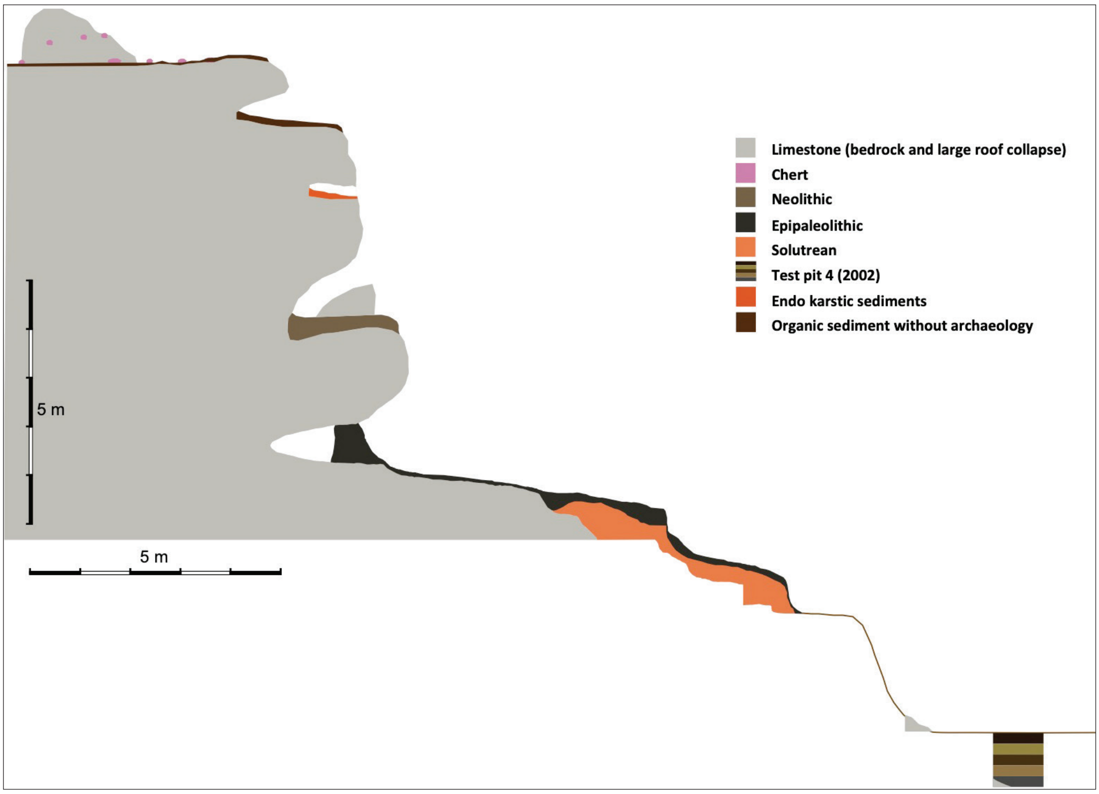


Figure 2. Poço Rock Shelter. Schematic profile with the location of the chert outcrop, the excavated trench, and the test pit excavated in 2002 that lead to the identification of the site.

like cores), quartz (prismatic and bipolar cores, chipped stones, small flakes and bladelets) but mostly chert (prismatic cores, large burins, flakes, blades and bladelets, large amounts of crests, flanks, and bifacial trimming flakes along with bifacial preforms and bifacial fragmented tips with central tang). Lithics are often burned, suggesting in situ heat-treatment. AMS dates on indeterminate bone of medium/large fauna (19,170 ± 120 BP) and *Cervus elaphus* 18,510 ± 100 BP point for an occupation at the between the GS2 and the GS3.

4. Materials and Methods

Many of the raw material sources identified and georeferenced in the River Lis basin have been previously documented but not characterized (Carvalho 2011; Carvalho and Carvalho 2007; Município de Leiria 2015). With EcoPLis we began to produce a much more detailed geographic record of these primary, sub-primary and secondary sources and their characterization. With regard to chert, primary sources were defined as a continuous limestone formation with chert nodules and/or lenses. Sub-primary sources were defined as concentrations of nodules or chunks found outside of the bedrock but adjacent to it, usually immediately in front of, or downslope of, the outcrop. Finally, secondary sources were defined as a concentration of nodules or chunks that are outside of and clearly away from the original bedrock. In this case, these nodules or chunks are usually rolled and packed in marine or fluvial terraces, or can be found along the coast, brought in by wave action. This suggests they were brought from inland by the fluvial network, or that there are other chert sources underwater that may have been available to Pleistocene hunter-gatherers when the sea was several kilometres away. Thus, these and other outcrops may not be visible (e.g. covered by a thick deposit such as a marine or fluvial terrace, dune fields, the Ocean, or construction) or no longer exist (e.g. the softer limestone with chert is highly exposed and was heavily eroded to exhaustion, modern work obliteration, etc.). The concentration can occur at the surface (often as debris flow), inside or at the surface of a terrace or below in a colluvium but often as loose gravel and usually visible due to local erosion (e.g. a road cut, torrential stream or slope dynamics) (Figure 3).

The recording of the perimeter of each visible primary, sub-primary and secondary chert source has been marked using a tablet or smartphone with GPS in order to make a georeferenced polygon with a ca. 5 m error. In the case of quartz and quartzite used for knapping, as well as other local volcanic raw materials that may have been used for knapping and adornments (Nora *et al.* 2017; Pereira *et al.* 2018), these can be found in the rich gravel deposits associated with marine and fluvial terraces. These terraces have extensive areas and most of them are already mapped on geological maps (Teixeira *et al.* 1968). For the purpose of study of the chert, we collected multiple hand samples from each source in order to cover its internal variability (size, shape, colours, internal flaws, etc.).

To identify the geochemical signature of the different chert sources in the River Lis basin, we randomly selected hand samples from each source and analysed their geochemical composition. The geochemical analysis was done from Magnesium (^{12}Mg) to Uranium (^{92}U) by p-XRF for 240 seconds (equally divided in 120 seconds for heavy and light elements) using a portable energy dispersive spectrometer Bruker™ S1 Titan®. The equipment was mounted in «Desktop Configuration» with the lid closed during analysis on a solid professional desktop. During the readings, the personnel were kept at a safe distance to avoid radiation exposure and any contact that could result in the movement of the samples. The p-XRF was equipped with a rhodium X-ray tube and FAST® SDD detector, 5 mm collimator, S1RemoteCtrl filter, and S1Sync software. The calibration used was set on the default calibration (Application Geochem General Method Dual Mining). The archaeological specimens (Figure 4) were selected in order to get the most macroscopic variability as possible, and each artefact was analysed on a clean, flat and homogeneous surface. When possible, due to the dimensions and volume of the sample, more

Figure 3. Different chert sources in the basin of the River Lis and used in this study.
a) Bancada das Chitas; b) Martinela; c) Opeia; d) Remaining nodules
from the Poço plateau outcrop.

than one analysis was done on each specimen. The geological specimens were analysed on a clean, flat and homogeneous fresh cut.

Statistical analysis aimed to verify internal variability of the chert samples from Poço and their similarity to other regional sources. In order to do that we performed cluster analysis (Classical hierarchical clustering) with PAST® 3.24 software using the unweighted pair group method with arithmetic mean (UPGMA) algorithm and Euclidean Similarity Index and Stratigraphy Constrained with a cophenetic correlation of 0.2332.

5. Results

Results from the geochemical analysis can be seen in Figure 5 and Table 2.

Chert specimens present macroscopic and geochemical variability. From a geochemical point of view, the chert from the River Lis basin is relatively homogeneous with regard to the presence and absence of light and heavy elements. Bancada das Chitas (BChitas), Epigafe, Curvachia correspond to the same outcrop on the valley separated by only some hundred meters. These sources show some geochemical variability, including on the same nodule (ex: 589-590, 599-600 and 605-606). Areeiro do Aeródromo Este (AAE) is a 20 m thick sand-supported terrace with a gravel-supported base dominated by quartzite and quartz but in which large pebbles of good quality and homogeneous light-red chert are easily found. Usually these nodules are distinct and the original source is still to be found. Other nodules from this terrace cluster with those from Curvachia, Opeia and Tojeira suggesting natural feeding of the River Lis terraces by local but complex fluvial erosion and transportation of nodules. Tojeira and Picassinos

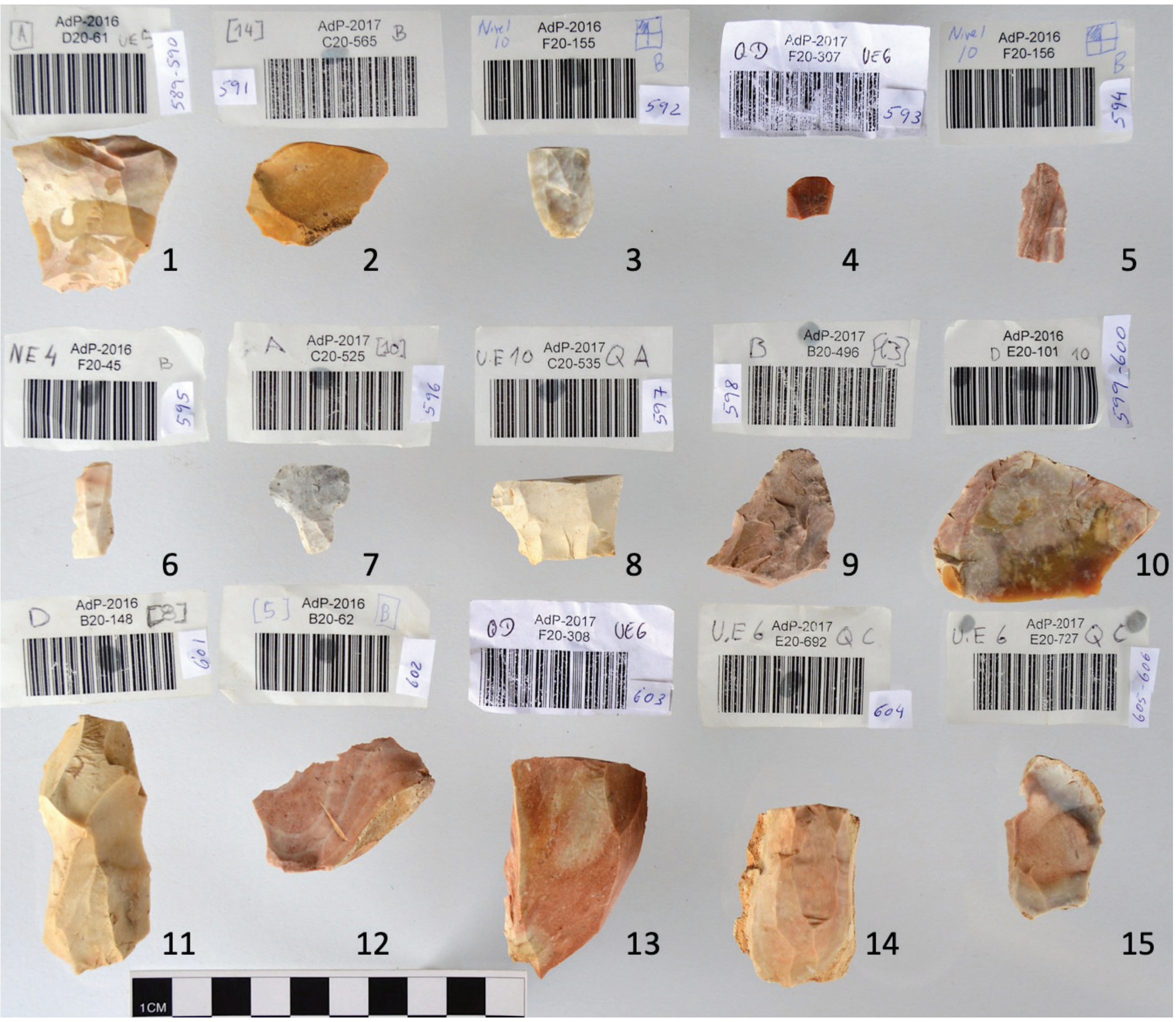


Figure 4. Poço Rock Shelter. Archaeological specimens used in this study.

correspond to a terrace with nodules in secondary position. The fact that they cluster with the samples taken from the primary and sub-primary sources of Opeia and Epígrafe reinforces this idea.

From a geochemical point of view, most samples have high values of Silicon but some samples gathered in secondary position are clearly dissilicified. Elements such as Cobalt, Nickel, Strontium, Zirconium, Molybdenum, Silver, Tin, Barium, Cerium, Tungsten and Zink are rare and Cobalt, Nickel, Zink, Silver, Tin, Barium, Cerium, Tungsten were not detected in Poço samples. Chromium was also not detected in Poço samples but is common in the ot her samples. Aluminum, Iron, Calcium and Potassium are relevant in the Poço samples.

Overall Poço (AdP) samples are very similar to each other and cluster outside of the remaining samples, suggesting an outcrop with very distinct characteristics. These characteristics are significantly different from the other nearby sources such as Bancada das Chitas, Martinela and Epígrafe, and this may have been the reason for the selection of this site for the production of the Solutrean points instead of the others, despite its being very small. Nevertheless, an overall perspective of this outcrop is difficult due to its almost complete exhaustion. Detailed and complementary analysis will be necessary in the near future, namely to recognize chert that may have been brought from other sources and discarded at Poço.

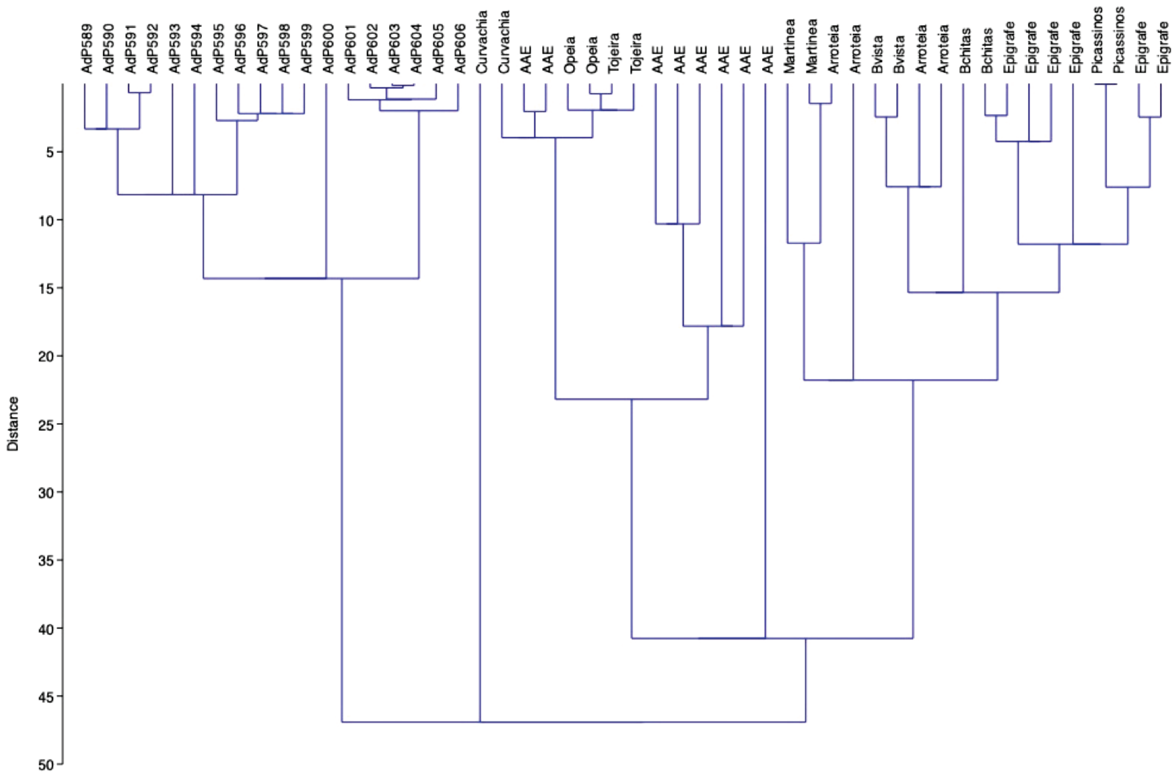


Figure 5. Classical hierarchical cluster analysis using the unweighted pair group method with arithmetic mean (UPGMA) algorithm and Euclidean similarity index and stratigraphy constraint.

6. Discussion

Previous work has shown that, following the pattern from Portugal, quartz, quartzite and chert were the most common raw materials used also in the Lis River basin during the Pleistocene and Early Holocene (Almeida *et al.* 2002; Aubry *et al.* 2005; Brás *et al.* 2006; Cunha-Ribeiro 1999; Haws *et al.* 2010; Pereira 2010; Zambujo and Carvalho 2005). These rocks occur in different conditions in the landscape. Nodules of quartz and quartzite of good quality can be easily found only in secondary position as water-worn pebbles in the gravel deposits of the marine and fluvial terraces. A different scenario occurs with chert that can be acquired in primary, sub-primary and secondary deposits. Primary deposits correspond to layers in Cenomanian limestone that can be very discrete and localized lenses or can cover larger areas but usually with ca. 100 m^2. Often the chunks gathered in these places have multiple flaws caused by tectonics that make them crumble very easily. Overall, the farther away the nodule is from the outcrop, the better its quality, because nature took care of destroying the smaller and fragile elements and of removing loose parts of larger boulders, leaving regular and homogeneous nodules of pebble- to boulder- size in the terraces. Still, these were better to use during the Acheulean, not only for the production of handaxes and cleavers but also because it is where it seems that people were living. In fact, occupations of such age are still unknown in the canyons, suggesting that the formation of the canyons may have been later, but before the Upper Palaeolithic.

The geomorphology of Chitas canyon makes it an easy and safe path between the inland mountains and the coast, while its fertile and humid conditions allow a diverse and abundant fauna and flora. As such, it may have had almost perfect ecological conditions to serve as a refuge during the harsher portions of the Pleistocene. The sheltered position of Poço Rock Shelter, facing two transversal smaller valleys, the presence of a spring, and the abundance of chert make it a perfect hunting stand. The combination of these assets in a single place may have been

File #	MgO	MgO Err	Al2O3	Al2O3 Err	SiO2	SiO2 Err	P2O5	P2O5 Err	S	S Err	Cl	Cl Err	K2O	K2O Err	CaO	CaO Err	TiO2	TiO2 Err	V	V Err	Cr
AdP589	< LOD	0.6332	0.6908	0.1630	100.0000	0.5908	0.0291	0.0092	0.0368	0.0064	< LOD	0.0120	0.0820	0.0049	0.0099	0.0039	0.0062	0.0031	< LOD	< LOD	< LOD
AdP590	0.7724	0.6680	3.6204	0.2028	98.6415	0.5698	0.0409	0.0105	0.0454	0.0066	0.0143	0.0118	0.1668	0.0059	0.0515	0.0043	0.0216	0.0031	< LOD	< LOD	< LOD
AdP591	< LOD	0.6410	0.5189	0.1629	100.0000	0.5969	0.0350	0.0096	0.0373	0.0065	< LOD	0.0117	0.0482	0.0045	0.0347	0.0042	0.0033	0.0031	< LOD	< LOD	< LOD
AdP592	< LOD	0.6331	< LOD	0.1531	100.0000	0.5847	0.0273	0.0092	0.0250	0.0064	< LOD	0.0122	0.0505	0.0046	< LOD	0.0038	0.0043	0.0032	< LOD	< LOD	< LOD
AdP593	< LOD	0.3602	0.7417	0.1506	91.6757	0.5281	0.0424	0.0083	< LOD	0.0061	0.1385	0.0164	0.0560	0.0041	< LOD	0.0034	0.0059	0.0027	< LOD	0.0002	< LOD
AdP594	< LOD	0.6549	0.4399	0.1654	100.0000	0.6217	0.0291	0.0095	0.0574	0.0068	0.0323	0.0122	0.1043	0.0053	0.0508	0.0044	0.0107	0.0031	< LOD	< LOD	< LOD
AdP595	< LOD	0.3712	0.6227	0.1544	96.3779	0.5547	0.0508	0.0096	0.0392	0.0066	0.0446	0.0139	0.0491	0.0043	0.1840	0.0057	0.0076	0.0028	< LOD	0.0001	< LOD
AdP596	< LOD	0.3810	0.5091	0.1593	100.0000	0.5992	0.0512	0.0093	0.0402	0.0064	0.0215	0.0133	0.0483	0.0044	0.1881	0.0057	0.0052	0.0029	< LOD	< LOD	< LOD
AdP597	0.6916	0.6363	0.9498	0.1641	97.7370	0.5638	0.0262	0.0094	0.0185	0.0064	< LOD	0.0124	0.0580	0.0047	0.0254	0.0042	0.0063	0.0031	0.0001	0.0001	< LOD
AdP598	< LOD	0.6419	0.6135	0.1616	100.0000	0.5760	0.0339	0.0102	0.0094	0.0063	< LOD	0.0120	0.0671	0.0049	0.0250	0.0042	0.0112	0.0031	< LOD	< LOD	< LOD
AdP599	< LOD	0.6564	1.6253	0.1758	98.0419	0.5660	0.0286	0.0099	0.0122	0.0065	< LOD	0.0126	0.1067	0.0054	< LOD	0.0040	0.0097	0.0032	0.0002	< LOD	< LOD
AdP600	0.7089	0.6018	1.4365	0.1603	84.1478	0.4909	0.0438	0.0110	< LOD	0.0065	< LOD	0.0126	0.0862	0.0050	0.3152	0.0069	0.0150	0.0031	0.0022	0.0004	< LOD
AdP601	< LOD	0.4180	2.1261	0.1850	100.0000	0.5876	0.0481	0.0107	0.0439	0.0067	< LOD	0.0115	0.0911	0.0051	0.0768	0.0046	0.0187	0.0032	< LOD	< LOD	< LOD
AdP602	< LOD	0.3850	0.6493	0.1603	100.0000	0.5873	0.0474	0.0087	< LOD	0.0062	0.0490	0.0157	0.0522	0.0043	0.0088	0.0039	0.0093	0.0028	< LOD	< LOD	< LOD
AdP603	< LOD	0.6647	0.6225	0.1660	100.0000	0.6040	0.0255	0.0094	0.0307	0.0065	< LOD	0.0121	0.0670	0.0049	0.0246	0.0041	0.0090	0.0032	< LOD	< LOD	< LOD
AdP604	< LOD	0.6813	0.7573	0.1704	100.0000	0.6084	0.0292	0.0099	0.0217	0.0064	< LOD	0.0121	0.0762	0.0051	0.0285	0.0042	0.0055	0.0032	< LOD	< LOD	< LOD
AdP605	< LOD	0.4526	1.7932	0.1904	100.0000	0.6426	0.0428	0.0102	0.0344	0.0066	0.0134	0.0131	0.1196	0.0056	0.0658	0.0046	0.0126	0.0032	< LOD	< LOD	< LOD
AdP606	0.6452	0.6017	1.4597	0.1694	98.2624	0.5668	0.0562	0.0095	0.0282	0.0062	< LOD	0.0135	0.0717	0.0046	0.1092	0.0049	0.0108	0.0029	< LOD	< LOD	< LOD
Curvachia	1.1812	0.3973	0.1501	0.1161	43.5038	0.3314	0.1381	0.0165	< LOD	0.0102	< LOD	0.0077	0.0348	0.0046	0.0916	0.0052	0.0333	0.0026	< LOD	0.0015	0.0072
Curvachia	< LOD	< LOD	0.2296	0.1688	100	0.6434	0.0717	0.0127	0.0074	0.0051	< LOD	0.0162	0.0317	0.0044	0.0188	0.004	0.004	0.0017	< LOD	< LOD	0.0069
AAE	< LOD	< LOD	0.2241	0.1534	97.0368	0.5656	0.0545	0.0121	< LOD	0.0056	0.0186	0.0159	0.0275	0.0042	0.0116	0.0038	0.0046	0.0017	0.0003	0.0001	0.0066
AAE	< LOD	< LOD	0.5593	0.157	95.0225	0.5534	0.0533	0.012	0.0148	0.0059	0.0357	0.0157	0.0576	0.0046	0.0268	0.004	0.0046	0.0016	0.0002	0.0001	0.0061
Opeia	< LOD	< LOD	< LOD	0.1518	100	0.5892	0.066	0.0109	0.0343	0.0053	0.0231	0.0152	0.0361	0.004	0.013	0.0034	0.0026	0.0016	< LOD	< LOD	0.008
Opeia	< LOD	< LOD	< LOD	0.1482	97.5249	0.5687	0.0666	0.0113	0.0128	0.0054	< LOD	0.0154	0.0255	0.0041	0.0089	0.0036	< LOD	0.0016	0.0001	< LOD	0.0073
Tojeira	< LOD	< LOD	0.278	0.1539	98.2064	0.5736	0.0643	0.0121	< LOD	0.0054	0.0202	0.0152	0.0374	0.0044	0.0534	0.0044	0.0038	0.0017	0.0001	< LOD	0.0065
Tojeira	< LOD	< LOD	< LOD	0.1564	99.7592	0.5863	0.0782	0.0132	< LOD	0.0054	< LOD	0.0153	0.0257	0.0042	0.037	0.0042	0.009	0.0018	< LOD	< LOD	0.008
AAE	1.0205	0.4041	0.7712	0.1414	72.8204	0.4467	0.0505	0.012	< LOD	0.007	0.04	0.0128	0.0969	0.0051	0.1356	0.0052	0.0124	0.0019	0.0063	0.0006	0.0033
AAE	1.2835	0.353	< LOD	0.1135	62.5505	0.4027	0.0529	0.0107	< LOD	0.007	< LOD	0.0105	0.0183	0.0037	0.0442	0.0039	0.0074	0.0018	0.0089	0.0008	0.0021
AAE	1.1205	0.4257	0.5948	0.1377	75.745	0.4586	0.0525	0.0114	< LOD	0.0063	< LOD	0.0122	0.0405	0.0041	0.0651	0.0042	0.0091	0.0018	0.0033	0.0006	0.002
AAE	< LOD	< LOD	0.7017	0.1534	90.9782	0.531	0.063	0.0117	< LOD	0.0057	< LOD	0.0152	0.0432	0.0044	0.0495	0.0042	0.0081	0.0017	0.0017	0.0002	0.007
AAE	1.0794	0.477	3.412	0.1879	73.4145	0.4526	0.1727	0.0162	< LOD	0.0071	< LOD	0.0134	0.1088	0.0052	0.0442	0.0042	0.0142	0.002	0.0031	0.0006	0.0103
AAE	1.1326	0.3684	0.2585	0.1126	47.8521	0.3437	0.1183	0.0136	< LOD	0.0086	< LOD	0.0092	0.0094	0.0037	0.0138	0.0036	0.0097	0.0021	0.0109	0.0012	0.0017
Martinea	< LOD	< LOD	0.4248	0.1733	100	0.6536	0.0719	0.0122	0.0169	0.0052	< LOD	0.0168	0.0615	0.0048	0.0402	0.0042	0.0067	0.0017	< LOD	< LOD	0.0085
Martinea	1.0829	0.4495	< LOD	0.1375	89.0487	0.5207	0.0547	0.0112	< LOD	0.0057	< LOD	0.0149	0.0242	0.004	0.0114	0.0036	0.0069	0.0017	0.0023	0.0003	0.006
Arroteia	1.2235	0.4666	0.4129	0.1459	87.659	0.5141	0.0539	0.0115	< LOD	0.006	< LOD	0.0149	0.0528	0.0045	0.0204	0.0039	0.0121	0.0018	0.0022	0.0003	0.0041
Arroteia	1.1002	0.4127	1.4292	0.1509	70.4911	0.4367	0.0523	0.0118	< LOD	0.0072	< LOD	0.0124	0.0809	0.0048	0.0254	0.0038	0.0168	0.0019	0.0063	0.0007	< LOD
Bvista	< LOD	< LOD	4.0835	0.2138	98.5383	0.576	0.0756	0.0136	0.0062	0.0056	< LOD	0.0167	0.1324	0.0057	0.0338	0.0041	0.0073	0.0016	0.0001	< LOD	0.0071
Bvista	< LOD	< LOD	6.0461	0.2378	100	0.5922	0.0798	0.0134	0.0259	0.0057	< LOD	0.016	0.1924	0.0062	0.0834	0.0046	0.012	0.0016	< LOD	< LOD	0.0078
Arroteia	< LOD	< LOD	1.6398	0.1724	92.4239	0.539	0.0531	0.0125	< LOD	0.0059	< LOD	0.0157	0.0701	0.0048	0.0228	0.004	0.0114	0.0017	0.0014	0.0002	0.0067
Arroteia	< LOD	< LOD	1.68	0.187	100	0.6306	0.0724	0.0121	0.029	0.0052	< LOD	0.016	0.0361	0.0042	0.0469	0.004	0.0063	0.0016	< LOD	< LOD	0.0043
Bchitas	1.1108	0.6269	5.0183	0.2212	82.704	0.4949	0.5452	0.0255	0.1996	0.0105	0.025	0.0163	0.2388	0.0071	0.4675	0.0082	0.0232	0.002	0.0008	0.0004	0.0112
Bchitas	< LOD	< LOD	< LOD	0.1505	100	0.5863	0.0677	0.0118	0.0133	0.0054	< LOD	0.0156	0.017	0.004	0.0184	0.0038	0.0018	0.0016	< LOD	< LOD	0.0061
Epigrafe	< LOD	< LOD	2.3177	0.1995	100	0.6377	0.0838	0.0134	0.0277	0.0054	< LOD	0.0172	0.072	0.0049	0.0876	0.0047	0.0052	0.0016	< LOD	< LOD	0.0086
Epigrafe	< LOD	< LOD	3.0157	0.1969	95.9422	0.5599	0.0736	0.0134	< LOD	0.006	< LOD	0.0162	0.0795	0.0051	0.1367	0.0054	0.0092	0.0017	0.0003	0.0001	0.0066
Epigrafe	< LOD	< LOD	4.2652	0.2212	100	0.6124	0.0888	0.0143	0.0336	0.0059	< LOD	0.017	0.1004	0.0053	0.1064	0.0049	0.0114	0.0016	< LOD	< LOD	0.0091
Epigrafe	0.9034	0.4943	2.1223	0.1748	84.8381	0.5007	0.0701	0.0129	< LOD	0.0064	< LOD	0.0148	0.0575	0.0047	0.1249	0.0051	0.011	0.0018	0.0024	0.0004	0.0046
Picassinos	< LOD	< LOD	0.2636	0.1653	100	0.629	0.0727	0.012	0.0269	0.0052	< LOD	0.0163	0.0248	0.0042	0.0355	0.0041	0.002	0.0016	< LOD	< LOD	0.0077
Picassinos	< LOD	< LOD	0.2315	0.164	100	0.62	0.0684	0.0126	0.0132	0.0053	< LOD	0.0168	0.0226	0.0043	0.0501	0.0044	0.0025	0.0017	< LOD	< LOD	0.0085
Epigrafe	< LOD	< LOD	3.9727	0.2085	92.282	0.5402	0.0869	0.0149	< LOD	0.0063	< LOD	0.0162	0.1299	0.0059	0.3777	0.0074	0.0188	0.0018	0.0011	0.0002	0.0077
Epigrafe	< LOD	< LOD	1.9069	0.178	93.5759	0.5457	0.051	0.0131	< LOD	0.0058	< LOD	0.0154	0.064	0.0048	0.098	0.0049	0.009	0.0017	0.0006	0.0001	0.0066

Table 2. Supplementary Information : results from the geochemical analysis.

File #	Cr Err	MnO	MnO Err	Fe2O3	Fe2O3 Err	Co	Co Err	Ni	Ni Err	Cu	Cu Err	Zn	Zn Err	As	As Err	Se	Se Err	Rb	Rb Err	Sr	Sr Err
AdP589	0.0014	< LOD	0.0043	0.1181	0.0044	< LOD	0.0013	< LOD	0.0005	0.0011	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0004
AdP590	0.0014	< LOD	0.0041	0.1425	0.0048	< LOD	0.0013	< LOD	0.0006	0.0009	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0003
AdP591	0.0014	< LOD	0.0043	0.4917	0.0084	< LOD	0.0018	< LOD	0.0005	0.0011	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0003
AdP592	0.0015	< LOD	0.0041	0.0752	0.0036	< LOD	0.0012	< LOD	0.0005	0.0011	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0004
AdP593	0.0013	< LOD	0.0040	0.1125	0.0043	< LOD	0.0013	< LOD	0.0006	0.0013	0.0004	< LOD	0.0001	< LOD	0.0004	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003
AdP594	0.0014	< LOD	0.0040	0.1471	0.0048	< LOD	0.0013	< LOD	0.0005	0.0011	0.0004	< LOD	0.0000	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0003
AdP595	0.0013	0.0057	0.0042	0.0816	0.0038	< LOD	0.0012	< LOD	0.0006	0.0010	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0003
AdP596	0.0013	< LOD	0.0045	0.0911	0.0040	< LOD	0.0012	< LOD	0.0006	0.0008	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0003
AdP597	0.0015	< LOD	0.0040	0.1101	0.0043	< LOD	0.0012	< LOD	0.0005	0.0008	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0004
AdP598	0.0014	< LOD	0.0044	0.1403	0.0048	< LOD	0.0013	< LOD	0.0006	0.0008	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0004
AdP599	0.0015	< LOD	0.0042	0.1355	0.0047	< LOD	0.0013	< LOD	0.0006	0.0011	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0003
AdP600	0.0015	< LOD	0.0039	0.1089	0.0043	< LOD	0.0012	< LOD	0.0007	0.0008	0.0004	< LOD	0.0002	< LOD	0.0013	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004
AdP601	0.0014	< LOD	0.0044	0.1193	0.0045	< LOD	0.0013	< LOD	0.0006	0.0009	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0003
AdP602	0.0012	< LOD	0.0048	0.1581	0.0051	< LOD	0.0015	< LOD	0.0006	0.0010	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	0.0004	0.0003
AdP603	0.0014	< LOD	0.0045	0.1452	0.0048	< LOD	0.0014	< LOD	0.0005	0.0010	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0003
AdP604	0.0014	< LOD	0.0045	0.1264	0.0046	< LOD	0.0013	< LOD	0.0005	0.0012	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	0.0004	0.0003
AdP605	0.0014	< LOD	0.0047	0.1056	0.0043	< LOD	0.0013	< LOD	0.0005	0.0011	0.0004	< LOD	0.0000	< LOD	< LOD	< LOD	0.0003	< LOD	0.0000	0.0004	0.0002
AdP606	0.0013	< LOD	0.0045	0.1214	0.0045	< LOD	0.0013	< LOD	0.0006	0.0	0.0004	< LOD	0.0001	< LOD	< LOD	< LOD	0.0002	< LOD	0.0000	< LOD	0.0004
Curvachia	0.0013	2.0853	0.0178	< LOD	0.0047	0.0027	0.0009	< LOD	0.0008	0.0011	0.0004	< LOD	0.0003	< LOD	0.0002	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003
Curvachia	0.0008	0.0057	0.0025	0.0777	0.003	< LOD	< LOD	< LOD	0.0006	0.0012	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
AAE	0.0008	0.0025	0.0023	0.0762	0.0029	< LOD	< LOD	< LOD	0.0007	0.0008	0.0004	0.0005	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0003	0.0005	0.0003
AAE	0.0008	< LOD	0.0023	0.0786	0.003	< LOD	< LOD	< LOD	0.0007	0.0011	0.0004	0.0004	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	0.0004	0.0003
Opeia	0.0008	0.0027	0.0025	0.0651	0.0028	< LOD	< LOD	< LOD	0.0007	0.0009	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004
Opeia	0.0008	0.0025	0.0023	0.057	0.0026	< LOD	< LOD	< LOD	0.0007	0.0011	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
Tojeira	0.0009	0.0042	0.0024	0.0793	0.003	< LOD	< LOD	< LOD	0.0007	0.0008	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0003	< LOD	0.0003
Tojeira	0.0008	0.0031	0.0025	0.4113	0.0064	< LOD	< LOD	< LOD	0.0007	0.0011	0.0004	0.0006	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
AAE	0.0009	0.0024	0.0021	0.0659	0.0027	< LOD	0.0002	< LOD	0.0008	0.0009	0.0004	0.0004	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0004
AAE	0.0009	0.0033	0.002	0.0792	0.0029	< LOD	0.0004	0.0012	0.0009	0.0014	0.0004	0.0005	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0004
AAE	0.0009	0.0039	0.0021	0.0724	0.0028	< LOD	0.0001	< LOD	0.0008	0.0011	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0004
AAE	0.0008	0.0034	0.0023	0.0877	0.0031	< LOD	< LOD	< LOD	0.0007	0.001	0.0004	0.0003	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0003
AAE	0.001	0.0039	0.0024	0.5373	0.0071	< LOD	0.0002	< LOD	0.0007	0.0012	0.0004	0.0005	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003
AAE	0.0011	0.0027	0.002	0.3809	0.0059	< LOD	0.0009	0.0013	0.001	0.0012	0.0005	0.0004	0.0004	< LOD	0.0002	< LOD	0.0003	< LOD	0.0003	< LOD	0.0004
Martinea	0.0008	< LOD	0.0026	0.0842	0.0031	< LOD	< LOD	< LOD	0.0006	0.0007	0.0003	0.0003	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	0.0004	0.0003
Martinea	0.0009	< LOD	0.0022	0.0655	0.0027	< LOD	< LOD	< LOD	0.0007	0.0011	0.0004	0.0005	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0004
Arroteia	0.0009	0.0034	0.0022	0.0807	0.003	< LOD	< LOD	< LOD	0.0007	0.001	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003
Arroteia	0.0009	0.0031	0.0021	0.0718	0.0028	< LOD	0.0002	< LOD	0.0008	0.0011	0.0004	0.0004	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0004
Bvista	0.0008	0.0041	0.0024	0.1065	0.0034	< LOD	< LOD	< LOD	0.0007	0.0012	0.0004	0.0004	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
Bvista	0.0008	0.0036	0.0025	0.122	0.0036	< LOD	< LOD	< LOD	0.0006	0.0009	0.0003	0	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
Arroteia	0.0008	< LOD	0.0023	0.0772	0.0029	< LOD	< LOD	< LOD	0.0007	0.001	0.0004	0	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0003
Arroteia	0.0008	0.0033	0.0026	0.0677	0.0029	< LOD	< LOD	< LOD	0.0007	0.0012	0.0004	0.0004	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
Bchitas	0.001	0.0167	0.0028	0.2513	0.0051	< LOD	< LOD	< LOD	0.0006	0.0012	0.0003	0.0005	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004
Bchitas	0.0008	0.0028	0.0024	0.0661	0.0028	< LOD	< LOD	< LOD	0.0007	0.001	0.0004	0	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
Epigrafe	0.0008	0.0037	0.0025	0.1138	0.0035	< LOD	< LOD	< LOD	0.0006	0.001	0.0003	0.0003	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
Epigrafe	0.0009	0.0043	0.0024	0.0955	0.0032	< LOD	< LOD	< LOD	0.0006	0.001	0.0003	0.0004	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
Epigrafe	0.0008	0.0049	0.0026	0.0965	0.0033	< LOD	< LOD	< LOD	0.0006	0.0009	0.0003	0.0003	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004
Epigrafe	0.0009	0.0042	0.0022	0.0855	0.003	< LOD	< LOD	< LOD	0.0007	0.0009	0.0004	0.0003	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003	< LOD	0.0003
Picassinos	0.0008	0.0025	0.0025	0.0965	0.0033	< LOD	< LOD	< LOD	0.0006	0.001	0.0004	0.0003	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003
Picassinos	0.0008	0.0032	0.0025	0.0744	0.0029	< LOD	< LOD	< LOD	0.0006	0.001	0.0004	0.0004	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004
Epigrafe	0.0009	0.0036	0.0024	0.1402	0.0038	< LOD	< LOD	< LOD	0.0007	0.001	0.0004	0.0005	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0003	< LOD	0.0004
Epigrafe	0.0009	0.003	0.0023	0.1117	0.0034	< LOD	< LOD	< LOD	0.0007	0.0011	0.0004	0	0.0003	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004

Table 2. Continued.

File #	Y	Y Err	Zr	Zr Err	Nb	Nb Err	Mo	Mo Err	Rh	Rh Err	Pd	Pd Err	Ag	Ag Err	Cd	Cd Err	Sn	Sn Err	Sb	Sb Err	Ba	Ba Err	La
AdP589	< LOD	0.0003	< LOD	0.0003	< LOD	< LOD	< LOD	0.0001	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0015	< LOD	0.0000	< LOD	0.0102	< LOD
AdP590	< LOD	0.0003	< LOD	0.0002	< LOD	< LOD	< LOD	0.0002	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0018	< LOD	0.0000	< LOD	0.0107	< LOD
AdP591	< LOD	0.0003	< LOD	0.0002	< LOD	< LOD	< LOD	0.0001	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0013	< LOD	0.0000	< LOD	0.0096	< LOD
AdP592	< LOD	0.0003	< LOD	0.0003	< LOD	< LOD	< LOD	0.0002	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0017	< LOD	0.0000	< LOD	0.0082	< LOD
AdP593	< LOD	0.0002	< LOD	0.0004	< LOD	< LOD	< LOD	0.0004	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0003	< LOD	0.0030	< LOD	0.0000	< LOD	0.0113	< LOD
AdP594	< LOD	0.0003	< LOD	0.0002	< LOD	< LOD	0.0001	0.0001	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0008	< LOD	0.0000	< LOD	0.0080	< LOD
AdP595	< LOD	0.0002	< LOD	0.0003	< LOD	< LOD	< LOD	0.0003	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0001	< LOD	0.0024	< LOD	0.0000	< LOD	0.0113	< LOD
AdP596	< LOD	0.0003	< LOD	0.0003	< LOD	< LOD	0.0001	0.0001	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0013	< LOD	0.0000	< LOD	0.0104	< LOD
AdP597	< LOD	0.0003	< LOD	0.0003	< LOD	< LOD	< LOD	0.0002	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0021	< LOD	0.0000	< LOD	0.0104	< LOD
AdP598	< LOD	0.0003	< LOD	0.0003	< LOD	< LOD	< LOD	0.0002	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0016	< LOD	0.0000	< LOD	0.0107	< LOD
AdP599	< LOD	0.0003	< LOD	0.0003	< LOD	< LOD	0.0003	0.0002	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0021	< LOD	0.0000	< LOD	0.0111	< LOD
AdP600	< LOD	0.0002	< LOD	0.0005	< LOD	< LOD	< LOD	0.0006	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0008	< LOD	0.0044	< LOD	0.0010	< LOD	0.0115	< LOD
AdP601	< LOD	0.0003	< LOD	0.0002	< LOD	< LOD	0.0002	0.0001	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0015	< LOD	0.0000	< LOD	0.0090	< LOD
AdP602	< LOD	0.0003	0.0003	0.0003	< LOD	< LOD	0.0002	0.0002	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0017	< LOD	0.0000	< LOD	0.0118	< LOD
AdP603	< LOD	0.0003	< LOD	0.0002	< LOD	< LOD	0.0001	0.0001	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0012	< LOD	0.0000	< LOD	0.0104	< LOD
AdP604	< LOD	0.0003	< LOD	0.0002	< LOD	< LOD	0.0001	0.0001	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0011	< LOD	0.0000	< LOD	0.0084	< LOD
AdP605	< LOD	0.0003	< LOD	0.0001	< LOD	< LOD	0.0000	0.0000	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0005	< LOD	0.0000	< LOD	0.0081	< LOD
AdP606	< LOD	0.0003	< LOD	0.0003	< LOD	< LOD	< LOD	0.0002	< LOD	< LOD	< LOD	< LOD	< LOD	0.0000	< LOD	0.0000	< LOD	0.0022	< LOD	0.0000	< LOD	0.0099	< LOD
Curvachia	< LOD	0.0003	< LOD	0.0002	< LOD	0.0003	0.0007	0.0004	< LOD	0.0009	< LOD	< LOD	< LOD	0.0008	< LOD	0.001	< LOD	0.0104	< LOD	0.0015	< LOD	0.01	< LOD
Curvachia	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	0.0004	0.0003	< LOD	0.001	< LOD	0.0018	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0013	< LOD	0.0116	< LOD
AAE	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	< LOD	< LOD	0.0007	< LOD	0.0009	< LOD	0.0002	< LOD	0.0019	0.0255	0.0102	< LOD
AAE	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004	< LOD	0.0009	< LOD	0.0017	< LOD	0.0007	< LOD	0.0009	< LOD	0.0006	< LOD	0.002	0.0166	0.0105	< LOD
Opeia	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.0017	< LOD	< LOD	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.002	< LOD	0.0129	< LOD
Opeia	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	0.0017	< LOD	0.0007	< LOD	0.0009	< LOD	0.0001	< LOD	0.0019	< LOD	0.0121	< LOD
Tojeira	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	< LOD	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0019	< LOD	0.01	< LOD
Tojeira	< LOD	0.0003	0.0002	0.0002	< LOD	0.0001	0.0005	0.0003	< LOD	0.001	< LOD	0.0018	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0018	< LOD	0.0096	< LOD
AAE	< LOD	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0004	< LOD	0.0008	< LOD	< LOD	< LOD	0.0009	< LOD	0.0011	< LOD	0.0045	< LOD	0.0016	< LOD	0.0128	< LOD
AAE	< LOD	0.0004	< LOD	0.0003	< LOD	0.0003	< LOD	0.0005	< LOD	0.0008	< LOD	< LOD	< LOD	0.001	< LOD	0.0012	< LOD	0.006	< LOD	0.0025	< LOD	0.0134	< LOD
AAE	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004	< LOD	0.0009	< LOD	< LOD	< LOD	0.0009	< LOD	0.001	< LOD	0.004	< LOD	0.0022	< LOD	0.0127	< LOD
AAE	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	0.0005	0.0004	< LOD	0.0009	< LOD	< LOD	< LOD	0.0007	< LOD	0.001	< LOD	0.0013	< LOD	0.002	< LOD	0.0124	< LOD
AAE	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	0.0005	0.0004	< LOD	0.0009	< LOD	< LOD	< LOD	0.0007	< LOD	0.001	< LOD	0.0044	< LOD	0.002	< LOD	0.0116	< LOD
AAE	< LOD	0.0004	< LOD	0.0003	< LOD	0.0004	< LOD	0.0005	< LOD	0.0008	< LOD	< LOD	< LOD	0.001	< LOD	0.0012	0.0103	0.0083	< LOD	0.0026	< LOD	0.013	< LOD
Martinea	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.0011	< LOD	0.0019	< LOD	0.0007	< LOD	0.0008	< LOD	< LOD	< LOD	0.0017	< LOD	0.0115	< LOD
Martinea	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004	< LOD	0.0009	< LOD	< LOD	< LOD	0.0007	< LOD	0.001	< LOD	0.0018	< LOD	0.002	< LOD	0.0123	< LOD
Arroteia	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	0.0007	0.0004	< LOD	0.0009	< LOD	< LOD	< LOD	0.0007	< LOD	0.001	< LOD	0.002	< LOD	0.0014	< LOD	0.01	< LOD
Arroteia	< LOD	0.0004	< LOD	0.0002	< LOD	0.0003	< LOD	0.0004	< LOD	0.0008	< LOD	< LOD	< LOD	0.0009	< LOD	0.0011	< LOD	0.0049	< LOD	0.0023	< LOD	0.0127	< LOD
Bvista	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	0.0018	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0013	< LOD	0.0122	< LOD
Bvista	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	0.0018	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0013	< LOD	0.0122	< LOD
Arroteia	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004	< LOD	0.0009	< LOD	< LOD	< LOD	0.0007	< LOD	0.0009	< LOD	0.001	< LOD	0.0019	< LOD	0.012	< LOD
Arroteia	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	0.0005	0.0003	< LOD	0.0018	< LOD	< LOD	0.0014	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.002	< LOD	0.0134	< LOD
Bchitas	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0003	< LOD	0.001	< LOD	0.0018	< LOD	0.0007	< LOD	0.0009	< LOD	0.0026	< LOD	0.0013	< LOD	0.011	< LOD
Bchitas	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	0.0005	0.0003	< LOD	0.001	< LOD	< LOD	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0019	< LOD	0.0124	< LOD
Epigrafe	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	< LOD	< LOD	0.0018	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0018	< LOD	0.0119	< LOD
Epigrafe	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	< LOD	< LOD	0.0007	< LOD	0.0009	< LOD	0.0001	< LOD	0.0018	< LOD	0.0117	< LOD
Epigrafe	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	0.0018	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0018	< LOD	0.012	< LOD
Epigrafe	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004	< LOD	0.0009	< LOD	< LOD	< LOD	0.0007	< LOD	0.001	< LOD	0.0024	< LOD	0.0014	< LOD	0.0098	< LOD
Picassinos	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	0.0018	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0018	< LOD	0.01	< LOD
Picassinos	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	< LOD	< LOD	0.0007	< LOD	0.0009	< LOD	< LOD	< LOD	0.0018	< LOD	0.0119	< LOD
Epigrafe	< LOD	0.0003	< LOD	0.0002	< LOD	0.0001	< LOD	0.0003	< LOD	0.001	< LOD	< LOD	< LOD	0.0007	< LOD	0.0009	< LOD	0.0008	< LOD	0.0019	< LOD	0.0116	< LOD
Epigrafe	< LOD	0.0003	< LOD	0.0002	< LOD	0.0002	< LOD	0.0004	< LOD	0.0009	< LOD	< LOD	< LOD	0.0007	< LOD	0.0009	< LOD	0.0007	< LOD	0.002	< LOD	0.0122	< LOD

Table 2. Continued.

File #	La Err	Ce	Ce Err	Hf	Hf Err	Ta	Ta Err	W	W Err	Pt	Pt Err	Au	Au Err	Hg	Hg Err	Tl	Tl Err	Pb	Pb Err	Bi	Bi Err	Th	Th Err	U	U Err
AdP589	0.0141	< LOD	0.0054	< LOD	0.0017	< LOD	0.0047	< LOD	0.0036	< LOD	0.0012	< LOD	0.0005	< LOD	0.0026	< LOD	0.0004	< LOD	0.0010	< LOD	0.0004	< LOD	0.0015	< LOD	0.0006
AdP590	0.0110	< LOD	0.0054	< LOD	0.0015	< LOD	0.0045	< LOD	0.0035	< LOD	0.0012	< LOD	0.0005	< LOD	0.0025	< LOD	0.0005	< LOD	0.0009	< LOD	0.0005	< LOD	0.0015	< LOD	0.0005
AdP591	0.0134	< LOD	0.0052	< LOD	0.0016	< LOD	0.0046	< LOD	0.0035	< LOD	0.0012	< LOD	0.0005	< LOD	0.0025	< LOD	0.0004	< LOD	0.0009	< LOD	0.0004	< LOD	0.0015	< LOD	0.0004
AdP592	0.0095	< LOD	0.0056	< LOD	0.0017	< LOD	0.0081	< LOD	0.0036	< LOD	0.0012	< LOD	0.0005	< LOD	0.0026	< LOD	0.0005	< LOD	0.0009	< LOD	0.0005	< LOD	0.0015	< LOD	0.0006
AdP593	0.0102	< LOD	0.0040	< LOD	0.0016	< LOD	0.0040	< LOD	0.0033	< LOD	0.0011	< LOD	0.0005	< LOD	0.0023	< LOD	0.0003	< LOD	0.0008	< LOD	0.0012	< LOD	0.0015	< LOD	0.0011
AdP594	0.0111	< LOD	0.0050	< LOD	0.0016	< LOD	0.0045	< LOD	0.0035	< LOD	0.0012	< LOD	0.0005	< LOD	0.0024	< LOD	0.0004	< LOD	0.0009	< LOD	0.0001	< LOD	0.0015	< LOD	0.0002
AdP595	0.0149	< LOD	0.0040	< LOD	0.0016	< LOD	0.0044	< LOD	0.0035	< LOD	0.0011	0.0006	0.0005	< LOD	0.0024	< LOD	0.0004	< LOD	0.0009	< LOD	0.0008	< LOD	0.0015	< LOD	0.0009
AdP596	0.0144	< LOD	0.0047	< LOD	0.0016	< LOD	0.0046	< LOD	0.0035	< LOD	0.0012	< LOD	0.0005	< LOD	0.0025	< LOD	0.0004	< LOD	0.0009	< LOD	0.0003	< LOD	0.0015	< LOD	0.0005
AdP597	0.0099	< LOD	0.0057	< LOD	0.0016	< LOD	0.0046	< LOD	0.0035	< LOD	0.0012	< LOD	0.0005	< LOD	0.0026	< LOD	0.0004	< LOD	0.0009	< LOD	0.0007	< LOD	0.0015	< LOD	0.0008
AdP598	0.0148	< LOD	0.0054	< LOD	0.0017	< LOD	0.0047	< LOD	0.0037	< LOD	0.0012	< LOD	0.0005	< LOD	0.0026	< LOD	0.0004	< LOD	0.0009	< LOD	0.0005	< LOD	0.0015	< LOD	0.0006
AdP599	0.0108	< LOD	0.0058	< LOD	0.0019	< LOD	0.0048	< LOD	0.0037	< LOD	0.0012	< LOD	0.0005	< LOD	0.0026	< LOD	0.0004	< LOD	0.0010	< LOD	0.0007	< LOD	0.0015	< LOD	0.0007
AdP600	0.0126	< LOD	0.0062	< LOD	0.0017	< LOD	0.0072	< LOD	0.0036	< LOD	0.0011	0.0005	0.0005	< LOD	0.0026	< LOD	0.0003	< LOD	0.0010	< LOD	0.0018	< LOD	0.0016	< LOD	0.0018
AdP601	0.0158	< LOD	0.0052	< LOD	0.0016	< LOD	0.0047	< LOD	0.0035	< LOD	0.0012	< LOD	0.0005	< LOD	0.0025	< LOD	0.0004	< LOD	0.0009	< LOD	0.0004	< LOD	0.0015	< LOD	0.0005
AdP602	0.0114	< LOD	0.0038	< LOD	0.0017	< LOD	0.0046	< LOD	0.0035	< LOD	0.0012	0.0006	0.0005	< LOD	0.0025	< LOD	0.0004	< LOD	0.0009	< LOD	0.0005	< LOD	0.0015	< LOD	0.0006
AdP603	0.0102	< LOD	0.0053	< LOD	0.0016	< LOD	0.0049	< LOD	0.0037	< LOD	0.0013	< LOD	0.0006	< LOD	0.0026	< LOD	0.0004	< LOD	0.0009	< LOD	0.0003	< LOD	0.0015	< LOD	0.0004
AdP604	0.0102	< LOD	0.0053	< LOD	0.0016	< LOD	0.0079	< LOD	0.0036	< LOD	0.0012	< LOD	0.0005	< LOD	0.0025	< LOD	0.0004	< LOD	0.0009	< LOD	0.0002	< LOD	0.0015	< LOD	0.0003
AdP605	0.0146	< LOD	0.0050	< LOD	0.0017	< LOD	0.0048	< LOD	0.0036	< LOD	0.0012	0.0007	0.0006	< LOD	0.0027	< LOD	0.0005	< LOD	0.0010	< LOD	0.0000	< LOD	0.0015	< LOD	0.0000
AdP606	0.0117	< LOD	0.0047	< LOD	0.0015	< LOD	0.0076	0.0040	0.0034	< LOD	0.0012	< LOD	0.0005	< LOD	0.0024	< LOD	0.0004	< LOD	0.0008	< LOD	0.0006	< LOD	0.0015	< LOD	0.0007
Curvachia	0.0188	0.1002	0.0091	< LOD	0.0015	< LOD	0.0003	< LOD	0.0004	< LOD	0.0007	< LOD	0.0005	< LOD	0.0003	< LOD	0.0003	< LOD	0.0008	< LOD	0.0009	< LOD	0.0012	< LOD	0.0025
Curvachia	0.0113	< LOD	< LOD	< LOD	0.0018	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	0.0007	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0022
AAE	0.0176	< LOD	< LOD	< LOD	0.0015	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0004	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0024
AAE	0.0187	< LOD	< LOD	< LOD	0.0016	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0004	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0024
Opeia	0.0186	< LOD	< LOD	< LOD	0.0015	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	0.0005	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
Opeia	0.0125	< LOD	< LOD	< LOD	0.0015	< LOD	0.0004	< LOD	0.0004	< LOD	0.0005	< LOD	0.0005	< LOD	0.0004	< LOD	0.0005	< LOD	0.0008	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
Tojeira	0.0124	< LOD	< LOD	< LOD	0.0016	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0024
Tojeira	0.0117	< LOD	< LOD	< LOD	0.0017	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
AAE	0.0147	< LOD	< LOD	< LOD	0.0014	< LOD	0.0003	0.0006	0.0005	< LOD	0.0006	< LOD	0.0006	< LOD	0.0003	< LOD	0.0004	< LOD	0.001	< LOD	0.001	< LOD	0.0013	< LOD	0.0029
AAE	0.0233	< LOD	< LOD	< LOD	0.0013	< LOD	0.0003	< LOD	0.0005	< LOD	0.0006	< LOD	0.0006	< LOD	0.0002	< LOD	0.0002	< LOD	0.0011	< LOD	0.001	< LOD	0.0014	< LOD	0.0031
AAE	0.0144	< LOD	< LOD	< LOD	0.0014	< LOD	0.0005	< LOD	0.0004	< LOD	0.0006	< LOD	0.0006	< LOD	0.0003	< LOD	0.0004	< LOD	0.0009	< LOD	0.0009	< LOD	0.0013	< LOD	0.0027
AAE	0.0187	< LOD	< LOD	< LOD	0.0015	< LOD	0.0002	0.0005	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0004	< LOD	0.0004	< LOD	0.0008	< LOD	0.0008	< LOD	0.0012	< LOD	0.0025
AAE	0.0186	< LOD	< LOD	< LOD	0.0015	< LOD	0.0004	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0004	< LOD	0.0004	< LOD	0.0008	< LOD	0.0008	< LOD	0.0012	< LOD	0.0024
AAE	0.0244	< LOD	< LOD	< LOD	0.0013	< LOD	0.0003	< LOD	0.0005	< LOD	0.0006	< LOD	0.0007	< LOD	0.0002	< LOD	0.0002	< LOD	0.0011	< LOD	0.0011	< LOD	0.0015	< LOD	0.0033
Martinea	0.0112	< LOD	< LOD	< LOD	0.0019	< LOD	0.0004	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0006	< LOD	0.0006	< LOD	0.0007	< LOD	0.0008	< LOD	0.001	< LOD	0.0022
Martinea	0.013	< LOD	< LOD	< LOD	0.0014	< LOD	0.0003	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0004	< LOD	0.0004	< LOD	0.0008	< LOD	0.0009	< LOD	0.0012	< LOD	0.0026
Arroteia	0.0187	< LOD	< LOD	< LOD	0.0015	< LOD	0.0003	< LOD	0.0004	< LOD	0.0006	0.0007	0.0005	< LOD	0.0004	< LOD	0.0004	< LOD	0.0008	< LOD	0.0009	< LOD	0.0012	< LOD	0.0023
Arroteia	0.0151	< LOD	< LOD	< LOD	0.0014	< LOD	0.0003	0.0006	0.0005	< LOD	0.0006	< LOD	0.0006	< LOD	0.0003	< LOD	0.0003	< LOD	0.001	< LOD	0.0009	< LOD	0.0013	< LOD	0.0027
Bvista	0.0178	< LOD	< LOD	< LOD	0.0017	< LOD	0.0004	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
Bvista	0.0123	< LOD	< LOD	< LOD	0.0016	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
Arroteia	0.0125	< LOD	< LOD	< LOD	0.0015	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0004	< LOD	0.0004	< LOD	0.0008	< LOD	0.0008	< LOD	0.0011	< LOD	0.0024
Arroteia	0.0131	< LOD	< LOD	< LOD	0.0016	< LOD	0.0002	< LOD	0.0004	< LOD	0.0005	0.0007	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
Bchitas	0.012	< LOD	< LOD	< LOD	0.0016	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0008	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
Bchitas	0.0178	< LOD	< LOD	< LOD	0.0016	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
Epigrafe	0.0166	< LOD	< LOD	< LOD	0.0017	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	0.0005	0.0005	< LOD	0.0005	< LOD	0.0006	< LOD	0.0006	< LOD	0.0008	< LOD	0.001	< LOD	0.0022
Epigrafe	0.0121	< LOD	< LOD	< LOD	0.0016	< LOD	0.0004	< LOD	0.0004	< LOD	0.0006	0.0005	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
Epigrafe	0.012	< LOD	< LOD	< LOD	0.0016	< LOD	0.0004	< LOD	0.0004	< LOD	0.0006	0.0008	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0007	< LOD	0.0011	< LOD	0.0023
Epigrafe	0.0132	< LOD	< LOD	< LOD	0.0015	< LOD	0.0003	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0004	< LOD	0.0005	< LOD	0.0008	< LOD	0.0009	< LOD	0.0012	< LOD	0.0024
Picassinos	0.0121	< LOD	< LOD	< LOD	0.0016	< LOD	0.0004	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0021
Picassinos	0.0169	< LOD	< LOD	< LOD	0.0017	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0007	< LOD	0.0008	< LOD	0.0011	< LOD	0.0023
Epigrafe	0.0121	< LOD	< LOD	< LOD	0.0017	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	< LOD	0.0005	< LOD	0.0005	< LOD	0.0005	< LOD	0.0008	< LOD	0.0008	< LOD	0.0011	< LOD	0.0022
Epigrafe	0.0127	< LOD	< LOD	< LOD	0.0015	< LOD	0.0002	< LOD	0.0004	< LOD	0.0006	0.0005	0.0005	< LOD	0.0004	< LOD	0.0005	< LOD	0.0008	< LOD	0.0008	< LOD	0.0011	< LOD	0.0024

Table 2. Continued.

even more attractive during the Last Glacial Maximum. Afterwards, during the Epipaleolithic occupation, the abundant marine evidence suggest that the occupation was by inland groups after they had harvested at the coast. It is, in fact, possible that the site represents the limit of safe consumption of coastal resources. Otherwise, it would be expected that coastal groups would consume those resources closer to the source, where quartzite, quartz and chert nodules could also be found easily.

Since the Portuguese Upper Palaeolithic is mostly based on bladelets and flakes (Zilhão, 1997) the characteristics of outcrops highly affected by tectonics would allow such production through the exploitation of any primary, sub-primary or secondary source. However, for periods such as the Solutrean, during which high quality nodules were necessary for the production of bifacial arrow tips sometimes using heat treatment, not all of these sources were suitable and probably only those with extraordinary quality would have been selected. This may be a parsimonious explanation for the explicit selection of this site to the detriment of others (including those just to the side and just in front of it but where tectonic flaws occur in almost all nodules), the almost exhaustion of the outcrop and the in situ heat-treatment processing of the chert. It is then possible that Poço chert may be found across this transect and deeper in the inland mountains at East.

The irregular terrain of the River Lis basin, marked by plateaux and steep rich canyons surely marked the circulation of past hunter-gatherers. This may include the possible construction of short circular and long bi-directional range paths according the morphology of the valleys. The presence of regional sources with different qualities and chemical signatures may allow the reconstruction and corroborating of such circulation.

7. Conclusion

With this geochemical analysis it was possible to characterize the Poço Rock Shelter lithic raw material procurement. Our results show that the driving factor of use of this site must have been a small outcrop with nodules of outstanding quality. Such a combination of size and quality led to its almost complete exhaustion, and the absence of similar occupations in sources right to the side and immediately in front of the source, but marked by abundant cleavages due to tectonics. Chert from other sources is also present at the site, suggesting the exploitation of other local sources as, contrary to most Portuguese regions, in the River Lis basin chert is a ubiquitous raw material. However, these occur in small amounts. Considering the quality of the Poço outcrop, it is highly plausible that this chert may be found in other sites of the region and also in adjacent regions. Its distinct geochemical signal (that makes it distinct even from other sources from the same valley) will support that approach. Nevertheless, and notwithstanding their similarities and differences, the Lis samples show internal coherence, which allow using them as reliable markers for the variability of the western-most Iberian chert sources.

Acknowledgements

We would like to thank the Fundação para a Ciência e a Tecnologia (project IF/01075/2013), the Wenner-Gren Foundation (GR 9296) for funding the 2016 field season, EST, S.A., União de Freguesias de Santa Eufémia e Boa Vista and the City of Leiria for the logistical support.

References

Abrantes, F. 1988. Diatom assemblages as upwelling indicators in surface sediments off Portugal. *Marine Geology* 85, 15-39.

Abrantes, F. 1990. Increased upwelling off Portugal during the last deglaciation: diatom evidence. *Marine Micropaleontology* 17, 285-310.

Abrantes, F. 1991. Variability of upwelling of NW Africa during the latest Quaternary evidence. *Paleoceanography* 6, 431-460.

Abrantes, F. 2000. 200,000 yr diatom records from Atlantic upwelling sites reveal maximum productivity during LGM and a shift in phytoplankton community structure at 185,000 yr. Earth and *Planetary Science Letter* 176, 7-16.

Abrantes, F., Baas, J., Hajlidason, H., Rasmussen, T., Klitgaard, D., Loncaric, N., Gaspar, L. 1998. Sediment fluxes along the Northeastern European Margin: inferring hydrological changes between 20 and 8 kyr. *Marine Geology* 152, 7-23.

Abrantes, F., Moita, T. 1999. Water column and recent sediment data on diatoms and coccolithophorids, off Portugal confirm sediment record as memory of upwelling events. *Oceanologica Acta* 22: 319-336.

Almeida, A.C., Gama, A., Cunha, L., Jacinto, R., Boura, I., Medeiros, J., Brandão, J. 1989. *A Bacia Hidrográfica do Rio Lis – contributo para o estudo da organização do espaço e dos problemas de ambiente*. Comissão de Coordenação Regional do Centro / Câmara Municipal de Leiria. Coimbra.

Almeida, F., Gameiro, C., Zilhão, J. 2002. The Artifact Assemblage. In Zilhão, J., Trinkaus, E. (eds.) Portrait of the Artist as a Child. The Gravettian Human Skeleton from the Abrigo do Lagar Velho and its Archaeological Context. Lisboa, Instituto Português de Arqueologia. *Trabalhos de Arqueologia* 22: 202-220.

Aubry, T., Cunha-Ribeiro, J.P., Angelucci, D. 2005. Testemunhos da ocupação pelo Homem de Neandertal: o sítio da Praia do Pedrógão. In Carvalho, S. (coord.) *Habitantes e Habitats – Pré e Proto-História na Bacia do Lis*, Câmara Municipal de Leiria, Leiria: 26-33.

Azerêdo, A.C., Duarte, L.V., Henriques, M.H., Manuppella, G. 2003. *Da dinâmica continental no Triásico aos mares do Jurássico Inferior e Médio*. Instituto Geológico e Mineiro. Lisboa.

Brás, A.F., Gaspar, F., Pereira, T. 2006. Vale da Ribeira das Chitas –sondagens de diagnóstico. Relatório Final –Fase 1, Torres Novas, Junho de 2006 [Unpublished].

Carvalho, V. 2011. *O Abrigo do Lagar Velho e o Paleolítico Superior em Leiria, Portugal: análise dos dados arqueológicos no actual context da evolução humana*. Master thesis. University of Coimbra.

Carvalho, S., Carvalho, V. 2007. *Relatório de progresso da Carta Arqueológica de Leiria (2004-2007). Câmara Municipal de Leiria*. Leiria. [Unpublished].

Cunha-Ribeiro, J.P. 1999. *O Acheulense no Centro de Portugal: o vale do Lis. Contribuição para uma abordagem tecno-tipológica das suas indústrias líticas e problemática do seu contexto cronoestratigráfico*. PhD Thesis University of Lisbon. [Unpublished].

Dias, J.M.A., Boskia, T., Rodrigues, A., Magalhães, F. 2000. Coast line evolution in Portugal since the Last Glacial Maximum until present – a synthesis. *Marine Geology* 170: 177-186.

Dias, J.M.A., 2004. A história da evolução do litoral português nos últimos vinte milénios. In Tavares, A.A. (ed.) *Evolução Geohistórica do Litoral Português e Fenómenos Correlativos: Geologia, História, Arqueologia e Climatologia*, 157-170. Lisboa: Universidade Aberta.

Dinis, P.A. 1996. *Dinâmica Sedimentar e Evolução do Estuário do Lis.Dissertação para obtenção de grau de Mestre em Geociências*. Faculdade de Ciências e Tecnologia da Universidade de Coimbra. Coimbra.

Fiuza, A. 1982. The Portuguese coastal upwelling system. In *Actual Problems of Oceanography in Portugal*: 45-71. Lisbon: Junta Nacional Científica e Tecnológica.

Fiuza, A. 1983. Upwelling patterns off Portugal. In Suess, E. and Thiede, J. (eds.) *Coastal Upwelling: Its Sedimentary Record*: 85-98. New York: Plenum.

Gonçalves, P., Dinis, J. 2007. The Holocene Evolution Of The Lis River – Historical, Geomorphological And Sedimentological Approach. In *Iberian Coastal Holocene paleoenvironmental evolution – Coastal Hope 2010 – Proceedings*: 59-60.

Haws, J.A., Benedetti, M.M., Funk, C.L., Bicho, N.F., Daniels, J.M., Hesp, P.A., Minckley, T.A., Forman, S.L., Jeraj, M., Gibaja, J., Hockett, B.S. 2010. Coastal wetlands and Neanderthal settlement of Portuguese Estremadura. *Geoarchaeology* 25(6): 709744.

INAG. 1999. *Plano de Bacia Hidrográfica do Rio Lis. 1º Fase – Síntese da Análise e Diagnóstico da Situação Actual.* Lisboa.

Loureiro, S., Newton, A., Icely, J. 2005. Microplankton composition, production and upwelling dynamics in Sagres (SW Portugal) during the summer of 2001. *Scientia Marina* 69: 323-341.

Nora, D., Pereira, J., Paixão, E., Assis, S., Évora, M., Duarte, C., Marreiros, J., Carvalho, V., Holliday, T., Pereira, T. 2017. Abrigo da Buraca da Moira, Leiria: Resultados Preliminares do Projeto EcoPLis. In *Atas do congresso da AAP*, p. 391-403.

Pereira, T. 2010. *A exploração do quartzito na faixa Atlântica peninsular no final do Plistocénico. Tese de Dissertação de Doutoramento. Faculdade de Ciências Humanas e Sociais da Universidade do Algarve*. Faro. [Unpublished].

Pereira, T., Assis, S., Monteiro, P., Paixão, E. Bárbara, S., Nora, D., Carvalho, V., Holliday, T. 2018. Abrigo da Buraca da Moira: contribution for the understanding of the human occupation during the Final Neolithic/Chalcolithic in Leiria region, Portugal, In Senna-Martinez, J.X., Duiniz, M., Caevalho, A.F. (eds.) *De Gibraltar aos Pirenéus. Megalitismo, vida e morte na fachada atlântica peninsular* : 177-193. Nelas, Fundação Lapa do Lobo.

Teixeira, C., Zbyszewski, G., Assunção, C.T., Manuppella, G. 1968. *Carta geológica de Portugal na escala 1/50.000. Notícia explicativa da folha 23-C*, Leiria. Lisboa: Serviços Geológicos de Portugal.

Zambujo, G., Carvalho, S. 2005. Quinta do Bispo –Parceiros: o primeiro sítio Mesolítico da Bacia do Lís. In Carvalho, S. (coord.) *Habitantes e Habitats – Pré e Proto-História na Bacia do Lis*, Câmara Municipal de Leiria, Leiria: 84-103.

Zilhão, J. 1997. *O Paleolitico Superior da Estremadura Portuguesa*. Colibri, Lisbon, Pereira, T. 2010. *A exploração do quartzito na faixa Atlântica peninsular no final do Plistocénico.Tese de Dissertação de Doutoramento. Faculdade de Ciências Humanas e Sociais da Universidade do Algarve*. Faro. [Unpublished].

Pereira, T., Assis, S., Monteiro, P., Paixão, E. Bárbara, S., Nora, D., Carvalho, V., Holliday, T. 2018. Abrigo da Buraca da Moira: contribution for the understanding of the human occupation during the Final Neolithic/Chalcolithic in Leiria region, Portugal, In Senna-Martinez, J.X., Duiniz, M., Caevalho, A.F. (eds.) *De Gibraltar aos Pirenéus. Megalitismo, vida e morte na fachada atlântica peninsular* : 177-193. Nelas, Fundação Lapa do Lobo.

Teixeira, C., Zbyszewski, G., Assunção, C.T., Manuppella, G. 1968. *Carta geológica de Portugal na escala 1/50.000. Notícia explicativa da folha 23-C*, Leiria. Lisboa: Serviços Geológicos de Portugal.

Zambujo, G., Carvalho, S. 2005. Quinta do Bispo –Parceiros: o primeiro sítio Mesolítico da Bacia do Lís. In Carvalho, S. (coord.) *Habitantes e Habitats – Pré e Proto-História na Bacia do Lis*, Câmara Municipal de Leiria, Leiria: 84-103.

Zilhão, J. 1997. *O Paleolitico Superior da Estremadura Portuguesa*. Colibri, Lisbon.