The management of lithic resources during the V millennium cal BC at Espluga de la Puyascada (La Fueva, Huesca)

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SUMMARY - The management of lithic resources during the V millennium cal BC at Espluga de la Puyascada (La Fueva, Huesca) - Although the archaeological site of Espluga de la Puyascada was only excavated during one campaign (1975), this cave might be considered one of the most significant sites in the pre-Pyrenean mountains of Huesca. The materials found in the survey excavation provide several information about the economy of the pastoral and agricultural groups living in the area during the V millennium cal BC. The results of the analysis of the lithic assemblage, and its petrological, technological, and functional characterisation, are presented in this paper. The data obtained indicates that the lithic implements were mainly constituted of blade blanks, which production was based on the procurement of raw materials in a regional context over a distance of about 80-90 kilometres. The lithic tools were used in productive processes associated with both the acquisition of food and the manufacture of other implements and goods.

RIASSUNTO - La gestione delle risorse litiche durante il V millennio cal BC alla Espluga de la Puyascada (La Fueva, Huesca) - Sebbene scavata nel corso di solo una campagna (1975), la grotta di Espluga de la Puyascada è considerata uno dei più significativi siti preistorici della regione pirenaica di Huesca (Spagna). Le evidenze archeologiche forniscono numerose informazioni sulla economia dei gruppi agropastorali che vissero nella regione durante il V millennio cal. BC. In questo lavoro vengono presentati i risultati degli studi petrografici, tecnologici e funzionali dei manufatti litici. I dati ottenuti indicano che i manufatti litici erano ottenuti attraverso la produzione di lame ricavate da materie prime presenti nella regione fino a circa 80-90 km di distanza. Gli strumenti erano utilizzati in processi produttivi finalizzati sia all’acquisizione di cibo che alla manifattura di altri strumenti e beni.

Key words: Mountain occupation, Neolithic, Functional analysis, means of production.
Parole chiave: Occupazione della montagna, Neolitico, Analisi funzionale, mezzi di produzione

1. INTRODUCTION

Studies of the human occupation of high mountainous areas in the Western Pyrenees have increased significantly over the last ten years, with the development of several research projects on both sides of the mountain chain (Rendu 2003; Galop 2006; Palet et al. 2006-2007; Miras et al. 2007; Péachs et al. 2007; Bal et al. 2010; Gassiot et al. 2010; Ejarque et al. 2010).

The data obtained from pollen columns and intensive archaeological surveying have succeeded in creating a new image of the human occupation of these high altitude areas, which have traditionally been considered as archaeologically "empty zones"; poorly exploited by prehistoric populations and characterized by a low level of human settlements in comparison with lowland areas and/or the valley floors (Jiménez 2007). On the contrary, those recent studies suggests that mountains areas have been heavily influenced by the human populations and their economic activities starting from the middle Holocene. More specifically, Western Pyrenees were characterized by a continuous process of humanization which started from the early and middle Neolithic period (VI millennium cal BC) and rapidly increased during late Neolithic and Chalcolithic period (late IV millennium and first half of the III millennium cal BC) (Galop 2006; Gassiot et al. 2010; Ejarque et al. 2010).

This scenario fundamentally seem to confirm the data available for the lower and medium altitudes. In fact, even if high mountain zones have been for long ignored by the archaeological research, during the last forty years in the pre-Pyrenees have been carried out a number of research projects that lead to the discovery of a significant number of archaeological sites with similar chronologies (VI - III millennium cal BC) (Baldellou 1987; Baldellou & Castán 1985; Utrilla & Mazo 1992; Baldellou & Utrilla 1995; Petit 1996; Utrilla & Mazo 2007; Oms et al. 2008; Oms et al., 2009). This data suggest that starting from the middle Holocene both lower and higher mountain areas have been characterized by an important process of humanization, probably due to the spread of agricultural and pastoral activities.
In this paper, we will focus our attention on one of these sites located in a mountain environment: the Esplug de la Puyascada, a site that has been only partially investigated during the 70s, revealing the existence of a number of levels of occupation dated to the Middle Neolithic. However, for logistical reasons the excavations were interrupted, thus leading to the interruption of the study of the materials, which were only preliminarily published (Baldellou 1987). Our objective is to present a renewed analysis of the lithic assemblage retrieved during the excavations, covering aspects as raw material procurement, technological and use-wear analysis, in order to determine how these resources were managed during the Neolithic period. In this way, we hope to appraise and integrate the data from the old excavation, contributing to the understanding of the economic orientation of the site.

2. ARCHAEOLOGICAL CONTEXT

The Esplug de la Puyascada is located in the northeast of the Iberian Peninsula, in the region of Aragon and the province of Huesca. It is situated in the municipality of La Fuente, a few kilometres from the town of San Juan de Toledo, in the Sobrarbe district (Fig. 1, a).

The cave is formed in a limestone massif called Sierra Ferrera which runs in a NW-E direction from the Cinca Valley to the Esera Valley. This is part of the Interior Mountains which run parallel to the Pyrenees chain and which reach considerable altitudes of over 2000m in the central and western sections. The cave entrance is at 1300m above sea level in the middle of a limestone ridge, in an area characterised by steep slopes and abrupt relief. The dimensions of the cave entrance are large: it consists of a single chamber, from Huesca Provincial Museum, four surveys were excavated in arti-ficial spits each one between 5 and 10 cm thick, which were later unified in sedimentary macro-units. Although the stratigraphic sequence was not uniform in the different surveys, three levels were distinguished (Fig. 1, b-c).

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Tab. 1 - **14C Dates from the Esplug de la Puyascada, phases 1 & 2 Calibrated dates have been realized with OxCal software 4.1 (Bronk & Ramsey 2009).**

Tab. 1 - *Datazioni radiometriche di Esplug de la Puyascada, fasi 1 e 2 (Baldellou 1985). Le date calibrate sono state realizzate con OxCal software 4.1 (Bronk & Ramsey 2009).*
Fig. 1a - Geographical framework. The white star ‘P’ represent the “Espluga de la Puyascada” site, while the black stars represent other archaeological sites of the period: a) Cueva de Chaves; b) Cueva del Moro de Olvena; c) Cueva Colomera; d) Cueva del Parco; e) Cueva de Els Trocs; f) Cueva del Sardo. Circles represent chert outcrops: 1) Lacustrine Ebro valley outcrops; 2) Tremp fm. outcrops; 3) Cretaceous marine chert outcrops.

Fig. 1b - a) Stratigraphic sequence of survey C1; b) Stratigraphic sequence of survey C3.

Fig. 1b - a) Sequenza stratigrafica della trincea C1; b) Sequenza stratigrafica della trincea C3.
during the first half of the fifth millennium, from 4965 to 4688 cal BC, whereas the second, from survey C3, was dated to 4556-4323 cal BC. It is thus difficult to determine whether these represent a single prolonged occupation phase or two separate phases. More radiocarbon dates are required to verify the existence and duration of the human occupation along the fifth millennium. However, bearing in mind these results and the study of the ceramic remains (Baldellou 1987), it seems reasonable to consider Level E.2 a homogeneous unit.

3. MATERIALS AND METHODS

This study is focused on the chipped lithic assemblage recovered from the level E.2. This assemblage might be regarded as relatively abundant considering the surface area that was excavated and the thickness of the layer; level E.2 occupied a surface of only 10m² considering all the surveys. It may be regarded as a single assemblage, as the pottery typology is homogeneous throughout the level (Baldellou 1987).

The lithic remains have been studied within the theoretical framework developed by the Institución Milà y Fontanals (CSIC), which covers all the productive processes from the procurement of the raw material, its transformation into implements and the use made of them (Pie and Vila 1992; Clemente 1997; Terradas 2001; Briz et al. 2005).

The petrological analysis of the remains has been carried out only on a macroscopic level, on a macroscopic level to avoid the destruction of the archeological samples. The petrographic characterisation was based on the micropalaeontological and textural features, through the use of a stereoscopic microscope (Leica MZ16A, 20x-40x). The micro-fossils present in the rock have been employed to relate the archaeological materials with the palaeoenvironmental conditions existed at the time of the geological formation (marine or lacustrine conditions). Features as texture and composition (aspect, colour, granulometry, density, presence or absence of minerals and/or grains, etc.) were related with the raw material sources by comparing them with the reference collection of the Institución Milà y Fontanals siliceous (LitoCat).

The use-wear analysis was carried out with both stereoscopic microscope (Leica MZ16A, 20x-40x), to examine the macro-wear (notches, rounding of the edges, etc.) and transmitted light microscopy (Olympus BHMU, 50x-600x), to study the micro-wear (striations, micro-polish, etc.) (Semenv 1964; González and Ibáñez 1994; Clemente 1997).

4. RESULTS

The petrographic analysis of the lithic assemblage from Espluga de la Puyascada has differentiated the following lithological groups:

The largest group (n = 28; 73.7%) is represented by a brown/beige/black chert which can be distinguished by the presence of oogonia and stems of charophyceae algae (Fig. 2, h). Chert of this type are well-known in the region and can be found in the carbonate lacustrine formations of Oligocene and Miocene age in the central and eastern sectors of the Ebro river basin (Fig. 1, 3-4) (Anadón et al. 1989; Pardo et al. 2004). The nearest outcrops of this type of chert are about 80 or 90 kilometres from the cave.

A second group, of white-grey chert, is characterised by the presence of pseudomorphs of gypsum crystals and iron oxides (n = 6; 15.8%) (Fig. 2, f). It may be attributed to continental units of high-salinity lacustrine environments, of Palaeocene age, in the Tremp-Graus basin in the Pyrenees, in the provinces of Lerida and Huesca (Fig. 1, 2). Units of this kind have been identified in the Serraduy and Campo area, in the Ésera and Isábena Valleys, some 10 or 15km from the site (Rosell et al. 2001; Lópe-Martínez et al. 2006).

The third group seem to proceed from a local source. It is a dark chert type, characterised by the presence of marine foraminifers, among which mainly sponge spicules (n = 2, 5.3%) (Fig. 1, f). Several types of marine chert types known in the region; one of the nearest outcrops to the site is a limestone stratum with abundant flint nodules located only 15 kilometres away, in the Armeña district (Fig. XX, 3). It is an Upper Cretaceous chert containing spicules and some foraminifers like Lacinia (Garrido-Megías and Ríos 1972). Further west, similar chert types has been located in the Añisclo Canyon, some 7 kilometres from the site in a straight line (Fig. 1, l). In this case, it is an Eocene chert, distinguished by the presence of Alveolina and Nummulites (Van Lansen 1970; Mazo and Cuchi 1992). Both rock types are well-jointed, with frequent cracks and fissures, which means they are inappropriate for blade production. This may explain why they are so scarcely employed in the archaeological sites of this period. The sample from Puyascada consists of only two samples and due to the absence of diagnostic fossils, their exact provenance cannot be determined. However, they probably belong to local chert types.

The last flint type, represented by a single item (n = 1, 2.6%), probably comes from a more distant source, outside the region. It is a fragment that due to its texture and composition can be related with the so-called “honey flint” or silex blond (Fig. 2, g). The source of this material is being debated by different researchers, although one of the most plausible hypotheses suggest that it comes from Lower Cretaceous formations situated in Provence (Binder 1998).

5. TECHNICAL AND FUNCTIONAL MANAGEMENT

Although the archaeological fieldwork only consisted of survey excavations and the material recovered represent a partial sample of the lithic assemblage of the Esplug de la Puyascada, we believe that it is possible to highlight certain relevant aspects in the way these raw materials were exploited and used.

At a technological level, the first point to be highlighted is the preference for blade products (n = 26, 68.4%), while flakes (n = 8, 21.0%) and by-products of knapping (n = 2, 5.6%) are less common. Blades were produced mainly from chert types from the Ebro Valley. The presence of two cores and a re-sharpening tablet of this lithology, together with a higher frequency of artefacts with cortex (Table 2) suggests that at least a part of the knapping sequence was performed in situ. This means that the cores and/or preforms were transported over considerable distances.
Fig. 2 - Archaeological materials of the Espluga del Puyascada. 1) Bone ring; 2) Perforated shells; 3) Edible Cockles (*Cerastoderma edule*); 4) Bone spoon; 5) Bone spatula; 6) Bone punches; 7) Ebro flint type; 8) Marine cretaceous chert type; 9) Blond flint type; 10) Tremp flint type; 11) Hornfels polished axe.

Fig. 2 - Materiali archeologici del sito della Espluga della Puyascada. 1) Anello in osso; 2) Conchiglie perforate; 3) Molluschi (*Cerastoderma edule*); 4) Cucchiaio in osso; 5) Spatola in osso; 6) Punteruoli in osso; 7) Selce lacustre dell’Ebro; 8) Selce Marina Cretacea; 9) Selce beige-miele; 10) Selce Tremp; 11) Ascia levigata in corneana.
Use-wear analysis has succeeded in showing how many of the blade implements were used (n = 18, 73.1%). Most of them were used to work soft substances (n = 28, 68.3% of the active zones - AZ). More specifically, half of them were used in tasks connected with cutting herbaceous plants (n = 12, 29.2% AZ) while the others (n = 10, 24.3% AZ) for processing animal substances, mainly in tasks associated with butchery, as skinning, quartering, eviscerating AZ) for processing animal substances, mainly in tasks associated with butchery, as skinning, quartering, eviscerating, boning, etc. (Fig. 5, a). This group of tools would have been used to process domestic animals: pig (Sus scrofa domesticus), cattle (Bos taurus), sheep/goats (Ovis aries/Capra hircus), as well wild fauna: red deer (Cervus elaphus), roe deer (Capreolus capreolus), wolf (Canis lupus), chamois (Rupicapra rupicapra) and probably wild boar (Sus scrofa) (Castaños 1987).

Identified plant use-wears suggest that tools involved with plant working activities were probably employed to cut wild plants (Fig. 3, a). In four cases, it has observed a very rough and abrasive polish, probably produced cutting the plant at ground level, or very near the soil (n = 4, 9.7% AZ) (Fig. 3, b-c) (Clemente and Gibaja 1998). The plants that were gathered may have been used for food or for medicinal purposes, but more also as forage for livestock and/or to condition areas, as has been documented in the Neolithic level at Arene Candide (MacPhail et al. 1997). Only in one case (n = 1, 2.4% AZ) (Fig. 5, b), it seems possible that one of the blades was used to cut domestic cereals. This blade differs from the rest of the lithic implements for its shape and size. The use-wear marks observed show that it was initially used in agricultural tasks and then re-used to work an abrasive mineral material such as pottery or clay (Fig. 5, b). We suppose that this blade has been previously used as sickle and later taken to La Puyascada, where it has been re-used in a totally different activity. The presence of possible striations produced by transportation, located beneath the mineral polish, seem to confirm this hypothesis (Mazzucco and Clemente, 2013).

In addition to this blade, there are another two lithic implements that display use-wear related to pottery-making (Gassin and Garidel 1993; Torchy and Gassin 2010). One of these is a blade that, like the previous one, seems to have been used to smooth clay, while the other implement is a perforator apparently used to pierce dry pottery (Fig. 4, a), possibly while repairing and/or decorating a vessel. Future experimentation might serve to confirm this hypothesis. The study of the lithic remains from la Espluga de la Puyascada has succeeded in determining that the raw materials used to make the implements were obtained in three different areas.

Some of the raw materials come from local areas, within a radius of 5 to 15 kilometres from the site. They consist mainly of a type of grey/black marine flint, characterized by the presence of many fissures and cracks caused by the pressure of the surrounding limestone. A second flint type that proceed from a local context, is a white/grey chert known as belonging to the “Tremp Group”. It is more homogeneous and more suitable for knapping (Mangado et al. 2007).

The majority of the chert materials proceed from a regional context. Nearest outcrops are located at a distance up to a hundred kilometres from the site, in the Upper Ebro Valley. This area is characterised by a large number of primary outcrops and nodules that are usually of large dimensions. This chert type is quite homogeneous, characterized by a micro-crystalline quartz matrix that makes it highly suitable for knapping, especially to obtain elongated blanks.

The last group consists of rocks that proceed from outside the region. A fragment of “honey flint” has been recorded at La Puyascada. This suggests the existence of exchange networks through which this piece could be acquired (Weller, Figuls and Grandia 2007). In addition to this, the presence of two Cerastoderma edule fragments at La Puyascada, seem to suggest that such networks are related with Mediterranean coastal areas.

The lithic remains include blade cores, hammerstones, resharpening tablets and a relatively high percentage of pieces with cortex. This clearly indicates that the allochthonous raw materials were worked at the site. Blades were the more recurrent blanks and all of them tend to exhibit very intense uses, prolonged in time, including resharpening, transport and re-use. Those tools were used in various productive processes mainly connected with the exploitation of animal resources and the gathering of herbaceous plants. However lithic implements have been used also in other activities, as working hard animal substances in various productive processes mainly connected with the exploitation of animal resources and the gathering of herbaceous plants. However lithic implements have been used also in other activities, as working hard animal substances
Fig. 3 - 1) Blade used for cutting herbaceous plant. *a* - macro traces from cutting plants; *b* - smooth plant polish. 2-3) Blades used for cutting herbaceous plants showing contact with soil; *a* - macro traces; *b* - abrasive plant polish.

Fig. 3 - 1) Lama con macrotracce (*a*) e polish (*b*) di taglio di piante non legnose. 2-3) Lame con macrotracce (*a*) e polish (*b*) di taglio di piante non legnose con contatto con il suolo.
Fig. 4 - 1) Instrument used to perforate a mineral substance, probably chert. a- pronounced edge-rounding on the point; b- striae from mineral material. 2) Blade used for cutting herbaceous plant, and successively, for scraping bone/antler. a- macro-traces from plant cutting; b- abrasive plant polish; c- retouched notch; d- bone polish.

Fig. 4 - 1) Strumento usato per perforare sostanza minerale, probabilmente chert. a- forte arrotondamento del margine distale della punta; b- strie causate da materiale minerale. 2) Lama usata per tagliare piante non legnose e successivamente per raschiare materia dura animale. a- macrotracce di taglio di piante; b- polish; c- incavo ritoccato; d- polish di osso.
Fig. 5 - 1) Blade used for cutting animal substance (hide). a- pronounced edge rounding; b- polish from hide working; 2) Large blade used for cutting plants and after reemployed for working mineral substance, probably ceramic. a- pronounced rounding on the retouched edge; b-c- abrasive, striated polish; d- smooth plant polish; e- striation partially covered by use-polish, maybe produced by human transportation of the instrument.

Fig. 5 - 1) Lama con tracce di taglio di material animale (pelle). a- forte arrotondamento del margine; b- polish di lavorazione della pelle. 2) Lama larga con tracce di taglio di piante e riutilizzo su sostanze minerali, probabilmente ceramica. a- arrotondamento del margine ritoccato; b-c- polish con strie; d- polish di piante; e- strie parzialmente coperte dalla polish probabilmente prodotte dal trasporto del manufatto da parte dell’uomo.
and production/decoration and/or repair of pottery.

Previous papers on la Espluga de la Puyascada had regarded the lithic remains as "poor and not characteristic", in contrast with the very abundant and varied faunal remains and the rich and interesting bone industry (Baldellou Martínez V., 1981, 1987, 1988, 1994; Castaños 1987). However, this more detailed analysis of the lithic assemblage has enabled a more profound understanding of the site. Even if La Puyascada is undoubtedly interpreted as a mountain site, closely linked with pastoralism, the study of the lithic assemblage, despite it being a partial sample, has succeeded in proving the existence of a complex series of activities, related to food production and space conditioning.

Even if the cave appears to have been inhabited mainly on a seasonal scale, the human occupation of the site seems to display certain stability. Activities such as preparing inner living spaces, manufacturing lithic and bone tools, production and/or repairing of ceramic materials, and the transportation of raw materials from relatively distant sources, suggest that the cave may have been occupied with certain continuity by the prehistoric groups. It does not seem to have been simply used as shelter by pastoral groups during their migration toward summer pastures. The study of other contemporary sites in the Vall de Boí, in areas of higher altitude (Gassiot et al. 2010, 2012), has shown that the rock-shelters used by small pastoral groups during their migrations are characterised by much smaller occupations in which domestic activities would have been much more sporadic, if not non-existent, which is also reflected in an expedite use of mineral resources.

We therefore believe that la Espluga de la Puyascada is a potentially important site that can contribute towards attaining an understanding of population dynamics in the Aragonese Pyrenees in the Neolithic, as a large part of its surface remains unexcavated.

ACKNOWLEDGEMENTS

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