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Geological Raw Materials from a Mesolithic Archaeological Site in NW Portugal †

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Abstract: The present work concerns the study of geological raw materials obtained from an excavation site located in Serra da Cabreira (NW Portugal). The majority of the artifacts are made in quartz varieties (with minor occurrences of flint). Milky quartz is dominant, being similar to diverse occurrences of quartz veins in the immediate neighborhood. There are diverse other quartz varieties, indicating the possibility of locations farther away from the shelter. The study of geological raw materials can be seen as an important source of archaeological information, illustrating the evolution of past relationships between humans and geological resources, and also providing relevant information for the present and future, considering namely the extremely low environmental impact of the processing of raw materials.

Keywords: raw materials; pre-history; quartz; chert/flint; Mesolithic; lithic industry; provenance; economy and management

1. Introduction

The Mesolithic was a cultural and chronological concept, created in 1866 by Hodder Westropp, to conceptualize the very complex process, in its multiple aspects—social, technological, ecological, logistical, among others—in the period covered between the end of the last Ice Age and the establishment of the farming economy. Even though it is very reductionist to understand all of these shifts as a consequence of climate changes, we should not underestimate the huge influence exerted by the advent of the Holocene and its consequences to fauna and flora and, consequently, in the mobility patterns and in the survival strategies of prehistoric communities. According to new paleoclimate data, the beginning of the current interglacial period is proposed to be around 11.600 cal BP [1–3].

In the aspect of lithic technology and geological resources, the subjects of this paper, the Mesolithic witnessed the affirmation of a new lithic mode, known as Mode 5 [4], with an expressive size reduction in several components of lithic industries—the microlithic technology. The microlithic retouched tools, geometric (segments, triangles, or trapezes) or non-geometric (microlithic points, e.g.), are usually associated with the creation of composite tools, as well with the dissemination of the bow and arrow, proving that hunting activities still played a key role in the livelihood strategies of Mesolithic human communities.

In the context of Portuguese archaeology, quartz has not usually been referred to in provenance and lithic raw material economic and management studies, which have usually focused on the exotic and long-distance resources instead of the local ones [5]. Notwithstanding, within the framework of provenance studies, we must mention, inter alia, two of the most recent studies, one in the Sabor

valley and the other in Foz Côa region, both located in NE Portugal [6,7], where some essays of potential sources of different kinds of quartz were exposed.

For decades, the research on the Portuguese Mesolithic, famous for the shell middens in Tejo, Sado, and Muge estuaries, was concentrated on the interpretation of these structures and with the chronology and functionality/ethnicity value of lithic industries, especially of some geometrics [8,9]. However, the thematic of raw material provenance studies is beginning to improve, as the of work of Paixão et al. [10], where some hypothesis concerning the sources of chert through geochemical analyses of X-ray fluorescence were presented, proves.

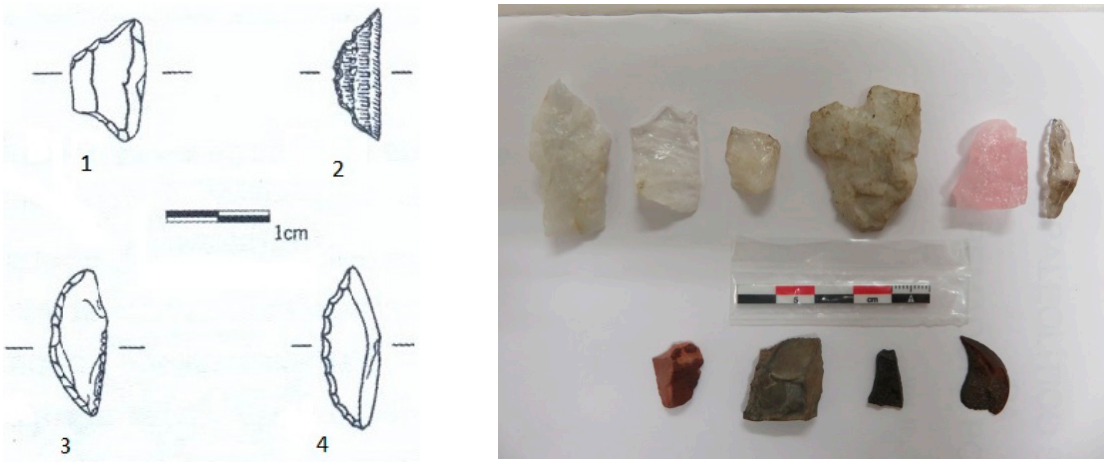
Our ongoing work aims to study the prehistoric lithic industry recovered in the archaeological site of Rock Shelter 1 of the Vale de Cerdeira, located in Serra da Cabreira, NW of Portugal. The discovery of this site, in the late 20th century, represented a great opportunity for research because until then, no prehistoric settlements of Mesolithic chronology had been identified in the mountain areas of NW Portugal [11,12]. Along with the techno–typological analysis, we intend to classify, characterize, and discuss the relation of different varieties of quartz, exploited, and manipulated by the prehistoric communities, to the surrounding geological context.

2. Archaeological Collection

Presently, a whole techno–typological study of the archaeological lithic industry is being conducted. Making assumptions over on ongoing work could be premature. For that reason, this section of the paper is based on previous works carried out by one of us [11–13].

The excavated area in Rock Shelter 1 of the Vale de Cerdeira amounts to around 20 m^2, and the sedimentary sequence recorded in the shelter does not reach 1 m thick. Three different stratigraphic units were observed: UE-1, UE-2, and UE-3 (base to top). The charcoal samples recovered from two combustion structures in UE- 1provided two ^{14}C dates placing the human occupation of the shelter between the third quarter of the sixth millennium BC (GrN-25614, 6240 ± 50 BP: 5316–5056 cal. BC 2σ) and the fifth quarter of the fifth millennium (GrN-25613, 6090 ± 40 BP: 5207–4853 cal. BC 2σ).

UE-3, disrupted by modern/contemporary occupations of the shelter, mainly associated with sheepherding and cattle activities, is rather too uncharacteristic. Consequently, only the first two units will be considered. The most represented category in both stratigraphic units is debris and chips, which prove that knapping activities took place in the shelter, reinforced by the presence of a significant number of cores. Therefore, the debris and chips category is followed by *debitage* products (flakes, blades, and bladelets), cores, fragments or nodules, and finally by retouched tools (illustrated in Figure 1) including the microliths (geometric and non-geometric) and the other tools of more common use (burins, scrappers, notches, denticulates, etc.).



(**a**) (**b**)

Figure 1. (**a**) Lithic industry of UE-1: 1—trapeze; 2–4—segments; (Adapted [12]); (**b**) raw materials from Rock Shelter 1 of Vale de Cerdeira. Above the 5 cm scale, left to right: milky quartz, hyaline quartz, translucent quartz, grey quartz, rose quartz, and smoky quartz; below 5 cm scale, left to right: two flakes of flint, schist, and quartzite.

Concerning the lithic raw materials in both stratigraphic units, we can observe that these come from the exploitation of different varieties of quartz, such as milky quartz, translucent quartz, rose quartz or even hyaline quartz, also known as rock crystal, and some very rare occurrences of smoky quartz. Despite its residual representation, we should mention the presence of other lithological resources of an exogenous nature to the local geological context, namely different types of chert. Other resources, such as quartzite, despite their presence, have virtually nil representation. This general panorama experiences some changes in the context of tool production where, although milky quartz continues to dominate, hyaline quartz and flint become more important, pointing to unequivocal management of the available raw material.

In UE-1, more than 13 600 objects were recovered considering different technological categories. Concerning the retouched tools, we should mention the microlithic character of this component since more than 65% were made through blades and microbladelets. Inside the microlithis group, geometrics dominate, more specifically segments, followed by trapezes. In the other classes of retouched tools, burins, borers, becs, and notches are the most representative. From a technical perspective, the *chaines operatoires*, recognized in the industry of UE-1 as seeking the attainment of two *debitage* products: flakes of a small module through the exploitation of expedite, bipolar, and peripheral cores, and bladelets and micro bladelets from prismatic cores, especially of hyaline quartz, i.e., blanks for the manufacture of the microlithic tools, is present. The different raw materials mentioned above, are present in all the technological categories, even in the case of the exogenous resources. That means, in the case of chert, that the raw material did not reach the shelter completely formed and that the acquisition of these resources was, probably, in the form of small nodules that, therefore, were knapped and shaped in the shelter. Only schist, quartzite, and smoky quartz do not fulfill all the categories.

The UE-2 provided another huge set of lithic materials, exceeding 9500 objects. In terms of abundance, debris are followed, as with the previous unit, by *debitage* products, then cores, fragments and nodules, and finally, retouched tools (geometric and of common use). In the scope of the application of raw material, the overview is quite identical to UE-1. However, we must underline a slight increase in chert and a small decrease in hyaline quartz. In retouched tools, from UE-1 to UE-2, we can clearly observe a greater importance now attained by flint in comparison to hyaline quartz and other types of quartz. The production system observed in this unit is identical to the one referred to for the UE-1. The industry reflects a low level of transformation of the *debitage* products. The microlithic component is reinforced by a more representative number of microlithic tools compared with the macrolithic ones. In the case of geometrics, the segments group maintain the majority, while in the non-geometrics, there is a decrease in points and a total absence of truncated tools. The technological categories are fulfilled with specimens of the different raw materials—milky quartz, translucent quartz, rosy quartz, grey quartz, hyaline quartz, and flint. The exceptions are again, schist, quartzite, and smoky quartz.

Through this brief presentation of the archaeological collection, we can conclude the existence of a strong resemblance between the UE-1 and UE-2 in their production systems and related *chaines operatoires.* Yet, there are some considerable differences in the material cultural domain present in UE-2 that should not be neglected, especially because of some chronological considerations that they can entail. In this regard, it needs to be noted the recovery of polished stone tools and the appearance of a small set (about twenty fragments) of manual ceramic production. A first analysis and review of these shreds provide some parallels with Early Neolithic productions, for instance, in the archaeological site of Prazo, in Foz Côa region [14].

3. Geological Context

We attempt here a characterization of the geological features of the region surrounding the excavation, based on analyses of the available geological information and our fieldwork. Our focus will be on quartz veins and pegmatites as these are the kind of geological bodies that might have quartz occurrences suitable for the archaeological tools found in the excavation.

The excavation is located at the NW corner of the 6-C (Cabeceiras de Basto) sheet of the 1:50,000 Portuguese Geological Map [15]. We also analyze the information from the sheets immediately to the north [16], west [17], and northwest [18]. The geological sheets under consideration have dimensions of around 20 km (X) and 32 km (Y) and hence, the excavation local will be roughly at the center of an area of 640 km^2 covered by these four sheets.

In the 6-C sheet, there are a multitude of quartz veins associated with faults with N-S and NNW-SSE dominant directions (as summarized in [19]) and some aplite–pegmatites occurrences in the proximity of the excavation local and in the rest of the sheet area. In the NE corner of the sheet (roughly around some 15 km from the excavation local), there are a multitude of aplite–pegmatites on metamorphic terrains of Silurian age (many of which were mined in the past). This same abundance of aplite–pegmatites on metamorphic terrains is also observed in the 6-A sheet where quartz veins are less abundant. In the 5-B sheet, there are many occurrences of quartz veins and some aplite–pegmatites, while in the 5-D sheet, there are more occurrences of aplite–pegmatites than quartz veins (but in the eastern quarter of the sheet, these two types occur with similar frequencies).

The report for the 5-B sheet [20] refers to the presence of geodes with big crystals of quartz and the occurrence of hyaline, and sometimes slightly rosy quartz in an old extraction site. It also mentions previous publications that list among the minerals found in the nearby Gerês mountain range, the presence of bipyramidal quartz, amethyst, and smoky quartz, bluish quartz, and rusty-yellow quartz, as well as chalcedony and "petrosilex" (petroflint), which might indicate geological samples instead of archaeological ones. Albuquerque [21] also presents a study of a set of quartz samples reportedly from the Gerês mountains (offered to the Museu e Laboratório Mineralógico e Geológico da Universidade de Coimbra in Portugal). In this set, smoky quartz was also dominant with some samples of hyaline and milky quartz. This publication also mentions the presence of quartz with tourmaline inclusions. The presence of tourmaline associated with quartz has been reported in pegmatites near the excavation site [22,23].

Another relevant study focused on the quartz (and feldspars) occurrences of mainland Portugal [24] referred to the occasional presence in geodes of quartz veins of hyaline crystals (sometimes with a slight amethyst tinge) and the presence in pegmatites of milky, rose, grey, and more rarely hyaline quartz.

Our fieldwork has shown that the frequencies of quartz varieties in the geological context are roughly similar to their abundance in the studied archaeological collection, in the sense that there are several occurrences of milky quartz while the other types are rarer or much rarer (as is the case of smoky quartz).

We have not found any onsite occurrence of chert, but the possibility of occurrence of this raw material in northern Portugal has been reported to us (Prof. C. Leal Gomes, personal communication).

4. Final Considerations

The archaeological collection collected in the Vale da Cerdeira 1 shelter is clearly dominated by the quartz variety (milky quartz) that occur in a multitude of locations in the area immediately surrounding the shelter and in many others places nearby, making the establishment of specific pinpoint sources for archaeological artifacts made from this variety of quartz unviable in practice. Nonetheless, these observations are compatible with a dominant exploitation of local, nearby, resources. Other quartz varieties occur in minor amounts in the archaeological collection and that present scarcer occurrences in the geological context (hence making them potentially useful for assessing provenance discussions).

The occurrence of chert in this archaeological collection could be the most complex situation to tackle in terms of regional sources, given the almost absence of regional geological knowledge in relation to this raw material coupled with the diffuse potential existence of conditions for its genesis and the (so far) scarce findings of onsite occurrences. Given the almost certain exogenous nature of these resources, their sources may be sought in others geological environments and formations, such as West Portuguese Meso-Cenozoic Border or Iberian Hercinian Massif, that according to some works (e.g., [25]) constituted the main sources of knappable siliceous rocks of prehistoric archaeological sites

of Central and Northeast Portugal. In our case, the comprehension of the provenance of these exotic raw materials can represent a major improvement in the work we are carrying out, allowing us to theorize about long-distance networks of lithic interchange and social interaction between human groups.

Presently, as we have previously mentioned, we are conducting the complete techno–typological study of the lithic industry of UE-1 and UE-2. This procedure will permit the comprehension of the nature and functionality of Rock Shelter 1 of the Vale de Cerdeira and the process of lithic raw materials economy and management practiced by the prehistoric communities in a key moment of human past: the transition between the last groups of hunter–gatherers and the first agro–pastoral communities of the Holocene period.

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