Quartzite pebble technology in the final Middle Pleistocene of the Ribeira da Ponte da Pedra site (High Ribatejo, Central Portugal)

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Abstract:

The lithic assemblage of Ribeira da Ponte da Pedra site (OIS8-9) was produced, almost exclusively, through the exploitation of good quality quartzite fluvial pebbles with a regular morphology. Quartzite fluvial pebbles are the most common raw material found in the Middle Pleistocene occupation sites in Portugal. Such feature results from the easy availability of these pebbles in the valleys where the great majority of the archaeological sites within this chronology are located, and also because of the quartzite's physical properties and suitability for knapping.

In a techno-typological point of view, its lithic assemblage is characterized by the application of two main reduction sequences that result in abundant worked pebbles, retouched pebbles, cortical and semi-cortical flakes, retouched flakes, a few cores and rare bifacial artefacts. Some artefacts present irregular and variable edge modifications described as 'atypical' edge modifications that could edge damage resultant from their utilization. From a strictly technical point of view the assemblage can be described as quite simple, however we can envisage an inherent complexity starting in an accurate selection and exploitation of the quartzite pebbles, whose regular morphology allows a 'predetermined' production of regular blanks through simple actions.

In order to better understand patterns of raw material selection and technical schemes adopted in the exploitation of the quartzite pebbles we compared a sample of pebbles collected in the same deposits identified in the site (t4 fluvial terrace deposits) with worked pebbles that have 1 or 2 removals that had not altered significantly the original morpho-volumetry of the pebbles. The goal of this comparison was to verify if there was a selection of the fluvial pebbles based on texture and morpho-volumetry and if so, relate such selection with the technical schemes identified by technological study of the assemblage.

Keywords: Middle Pleistocene; lithic technology; raw materials; quartzite pebbles; edge modifications; Experimental archaeology; Ribeira da Ponte da Pedra

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1. Introduction

Our study analyses the exploitation models of fluvial quartzite pebbles developed by the final Middle Pleistocene human groups living in Central Portugal. The focus is to define the ensemble of technical choices and economic objectives that satisfy the needs of the prehistoric human group with the understanding of the archaic human behaviour as one the main study goals (Grimaldi 1998). The key point is the lithic assemblage found in the Ribeira Ponte da Pedra open-air site (hereafter RPP), located in the deposits T4 fluvial terrace of the Low Tagus River valley in Central Portugal. In order to better understand patterns of raw material selection and technical schemes adopted in the exploitation of the quartzite pebbles we compared a sample of pebbles collected in the same deposits identified in the site (t4 fluvial terrace deposits) with worked pebbles that have 1 or 2 removals that had not altered significantly the original morpho-volumetry of the pebbles. The goal of this comparison was to verify if there was a selection of the fluvial pebbles based on texture and morpho-volumetry and if so, relate such selection with the technical schemes identified by technological study of the assemblage. The results presented in this paper lead us to recognise a predetermined exploitation of the quartzite pebbles available in the surroundings of the site. Pebbles with a regular morpho-volumetry and fine to medium grained texture were preferentially selected and allowed a "predetermined" production of blanks with "simple" technical schemes.

Despite the abundance of Middle Pleistocene quartzite assemblages in Europe, there have been few advances in the understanding on what concerns the technology and functionality of this raw material (Colonge & Mourre 2009; Cristiani 2010; Cura 2014; Cura *et al.* 2014; Di Modica & Bonjean 2009; Moncel *et al.* 2009; Moloney *et al.* 1996; Sternke *et al.* 2009; Tuffreau *et al.* 2009). Additional research integrating different methods of analysis is necessary to enhance our understanding of the real impact of the use of this raw material considering its mechanical properties, morpho-volumetry, acquisition strategies, manufacturing techniques, curation, transport, use, maintenance and discard, and thus providing insights into human behaviour.

1.1. Middle Pleistocene evidences in the Portuguese Low Tagus Valley

Most of the Middle Pleistocene evidences known today in the Low Tagus valley in Portugal are mainly found in river terraces and occasionally in karst deposits.

In what concerns to raw materials, quartzite is the dominant raw material in Portuguese Middle Pleistocene sites (Cunha Ribeiro 1999; Meireles 1992; Meireles & Cunha Ribeiro 1992; Oosterbeek *et al.* 2010) and has a considerable presence in Upper Pleistocene sites (Pereira *et al.* 2012). In fact the overriding presence of this raw material in the Middle Pleistocene extends to a large part of the Iberian Peninsula (Moloney *et al.* 1996). This situation is primarily determined by the general geological features of the area, which include vast regions devoid of calcareous formations (Santonja & Villa 2006) where other raw materials are available. Even in regions where flint is locally available, quartzite is often the most selected raw material for the production of Acheulean large blanks, as demonstrated, for example, by several sites in the region of La Rioja in Spain (Utrila & Mazzo 1996).

Studies at the archaeological sites located in the T4 fluvial terrace the Tagus River, near the Alpiarça village, are an example of research based on the typology of the lithic artifacts combined with geomorphologic analysis (Mozzi *et al.* 2000). In the Vale do Forno and Vale da Atela (Figure 1), within the two main sedimentary units of the middle terrace of the Tagus River, the Lower Gravels and the Upper Sands, several sites have been excavated and subject to detailed studies, including TL dating (Mozzi *et al.* 2000). The sites associated with the Upper Sands unit are more relevant, namely the sites of Vale do Forno 1, 3 and 8. The Vale do Forno 1 lithic artifacts consist, according to the author's, of a not very evolved Acheulean type (Middle Acheulean) (Mozzi *et al.* 2000). The Vale do Forno 8 excavation revealed an assemblage of around 3000 artefacts, which have not been extensively published, but are described as ''an Upper Acheulian industry with many tools on flakes and bifaces with good flaking technique'' (Mozzi *et al.* 2000: 365). Finally, the lithic assemblage from the Vale do Forno 3, also known as Milharós, is considered as Late Acheulian of Micoquian type. This cultural attribution is based on the exquisite configuration and other typological features of some lanceloate and micoquian bifaces (Mozzi *et al.* 2000: 365; Raposo 2002; Raposo *et al.* 1985; Raposo *et al.* 1993).

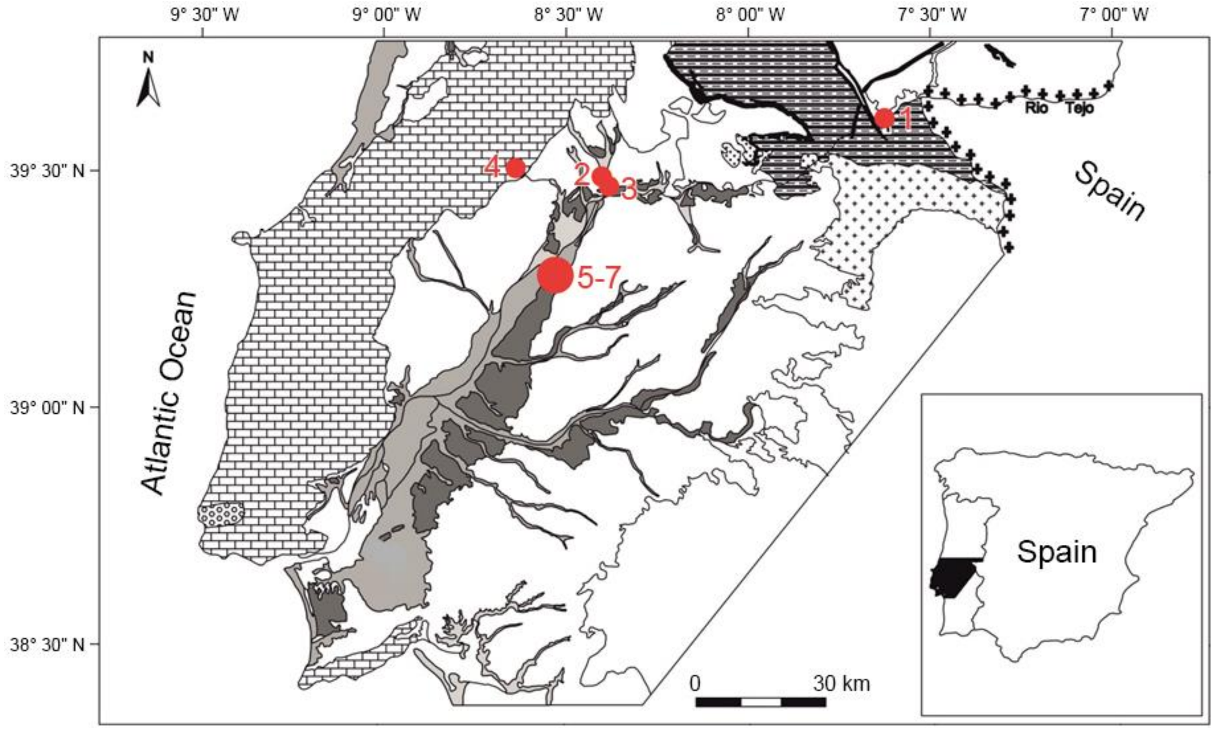

Figure 1. Sites in Central Portugal mentioned in the text: 1. Monte Famaco; 2. RPP; 3. Fonte da Moita; 4. Aroeira; 5-7. Vale do Forno 1, 3 and 8.

In summary, following typological criteria, the lithic industries of the sites are considered as representative of a Palaeolithic cultural sequence ranging from the Middle Acheulian to the Micoquian (Mozzi *et al.* 2000: 365).

Also in the Tagus valley, in the region of Vila Velha de Rodão, recently published detailed geomorphologic studies provide a more precise age for the archaeological materials from the site of Monte Famaco, recently considered to represent the T4 terrace (middle terrace) of a suite of six terraces identified at the Lower Tagus Basin and dated (IRSL) between 280-136 ka (Cunha *et al.* 2008; Martins *et al.* 2009). Two series of lithic industries were identified at Monte do Famaco (GEPP 1977; Raposo 1987; 1993).One comes from the T4 terrace, which is made up of a 1-m thick clast-supported gravel-boulder conglomerate, with poor sorting (Cunha *et al.* 2008). The assemblage is composed of thirty-four worn-out quartzite artifacts tentatively ''attributed to the early Middle Acheulean (Lower Palaeolithic)'' (Cunha *et al.* 2008: 47; Raposo 1987). The second series of 1500 artifacts was collected from a colluvial deposit at the top of the terrace. Though never extensively published, this assemblage includes, among other lithic morphologies, a high quantity of bifaces and cleavers (Raposo *et al.* 1993).

An exception to the open air contexts is the Aroeira Cave. This cave belongs to the Almonda karst system and is located in a south-facing cliff, near Torres Novas in the Portuguese Estremadura region. The excavation of this site started in the early 1990s and the currently published data indicates the existence of a series of geological units within the brecciated deposits (Marks *et al.* 1999; 2002a; 2002b). These units present five stratigraphic layers that yielded a dense quantity of lithic and bone remains. The Middle Pleistocene chronology of this site is testified by the characteristics of the faunal assemblage and several absolute dates ranging between 400 ka and 250 ka years ago (Hofman *et al.* 2013; Marks *et al.* 2002b).The bone record of this site contains the most ancient human remains identified so far in the Iberian Atlantic coast. Two archaic human teeth, a mandibular canine and a maxillary third molar, were recovered and are considered as being similar to those of other Middle Pleistocene European humans, still a more precise identification at the species level was not possible (Trinkaus *et al.* 2003). The lithic assemblage of Aroeira, is strikingly distinct from the others. Though essentially made on local raw materials (quartzite, quartz) it also has others local raw materials such as flint and limestone. It contains some artifacts considered as typical Acheulian. Use of the Levallois method is evident, but not as extensively as the discoid method. The authors underline the important component of small asymmetric bifacial tools, partly bifacial tools (points) and bifacial retouched knives, that are, from a morphological point of view, typical of the Micoquian (Keilmessergruppe) of central Europe (Marks 2005). According to the extensive cutmarks and other modifications found on faunal bones, extensive butchering and defleshing took place on the site; the assemblages may represent the material remains of, if not base camps, than of camp sites where a range of activities took place.

1.2. The Ribeira da Ponte da Pedra site and its geological setting

The RPP archaeological site, also known as Ribeira da Atalaia, is located in the valley of Ribeira (Portuguese for "stream") da Ponte da Pedra, a right tributary of the Tagus River in Central Portugal. It is in a region extending along the middle and lower Tagus River valley known as High Ribatejo (Figure 2).

This region comprises three main geological units: 1) the Pre-Cambrian and Palaeozoic schist-metamorphic complex (Ancient Massif); 2) the "Estremenho" Limestone massif, which is essentially Mesozoic with some Cenozoic deposits; 3) the Tagus Cenozoic sedimentary basin.

The regional quaternary deposits are composed of recent alluvial sediments, Pleistocene fluvial terraces, karstic cave fillings (in the limestone massif), and detritic covers.

This hydrological network is shaped by regional tectonics and, accordingly, the larger Tagus tributaries come from the North. The small Ponte da Pedra stream also flows from North to South and its valley has been totally excavated within the Tagus sedimentary basin and hence is characterised by fluvial-lacustrine detritic sediments from the Cenozoic (Miocene).

Until the Middle Pleistocene, the valley was longer than at present and continuous with the Nabão Valley. Presently, the stream valley is only a few kilometres (8 - 9km) shorter.

The landscape around RPP is characterized by fluvial terraces covering the slopes of the nearby low hills, which are less than 140 m high. The excavations taken during 10 field seasons exposed four geological units (from the oldest to the youngest): Miocene substrate, bottom of T4 fluvial terrace, top of T5 fluvial terrace and colluvial covering.

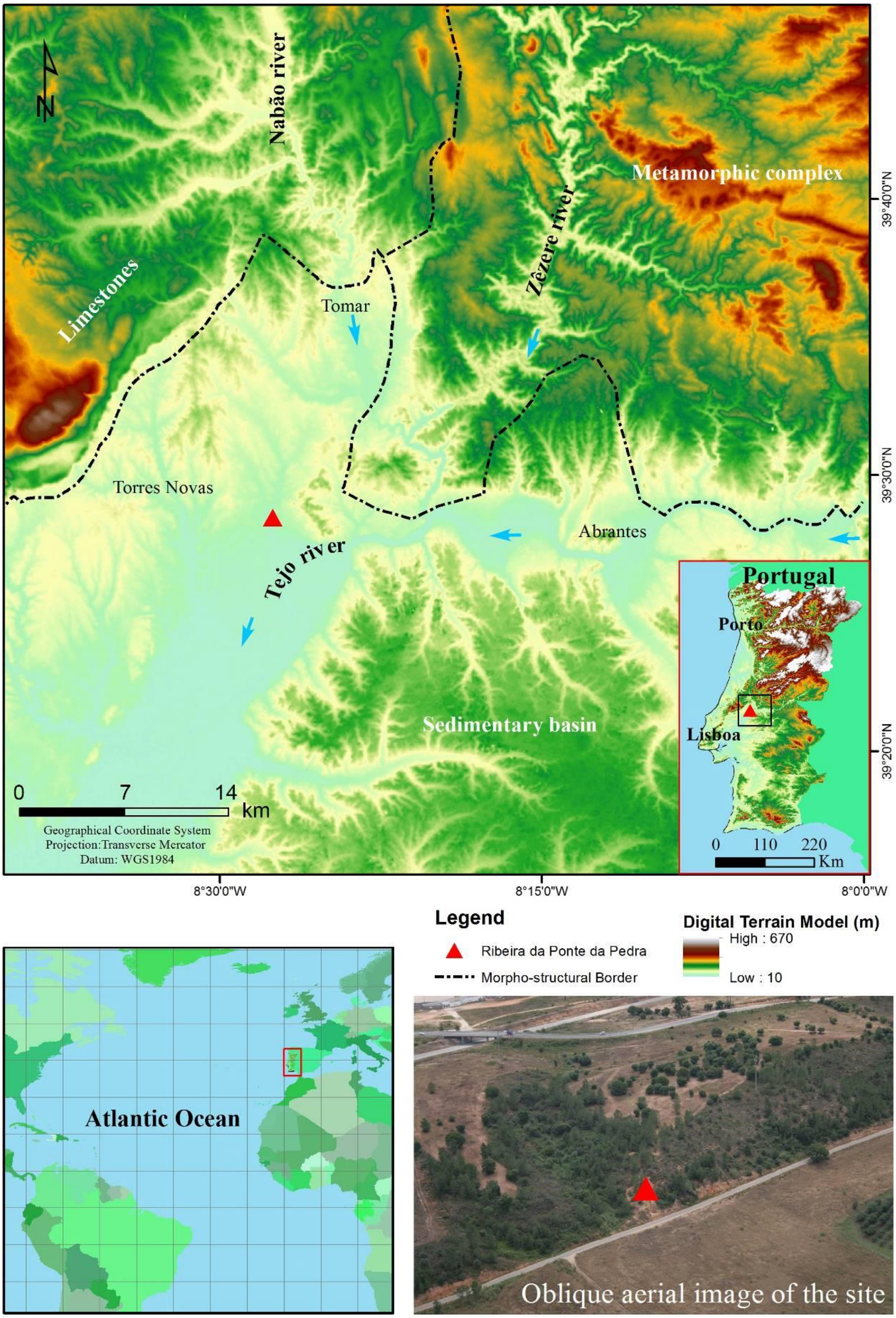

Figure 2. Ribeira da Ponte da Pedra: location of the site (red triangle). Geographical coordinate system projection: Transverse Mercator. Datum: WGS1984.

The T4 fluvial terrace bottom (from where the artefacts presented in this paper were recovered) is formed by, at least, four different depositional morphologies: a bar (formed by reddish coarse sand and pebbles); a channel (filled with big pebbles and cobbles, up to 35 cm, and reddish coarse sand) that cuts the bar; fine grained flood plain deposits (grey to yellow); and transverse channels (filled with reddish sand and pebbles, up to 10 cm) that have a very erosive contact with lower fine sands, these morphologies comprise 11 different lithological units (Table 1, Figure 3) (Rosina & Cura 2010; Rosina *et al*. 2011).

Table 1. Lithological Units description and geo-archaeological interpretation. Abbreviation: unc. - uncertain.

UL	Sediments	Interpretation	Artefacts	Geo-archaeology
20	Coarse sands	Colluviums	Present	Reworked (unc.)
46	Sands	Transversal channel	Very rare	Transported
47	Fine sands and silts	Floodplain or Overbank	Very rare	Not transported
	Palaeosurface (unc.)			
48	Sands and pebbles	Bar?	Present	(unc.)
49	Sands and gravels	Channel Fill	Abundant	Transported
60	Fine sands and silts	Floodplain or Overbank	Very Rare	Not transported
	Palaeosurface (unc.)			
42	Fine sands and silts	Floodplain or Overbank	Absent	_
45	Sands and pebbles	Channel Fill	Rare	Transported
50	Para-conglomerate	Channel	Abundant	Mass transported
30	Sands and gravels	Bar	Rare	Removed
99	Conglomerate layers	Lag deposits	Very Rare	Removed

According to previous attributions (Rosina 2002, 2004), partially confirmed by OSL (304 437 ± 19 595 BP), IRSL (175 ± 6 ka) and ERS (260 ± 35; 264 ± 39) dating of lithological unit 47 (see Figure 3) (Dias *et al* 2010; Martins *et al* 2010; Rosina *et al* 2014), the T4 fluvial terrace could be associated with OIS 8 and 9. The large chronological range of the different absolute dates are related with the nature of the different dating methods and feeding, respectively IRSL (age underestimated), OSL and ESR. We consider in our interpretation of the site and lithic assemblage chronology the results of the ERS dating (Rosina *et al* 2014).

1.3. The lithic assemblage

The lithic industry found at the bottom of the T4 fluvial terrace (1259 artefacts), is essentially characterized by three major groups: worked pebbles; non-retouched blanks; retouched blanks and blanks with ‘atypical’ edge modification (flakes and pebbles showing macro-scars that cannot be ascribed to regular retouch due to their irregular morphology, dimension, and sequence), and a minor group of associated cores and bifacial and unifacial tools. Even if rare, Unifacial and Bifacial Large Cutting tools (Table 2) as well as predetermined cores (from very large to very small) are present in the assemblage, indicating the knowledge of these more ‘complex’ technologies.

These groups should be considered together as the technological result of two main reduction sequences: small pebbles that were retouched mainly to be used as notches, and pebbles that have been knapped in order to produce flakes (mainly cortical or half-cortical), eventually these pebbles were also knapped and used as heavy duty tools (choppers) (Figure 4). The main debitage method is recurrent unifacial and unidirectional with hard hammer and direct percussion technique.

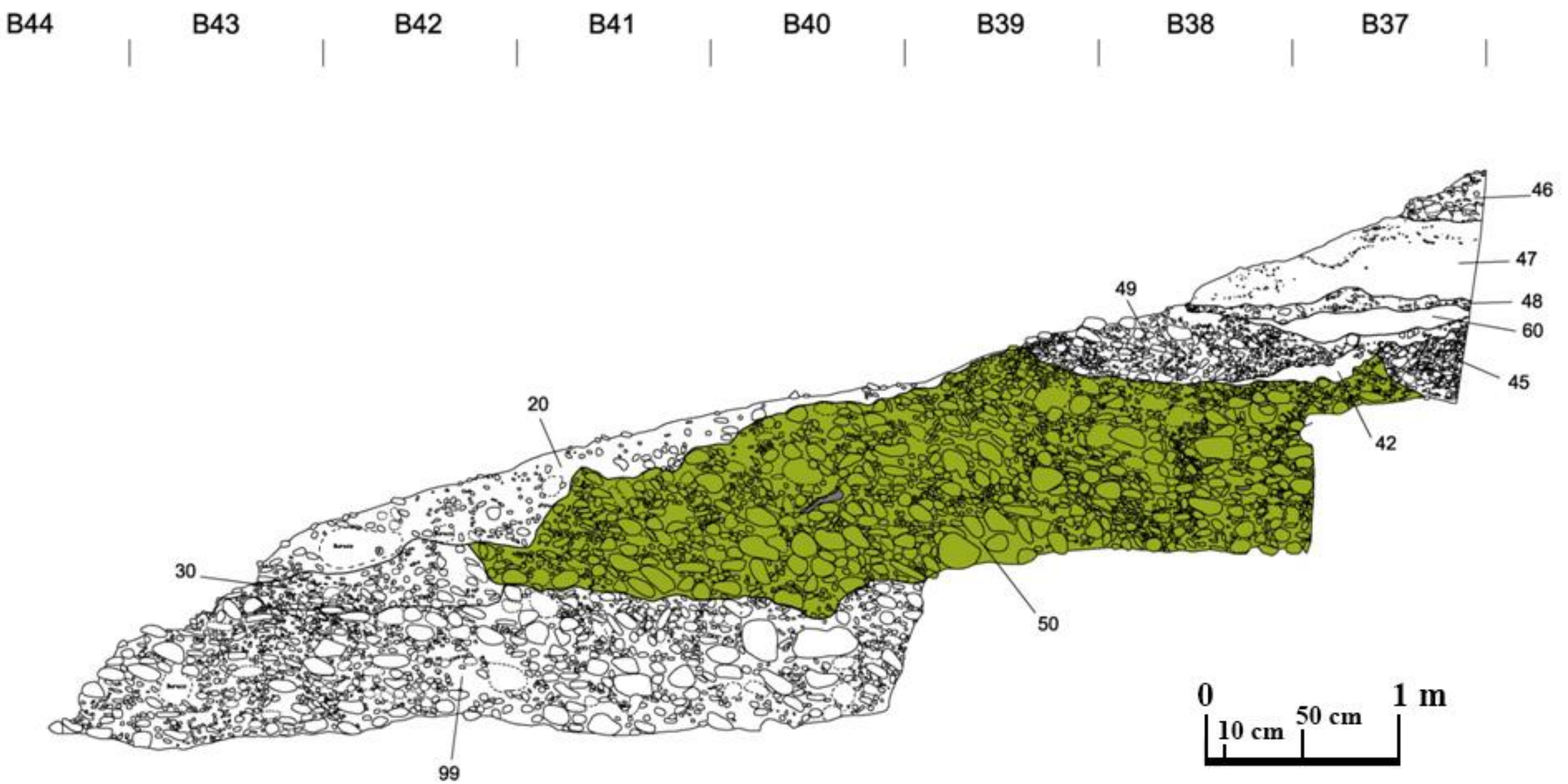

Figure 3. Stratigraphy of the site (in green the main lithological unit of artefacts provenance).

Table 2. Main techno-typological lithic categories.

Blank	Total percentage
Unifacial worked pebble	8,40%
Bifacial worked pebble	0,90%
Uniface	0,10%
Bifacial tool on pebble	0,20%
Bifacial tool on flake	0,10%
Cores	1,40%
Centripetal core	0,50%
Discoidal core	0,20%
Flake core	0,10%
Prismatic core	0,10%
Bifacial core	0,20%
Multifacial core	0,20%
Unretouched Flake	36,30%
Retouched flake	14,50%
Retouched pebble	6,80%
Fragments and debris	30,20%

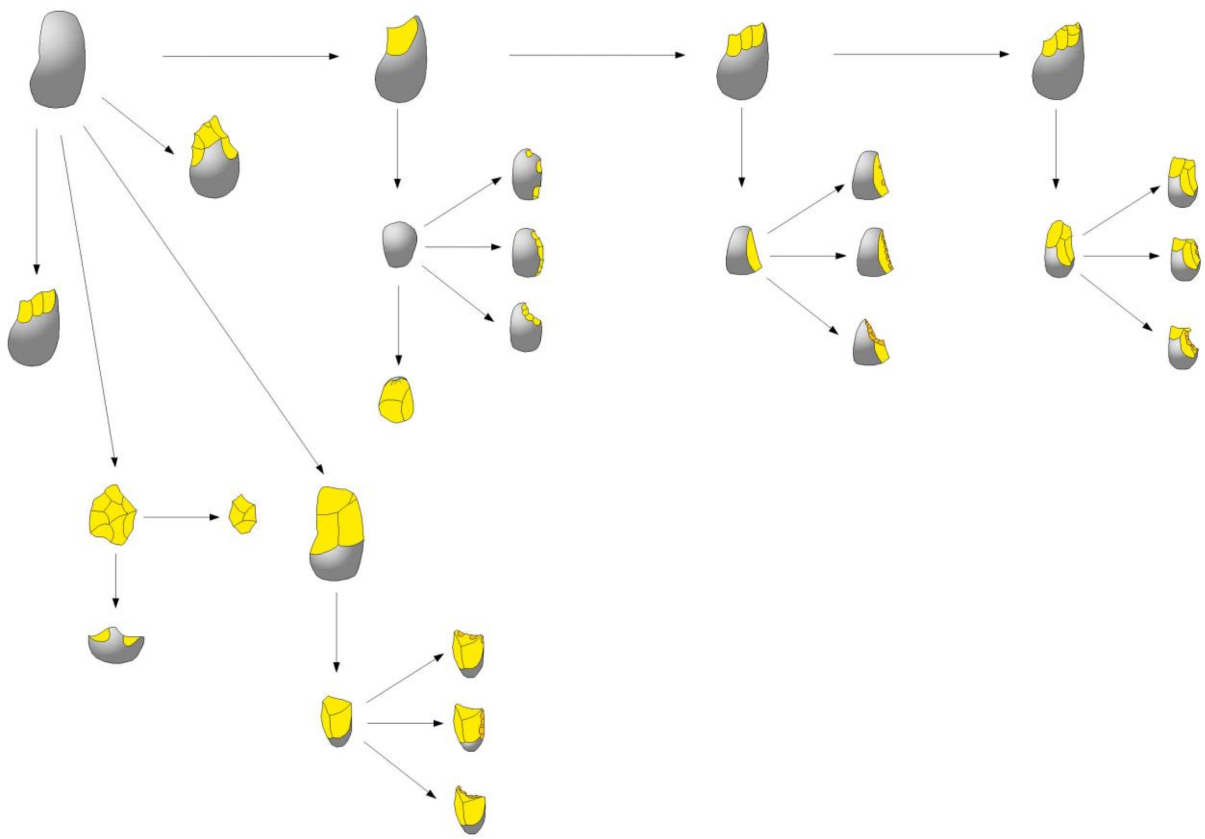

Figure 4. Reduction sequences and their variants recorded in Ribeira da Ponte da Pedra.

The scars on the worked pebbles and cores rarely out number 4 removals. We consider this as an achieved techno-functional goal for the production of cortical blanks, as well as a less economic behaviour given the large availability of local raw material (Table 3). The main knapping method consists on the removal of a first flake on one of the sides of the pebble, a second flake is removed on the other side using part of the negative of the first flake thus presenting a morphology in “quartier d’orange”, a third central flake is removed in the intersection of the two initial removals, presenting quadrangular or triangular morphologies.

Table 3. Total percentage of worked pebbles and their removals.The total is in relation with the total percentage of the lithic assemblage.

Technologic category	Total*
Pebble with one removal	3,40%
Pebble with 2 or 3 unifacial removals	3,70%
Pebble with 2 or 3 bifacial removals	0,50%
Pebble with 4 or more unifacial removals	1,30%
Pebble with 4 or more bifacial removals	0,40%

When the frequencies of blank categories are compared, we observe a lower percentage incidence of non-cortical blanks (Cura & Grimaldi 2009).

Retouched blanks are mainly on cortical or half cortical flakes and some on worked pebbles (Figure 5). Their percentage decreases along with the reduction of cortex presence, being less among non-cortical flakes. This seems to suggest that flakes showing modified edges were mainly in the cortical flakes category. (Table 4).

The analysis of the modified edges of the different blanks shows the presence of marginal or invasive, coarse and irregular alterations, quite variable in its position and location that we consider as ‘atypical’ (Table 4 and 5). These modifications do not correspond to a formal regular retouch and therefore this artifacts do not fit the ‘classic types’ of the F. Bordes (1961) formal tools. This exclusion from conventional typological list, however, doesn’t exclude these blanks as informal functional tools.

Considering the fluvial context of the lithic assemblages we didn’t exclude eventual edge modifications resulting from post-depositional processes (Chambers 2003; Hosfield & Chambers 2002). However, even if ‘atypical’ these modifications do not occur in all blanks of the assemblage and, observing its technical and functional features, we consider that they don’t represent a consequence of this type of phenomena. They do not resemble isolated abrupt removals in the more fragile margins caused by fluvial transport and shock.

Therefore we question whether these ‘atypical’ features are an intentional edge modification by irregular retouch or, on the other hand, are mechanical alterations as a consequence of the utilization of these blanks. To help clear up this question we carried out an experimental program with a series of 7 worked pebbles used to cut and fracture hand axe-like, and 68 large and medium sized flakes used to cut and fracture hand axe-like, scrap, saw and engrave. The materials worked were large fresh *Bos taurus, Capra hircus, Ovis aries* and *Sus scrofa* bones, fresh *Quercus ilex*, fresh *Salix alba* and fresh *Quercus ilex* without outer bark. The results so far obtained allow us to consider that most of the edges described as “atypical” edge modification might be the consequence of functional activities (Figures 6 and 7) linked to different subsistence tasks, namely those involving hard materials like wood and bone (Cristiani 2010; Cura 2014; Cura *et al.* 2014). However this possibility must be reinforced by further experimentations and traceological analysis. Over a selected sample of 47 flakes, 17 were characterised by less developed post-depositional alteration and were subject to functional analyses. The results indicate the activities of cutting, scraping and a combination of cutting and scraping. The worked materials were hard and medium hard and soft (Cristiani *et al.* 2010).

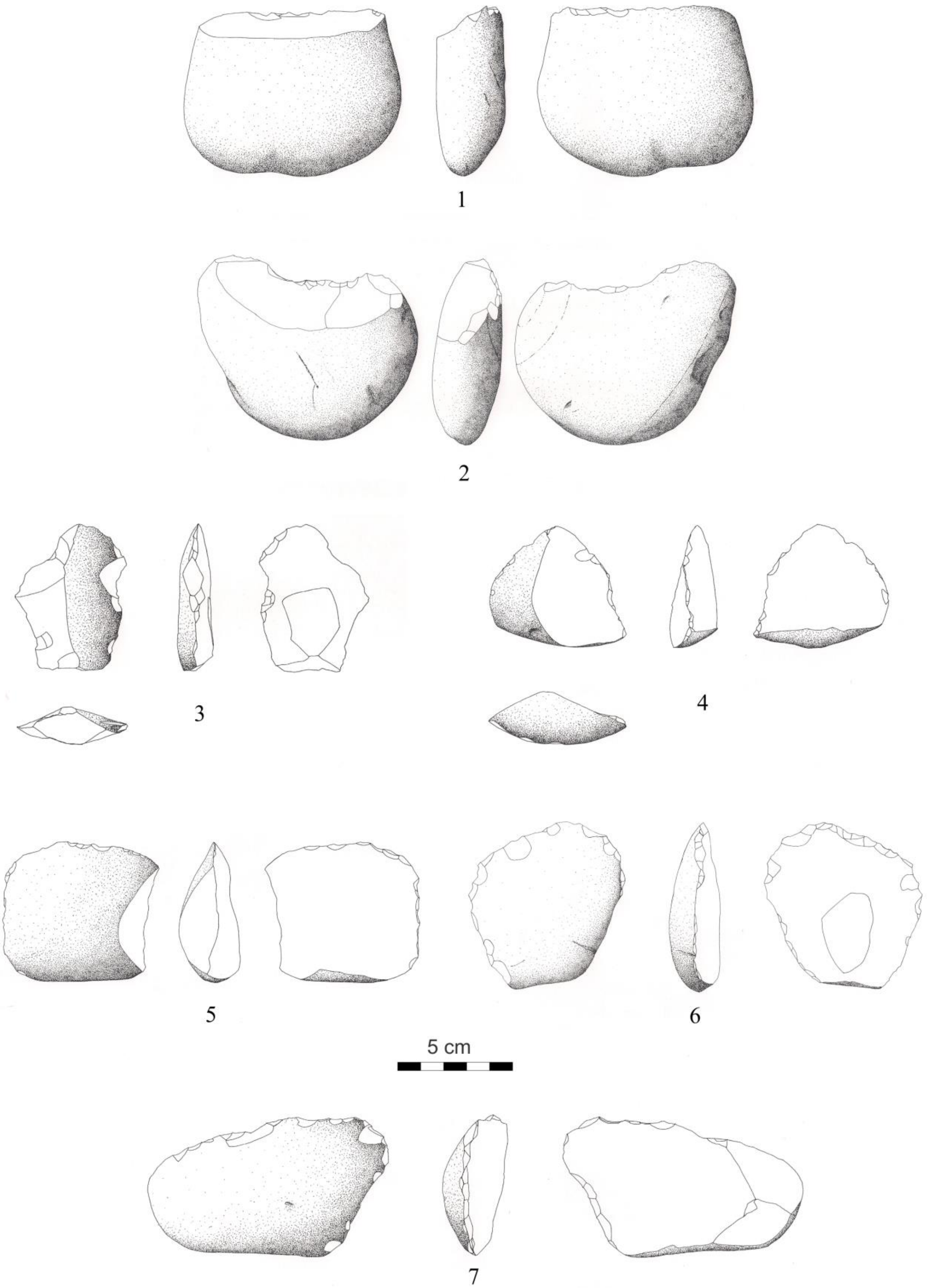

Figure 5. Lithic artifacts from RPP: 1 - Retouched pebble; 2 - Worked Pebble; 3 - Double notch on flake; 4-5 Retouched flakes; 6-7 - Informal retouched flakes.

Table 4. Relation between flake technological category and edge modification morphology.

	Edge modification morphology											
	Notch		Sub-parallel		Denticulate		Clactonian notch		Atypical		Total	
Technologic category	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Cortical Flake	10	58,8%	42	54,5%	16	57,1%	4	44,4%	77	43,5%	149	48,4%
Cortical flake (75% of cortex)	1	5,9%	10	13,0%	3	10,7%			34	19,2%	48	15,6%
Half cortical flake (50% de cortex)	1	5,9%	7	9,1%					33	18,6%	41	13,3%
Partial cortical flake (25% to 50% of cortex)	2	11,8%	2	2,6%					11	6,2%	15	4,9%
Partial cortical flake (25% of cortex)	1	5,9%	5	6,5%	3	10,7%	4	44,4%	5	2,8%	18	5,8%
Non-cortical flake (cortical butt)			6	7,8%	3	10,7%			9	5,1%	18	5,8%
Non-cortical flake	2	11,8%	5	6,5%	3	10,7%	1	11,1%	8	4,5%	19	6,2%
Total	**17**	**100%**	**77**	**100%**	**28**	**100%**	**9**	**100%**	**177**	**100%**	**308**	**100%**

Table 5. Total number and percentages of Non retouched, retouched and "atypical" retouch of the lithic assemblage.'

Blank	**Non retouched**		**Retouched**		**'Atypical' edge modification**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Worked pebble	96	12%	9	4%	12	5%	117	9%
Retouched pebble			67	29%	26	11%	93	7%
Flake	459	58%	131	57%	177	76%	769	61%
Core	37	5%			2	3%	39	3%
Bifacial tools	2	0,30%			2	1%	4	0%
Fragments and Debris	203	25%	21	9%	13	6%	237	19%
Total	**797**	**63%**	**228**	**18%**	**232**	**18%**	**1259**	**100%**

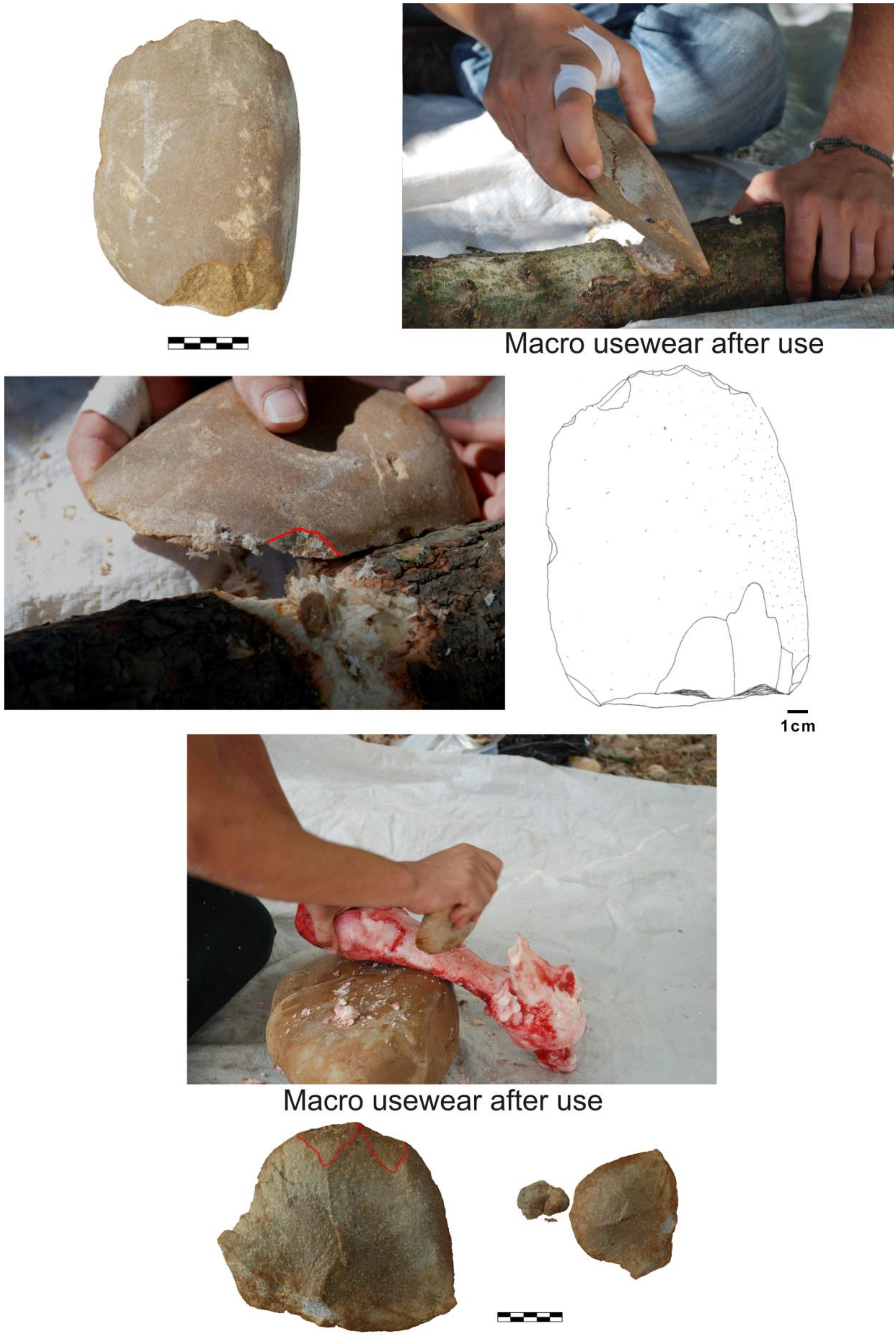

Figure 6. Experimental cutting of wood (fresh *Quercus ilex* with outer bark) and bone (fresh *Bos Taurus)* with cortical flakes.

Figure 7. Experimental cutting of wood (fresh *Quercus ilex* with outer bark) and bone (fresh *Bos Taurus)* with worked pebbles. The scale bars are divided into 1 cm sections.

2. Materials and methods

A sample of 250 ‘natural’ pebbles (Figure 8) were collected from the T4 fluvial terrace deposits in the surroundings of the site were the same lithological units were present. (Figure 9). This sample was compared with 83 archaeological worked pebbles that had 1 or 2 removals that had not altered significantly the original morpho-volumetry of the pebbles.

Figure 8. “Natural” sample of 250 pebbles collected in the T4 fluvial deposits in the surroundings of the site.

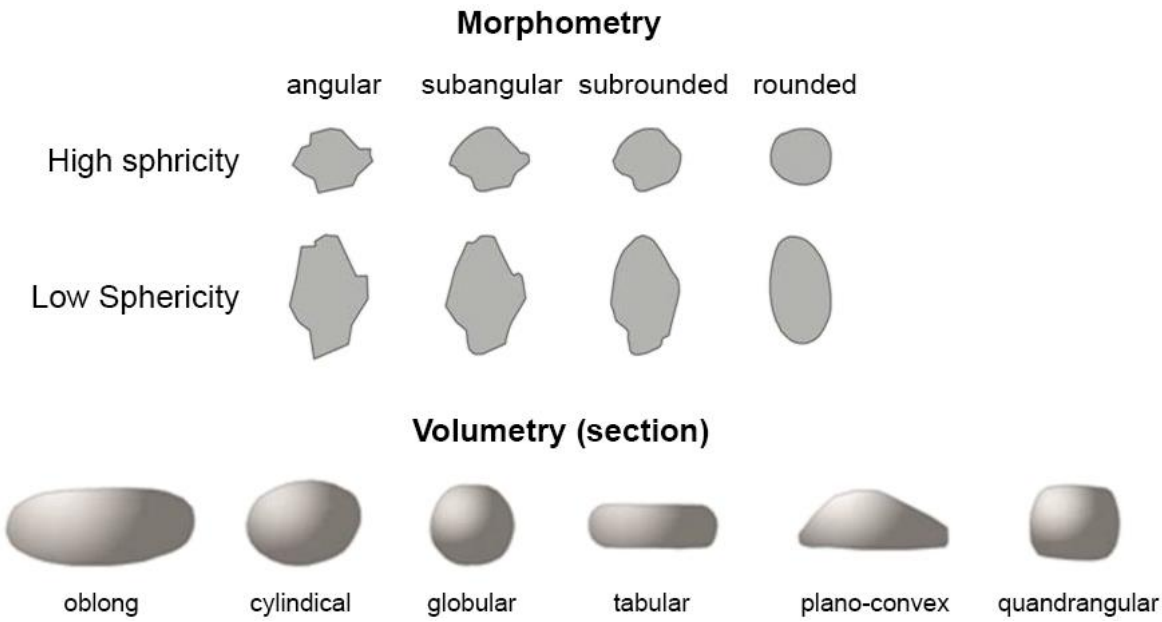

Figure 9. Morphometry and volumetry in section pebbles parameters of analyses.

All the 250 pebbles were analysed in the same way as the archaeological ones. The maximum length, width and thickness were measured. The morpho-volumetry was classified in morphometry according to high sphericity angular, high sphericity sub-angular, high sphericity sub-rounded, high sphericity rounded; low sphericity angular, low sphericity sub-angular, low sphericity sub-rounded, low sphericity rounded. The volumetry in section was classified as oblong, cylindrical, globular, tabular, plano-convex and quadrangular (Figure 9). All the "natural" pebbles were knapped in order to verify their texture. The parameters were: vitreous, fine, fine to medium, medium, medium to coarse, coarse, micro-crystalline, or conglomeratic. The texture was macroscopically analysed verifying the visibility of the quartz grains.

3. Data results and intepretation

Regarding the quartzite pebble texture, the most represented types in the archaeological sample are also the most frequent in the 'natural' sample, but in this one the values of fine texture are equal to the medium-coarse, barely represented in the archaeological sample. Pronounced selection was not evident, but coarse textures were more present in the "natural" sample indicating that these were not selected by the knappers who took advantage of the most abundant fine to medium grained pebbles that were more suitable for knapping and further utilization in the production of blanks (Table 6).

Table 6. Distribution of the observed textures in the archaeological sample in comparison with the 'natural' sample.

Texture	Archaeological Sample %	'Natural' Sample %
Vitreous	0,20%	0,80%
Fine	22,40%	14%
Fine to Medium	43,20%	43,20%
Medium	25,20%	14,40%
Medium to coarse	5,50%	14%
Coarse	1,90%	4,80%
Macro-crystalline	1,60%	6,40%
Conglomeratic		2%
Other		0,40%
Total	**100%**	**100%**

The observation of the morphometry seems to indicate a criteria of preference and selection; the most commonly found in the archaeological sample (low sphericity sub-rounded) is not the most abundant in the "natural" sample. This option might indicate a selection based on the technical objectives of exploitation found in this morphometry, which has the most suitable angles for the regular production of blanks (this fact was confirmed by us in repeated knapping experiments). The second most used morphometry in the archaeological sample is the most present in the natural "sample", and does not indicate a criteria of selection of this particular morphometry. We verified a more pronounced difference in the high presence of pebbles of high sphericity sub-rounded in the 'natural' sample, which present a low percentage in the archaeological sample. This seems to be related with the mismatch of this morphometry to knapping exploitation due to the lack of appropriate angles (Table 7), thus clearly indicating a selection between the available pebbles.

Table 7. Distribution of the observed morphometries in the archaeological sample in comparison with the 'natural' sample.

Morphometry	Archaeological sample %	'Natural' Sample %
High sphericity angular	2,20%	7%
High sphericitysubangular	3,10%	6,40%
High sphericitysubrounded	4,90%	27,60%
High sphericity rounded	3,10%	4,00%
Low sphericity angular	11,60%	3,60%
Low sphericitysubangular	14,70%	6,20%
Low sphericitysubrounded	23,20%	34,00%
Low sphericity rounded	30,40%	12,00%
Undetermined	6,70%	0,40%
Total	**100%**	**100%**

The volumetry in section does not show pronounced differences between the two samples. There is a high presence of oblong and plano-convex pebbles in the archaeological sample, as well as in the 'natural' one (Table 8). Such observation might indicate that at this level these morphologies were the most suitable for the required technical goals of exploitation for the production of regular blanks.

Table 8. Distribution of the observed volumetries in section in the archaeological sample in comparison with the 'natural' sample.

Volumetry (section)	Archaeological Sample %	'Natural' Sample %
Oblong	26,10%	21,20%
Cylindrical	12,20%	15,20%
Globular	4,10%	4,80%
Tabular	5,90%	8,00%
Plano-convex	28,80%	20,80%
Quadrangular	10%	16,00%
Undetermined	14,90%	14%
Total	**100%**	**100%**

There are no significant variations in length and thickness, but we noticed a difference in width. Despite the limited number of artefacts we can advance the hypothesis that among the available pebbles the medium and large, especially those with larger margins, were more commonly selected. This option can be related to the exploitation choices required to produce regular medium-large sized flakes, as well as with the functionality of the worked pebbles used as tools that would have wider active working edges.

4. Discussion and conclusions

In Ribeira da Ponte da Pedra, technical objectives might differ from those items traditionally identified as "predetermined" by typological or technological analyses: however, the predetermined technical objectives are represented through appropriate raw material selection and exploitation indicating a good level of foresight and planning in the exploitation of the quartzite pebbles.

We observe a marked balanced length, width and thickness ratio of the flakes and worked pebbles. This might indicate a functional need based on the metric features of both flakes (Figures 10 and 11) and worked pebbles pointing towards a simple technical exploitation, but predetermined on this level. This is probably linked to the regular production of flakes and with the utilization of both flakes and worked pebbles since the functional analyses and experimental activities revealed that they would be used mainly in the work of hard and medium materials (probably wood and bone) requiring blanks with balanced metric characteristics.

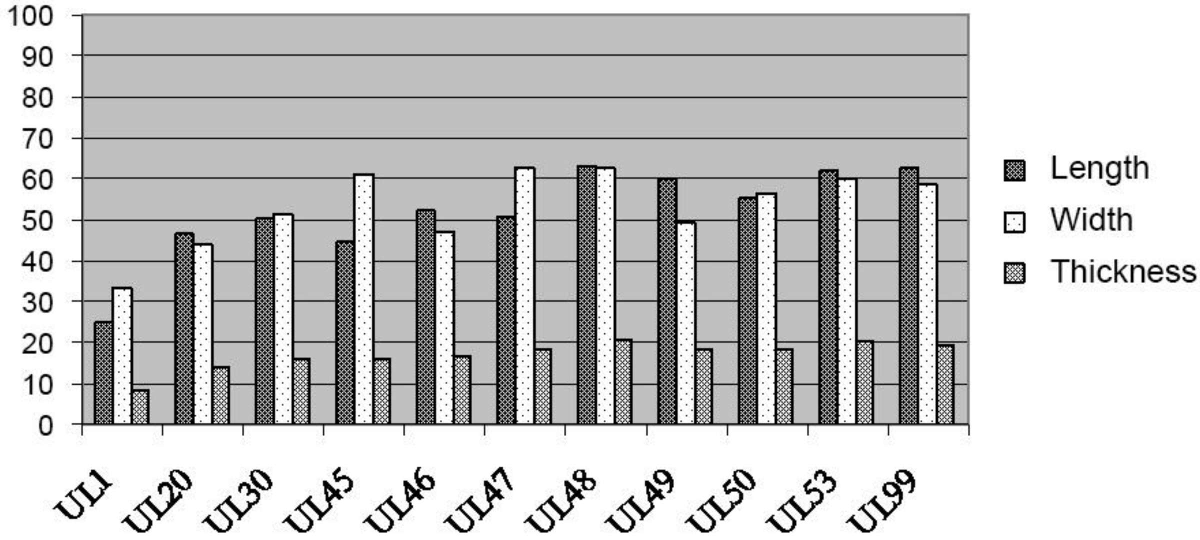

Figure 10. Flake dimensions (mm) distributed by the lithological units that contained flakes.

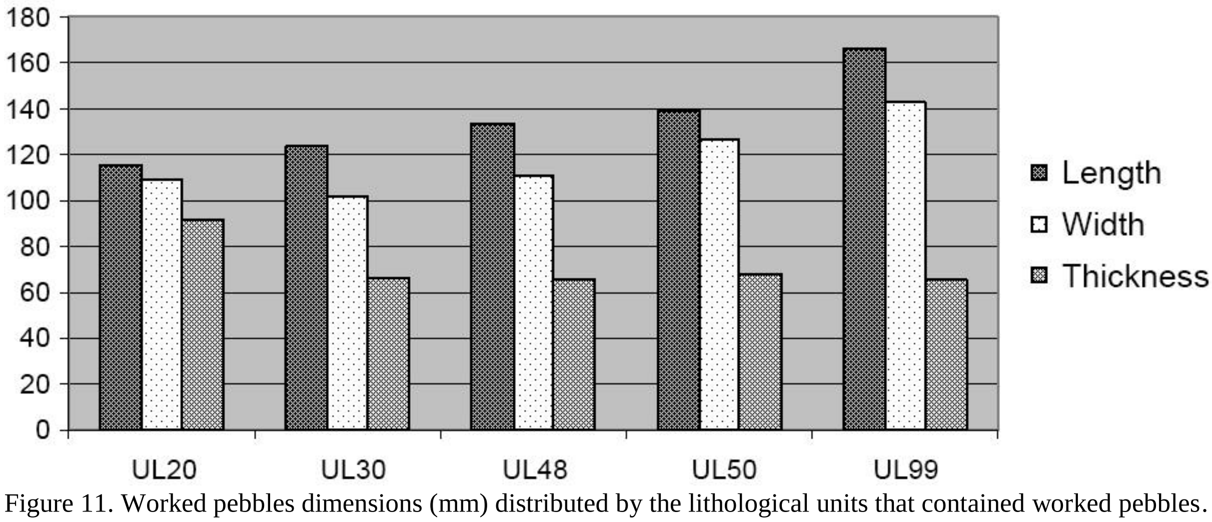

Figure 11. Worked pebbles dimensions (mm) distributed by the lithological units that contained worked pebbles.

The prehistoric knappers have consciously and reasonably profited from the characteristics of the quartzite pebbles (morpho-volumetry and texture) and, particularly, from the good quality of cortical cutting edges. The technical scheme is not simple in the sense that is pre-planned, starting with the selection of the pebbles and the utilization of the regular and appropriate natural angles of exploitation (Rodet *et al* 2014). The method might be simple, but not simplistic since is chosen and guided by the characteristics and properties of the pebbles to obtain standardized and predetermined blanks. We consider this to be the result of a technical and functional options driven by conscientious choices and goals rather than raw material constraints, since the raw material present in the vicinities is of good quality, allowing pursuit of any technical and conceptual choices in the given chrono-cultural context.

In our technological study of the lithic assemblage of the Ribeira da Ponte da Pedra we identified a main reduction sequence that consisted on the unifacial, sometimes bifacial, unidirectional removals on quartzite fluvial pebbles that in terms of technical behaviour is rather simple. Bifacial tools are very rare and cleavers are absent. Despite their very low percentage, various typologies of cores are present.

The features of the lithic industry, which lacks the characteristics typical of the Acheulean techno-complex, and the associated chronology, lead us to advance the question of whether it corresponds to a Final Lower Palaeolithic or to the Middle Palaeolithic (Santonja 2016). The analyses presented here indicate that the raw material characteristics were not a determining factor for the rarity or absence of production of typical *façonnage* Acheulean elements like bifaces and cleavers. We are in the presence of an industry consisting mainly of worked pebbles, abundant flakes, and a few cores (some centripetal and discoid). Could this be a Final Lower Palaeolithic or transitional industry that ultimately would “evolve” to Middle Palaeolithic and Mousterian techno-complexes?

There is an acknowledged recognition of the coexistence of typical Acheulean and Middle Palaeolithic assemblages in the Final Middle Pleistocene in the Iberian Peninsula, a period that could have been produced by multiple and heterogeneous human adaptive responses (Santonja 2016). In what concerns the RPP site the question remains open to debate, the confrontation with the available data for the Iberian Peninsula, especially with Middle Pleistocene Portuguese sites (mainly open air), where the most exploited raw material are quartzite pebbles, seems of outmost importance for future research (Marks 2002; Oosterbeek *et al.* 2010; Santonja 2016; Santonja & Villa 2006; Santonja & Pérez-Gonzalez 2010).

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