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La Cuevona de Avín (Avín, Asturias, North Spain): A new Late Pleistocene site in the lower valley of the River Güeña

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A B S T R A C T

The archaeological investigations carried out in the last twenty years in the Lower Valley of the River Güeña (Asturias, central part of northern Spain) have documented different prehistoric sites, particularly with Middle and Upper Palaeolithic occupations. This paper presents the results of the archaeological excavation carried out in the cave of La Cuevona de Avín. From the systematic study of the biotic and abiotic remains, a total of three occupation phases (Phases 1 to 3) have been determined, dated in the Late Pleistocene. The lithic studies indicate the use of local raw materials (mainly quartzite), but also regional ones (different types of flint) in the whole sequence. Retouched implements are typologically representative only during the Upper Magdalenian (Phase II) and use-wear analysis indicates the manufacture and use of artefacts *in situ* during this phase. Archaeozoological studies reveal continuity in subsistence strategies throughout the sequence, noting specialization in red deer hunting during the Azilian (Phase I), and more diversified prey in the older phases.

1. Introduction

The Late Upper Pleistocene is one of the best documented periods in North Spain. After 14,000 years BP, at the start of Greenland Interstadial 1, the number of prehistoric occupations increased exponentially, particularly at sites near the coast but also further inland (e.g. González

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Sainz and González Urquijo, 2007). Continuity in their use is seen at some of those sites, from the later Upper Pleistocene (Upper Magdalenian period) to the transition to the Mesolithic (Azilian), just before the onset of the Holocene. Examples of this continuity have been documented at coastal sites like La Riera in Asturias (Straus and Clark, 1986), La Pila in Cantabria (Bernaldo de Quirós et al., 2000) and Santa Catalina in the Basque Country (Berganza and Arribas, 2014) but also in the interior, at Los Azules in Asturias (Fernández-Tresguerres, 2007) and El Piélago I and El Piélago II, in Cantabria (García Guinea, 1985a and b), among others.

Here we present the detailed study of archaeological remains recovered by one of the authors (ACPLL) in a test excavation carried out

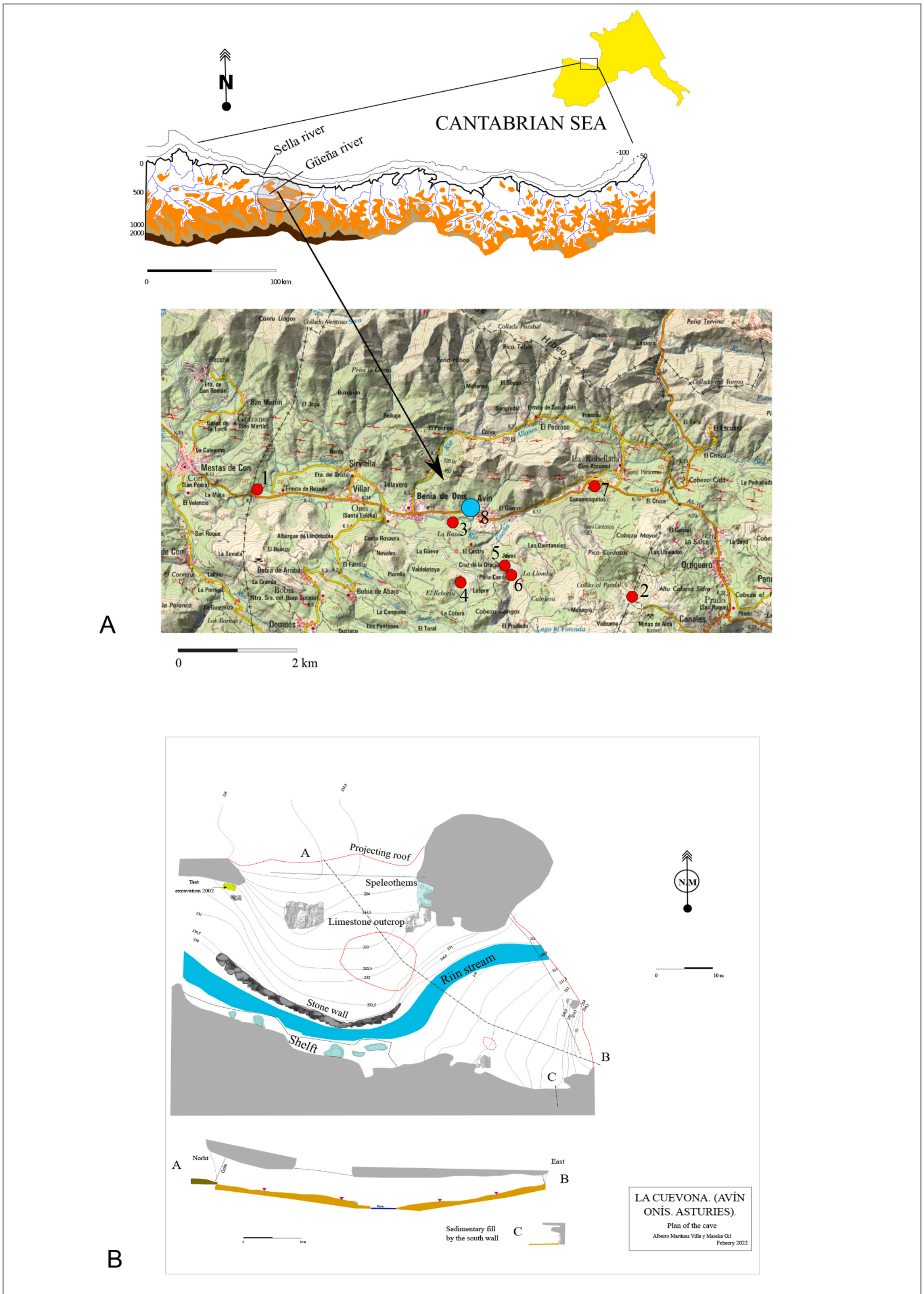


Fig. 1. A: Location of La Cuevona de Avín in the north of the Iberian Peninsula, indicating other sites located in the Lower Güeña valley. 1. Las Cámaras; 2. Alda, 3. Molín; 4. Pruneda; 5. Sopeña; 6. Soterraña; 7. Joullobu; 8. La Cuevona de Avín. B: Plan of the Cave, indicating the position of the excavated area in 2002.

in a cave in the Güeña valley, known as La Cuevona de Avín (Asturias), at the start of this century. The analysis of abiotic materials (lithic assemblage, raw materials, use-wear) and biotic remains (anthracological, archaeozoological and osseous industry) has determined three episodes of human occupation of the cave in the late Upper Pleistocene. Comparison with similar sequences elsewhere in northern Spain enables a better understanding of human occupation and management of the territory and resources at that time.

2. Prehistoric occupations in the lower Güeña valley

The lower Güeña region is located in the eastern part of the Principality of Asturias (northern Spain) (Fig. 1). It is in the Council of Onís, a geographic area at the junction of several routes that connect the west and east of that region. Thus, the River Güeña flows west to a confluence with the River Sella while, to the east, the Cares valley is easily accessed along the valley of the River Casaño. Although the nearby Cantabrian coast can be reached by following those rivers (Güeña-Sella to the Ribadesella estuary; Casaño-Cares-Deva to Tina Mayor estuary), the quickest access to the sea (17 km away at the present) is by the River Cabras-Bedón. Thanks to these excellent communications, the area enjoyed access to the wide range of resources (mountains, river valleys, coastal plains and maritime) offered by this rich ecotone. It is a karst limestone area, full of caves, which hosted a large number of prehistoric occupations.

Within the programme of archaeological documentation funded by the Principality of Asturias from 1983 to 1986, archaeological surveying in the Council of Onís recorded several caves and rock-shelters containing remains from different periods in prehistory as well as examples of cave art (Martínez-Villa, 1986). Some test pits were also carried out (Arias and Pérez, 1990). Equally, in the 1980s, the area was explored by members of the Polifemo Speleological Group (Quintanal, 1991).

In 2001 and 2002, one of the authors (ACPLL) explored several caves, and some of them proved to contain archaeological evidence. She also carried out some test excavations. This paper focuses on the analysis of materials recovered in a 2x1 m archaeological excavation at La Cuevona de Avín. In addition, she studied another six sites:

Fieldwork in **Sopeña Rock-shelter** (Avín) began in 2001, when a 2 m^2 test excavation was dug, reaching about 2 m depth and revealing 17 archaeological levels. Bedrock was not reached, and it is thought that the sequence continues deeper. Based on archaeological finds and dates obtained by C^{14} AMS, including ultrafiltered samples, and by ESR methods, the different occupations are thought to pertain to three prehistoric cultural periods. The most recent of these is the Gravettian use of the cave (Levels I to VII) with abundant faunal remains associated with diagnostic lithics (e.g., Gravette points), bone industry (a modest assemblage of sagaies and points), objects of adornment, etc. Levels VIII to XI are attributed to the Early Upper Palaeolithic; finally, the deeper Levels XII to XVII are ascribed to the Mousterian. Since then, excavations in course are progressing through an area of over 20 m^2 (Pinto-Llona, 2018; Pinto-Llona and Grandal d'Anglade, 2019; Pinto-Llona et al., 2012, 2022).

Joullobu Rock-shelter (Rebollada) was excavated in two seasons (2001–2002) (Pinto-Llona 2007). Although the deposit was disturbed, some paleontological remains were dated (including *Panthera leo* and *Panthera pardus*, *ca.* 49,000 cal BP), and archaeological materials indicated an occupation during the Chalcolithic, in *ca.* 4900 cal BP. Surveying by the Polifemo Group in 1980 had recovered lithic artefacts, among which they cited "Solutrean laurel-leaf points" associated with fauna (Quintanal 1991: 52; Adán 1997: 113).

Another test-pit was dug in **Cueva de Soterraña** (Avín) in 2002. In addition to the surface layer, in which undiagnostic faunal, anthracological and lithic remains were found, an archaeological level was identified (Level I), with about a hundred faunal remains, including caprids and felids and a dozen lithic artefacts in flint, quartzite and quartz. Finally, another three caves were explored in 2002: **Belbín** (Gamoneu), **Alda** (La Rebollada) and **Las Cámaras** (Pelmoru), where a few lithic remains in flint, quartzite and quartz were recovered together with fauna. The evidence documented in these four caves only shows that they were probably occupied at different indeterminate times in prehistory.

3. Archaeological background of La Cuevona de Avín

3.1. Fieldwork

La Cuevona de Avín (Avín, Onís, Asturias) is a cave located in the north-central region of Iberia (43° 20′5.93″N, 4°57′13.34″W, ETRS89), at 230 m above sea level. It is in a limestone hill in the centre of the wide Güeña valley in the area of Onís (Fig. 1A). It consists of large chamber with three wide entrances. The largest faces north, while the entrances to the east and west allow the Riín stream to flow through the cave longitudinally. A shaft nearly in the middle of the roof of the chamber provides natural lighting (Fig. 1B).

La Cuevona de Avín was discovered to the scientific community in 1981 by Pablo Arias, Carlos Pérez and Alberto Martínez-Villa and included by the last of these researchers in the "Archaeological Inventory of the Council of Onís". The deposit is found in three parts of the cave: on both sides of the north entrance, in a small passage in the south part of the cave, and in the upper part of the east entrance (Martínez-Villa, 1986). A small test pit (0.5 × 0.5 m) in this area in 1985 did not yield any archaeological remains (Arias and Pérez, 1990: 137).

From January to March 2002, Ana Pinto excavated a 2 m^2 test trench (Squares H6 and I6) about 80–100 cm deep, at the foot of the north-west wall, very near the north entrance (Fig. 1B). This was a flat, sheltered area, 16 m from the flowing stream and 4 m above it. The excavation was carried out according to the archaeological strata, sub-divided into arbitrary spits, 5 cm thick, following the different sedimentary layers that were observed. The sediment was sieved with different mesh sizes (between 8 and 2 mm) and the remains were washed, classified, and inventoried. Additionally, a sediment sample (8 dm^3) was collected from each of the stratigraphic units (SU) and screened with a 1 mm mesh in order to collect smaller remains, such as charcoal, small vertebrate bones, knapping waste, etc. The selected residue was processed in 2021.

3.2. Stratigraphy

The archaeological sequence at La Cuevona de Avín differentiated a total of ten SU, clearly distinct from one another in their sedimentology and with clear breaks between them, according to the information recorded in the excavation log-book (Table 1).

3.3. AMS radiocarbon dating

Two AMS radiocarbon dates for two bone samples belonging to macromammals (both with cut marks) have been obtained from two different SU at La Cuevona de Avín. SU-II is dated in the transition from the Greenland Interstadial 1 to Greenland Stadial 1 (Younger Dryas), and SU-VI is dated in the beginning of Greenland Interstadial 1 (Table 2).

4. Methodology for the study of the archaeological remains

4.1. Abiotic remains

The chipped lithic remains have been studied from the point of view of the procurement of raw materials in addition to the technological, typological and traceological approaches.

The raw materials study focused on the provenance of the flint artefacts. The analytical protocol was based on previous proposals for the identification of flint resources (e.g. Tarriño, 2006; Tarriño and Terradas, 2013; Herrero-Alonso, 2018). It involved the *de visu* observation of

Table 1
Description of the different SU documented in La Cuevona and their adscription to the three proposed Phases.

SU	Thickness	Description	Phase
I	3–5 cm	Surface layer. Flowstone-speleothem with very few archaeological remains	
II	10–20 cm	Very carbonated clay with limestone clasts and archaeological material (lithic industry and terrestrial fauna)	I
III	3 cm	flowstone-speleothem. No archaeological remains	
IV	6 cm	reddish carbonate sand, with some archaeological remains	II?
V	15 cm	dark brown clay, not compact, with angular limestone clasts in some cases over 10 cm long and archaeological lithic and osseous remains	II
VI	12–17 cm	dark brown clay, not compact, with smaller clasts than in SU-V. Presence of charcoal and lithic and osseous remain	
VII	5–15 cm	light brown silty sand, with clasts over 25 cm long. Similar to SU-IV. Practically sterile from the archaeological point of view, the few remains came from SU-VI	III
VIII	5 cm	dark brown clay, with less sand, and with limestone clasts > 5 cm. Practically barren	
IX	7 cm	dark brown plastic clay with some lighter reddish areas, containing gravel, organic matter and charcoal, together with angular clasts up to 20 cm long. Similar to SU-VIII. Practically sterile from the archaeological point of view	
X	12 cm	yellowish sand with gravel and small clasts. Barren from the archaeological point of view	

Table 2
Radiocarbon dates obtained in the archaeological sequence in La Cuevona de Avín. The dates were calibrated with the IntCal20 curve (Reimer et al., 2020) and OxCal 4.3 (Ramsey 2009).

SU	Phase	Sample	Lab. Cod.	Dates 14C BP	Dates cal. BP 2 σ (95.4 %)	$\delta^{13}C$	^{13}N
II	**I**	Bone (*C. elaphus* phalanx)	Beta-610104	11,180 ± 40	13,173 – 13,060 (93.8 %) 13,024 – 13,005 (1.6 %)	−20.8	3.6
VI	**II**	Bone (diaphysis)	Beta-607273	12,450 ± 40	14,752 – 14,315 (72.3 %) 14,940 – 14,764 (23.1 %)	−20.8	3.2

colour, gloss, transparency, touch and cortex, and later the texture and different inclusions, both mineral (detritic quartz, carbonates, sulphates and oxides) and organic (bioclasts) were studied with a Leica EZ4 HD stereomicroscope (10-20x magnification).

To determine the debitage systems, the typo-technological study has followed previous approaches (e. g., Perlès, 1991; Inizian et al., 1995; Pelegrin, 2000), as applied to other late Pleistocene sites in the Iberian Peninsula (Vadillo and Aura, 2020). Thus, first the category of cores and volumes with evidence of reduction has been differentiated. The debitage products, flakes or laminar blanks, have been grouped in another category and the management products in a further one. This latter category includes elements related to actions aiming at creating an appropriate morphology of the cores, either in their initial phase or during the reduction process. Another category includes the retouched tools, which have been classified in the type-lists of Sonneville-Bordes and Perrot (1953, 1954, 1956a and b). Finally, debris or knapping waste (objects with a conchoidal fracture < 1 cm in size) and indeterminate fragments fractured by heat-alteration or other causes have been grouped together.

The methodology employed for the functional analysis has been applied to retouched tools, in both flint and quartzite. This methodology derives from the pioneering works carried out by Semenov (1981), which were continued by authors such as Keeley (1980), Anderson-Gerfaud (1981), Vaughan (1985), and Ibáñez and González (1996). Microscopic traces (micro-polish, striations, abrasion platforms, etc.) were mainly used as diagnostic attributes for functional classification (Utrilla et al., 2003, Domingo 2005, Domingo et al., 2012) although marks that are observable to the naked eye (chips, fissures, edge-rounding, etc.) were also taken into consideration. The microscopic study was performed with a Leica DM 2700M optical microscope with white light LED illumination in both transmitted and reflected light modes. The images were acquired with a Leica MC190HD digital camera at x100 and x200 magnification and processed with Adobe Photoshop CS6.

Remains of minerals (iron oxides) and rocks (sandstone) have been quantified and classified (Blatt et al., 1980) and they have been studied to analyse the evidence of anthropic alterations. A sample of iron oxide remains has been studied in detail. Mineralogical and textural analyses were carried out in the Applied Microscopy Unit/laboratories at the IGME-CSIC using a binocular microscope Nikon SMZ-745T, and Scanning electron microscope (SEM), JEOL JSM-6010 PLUS/LA, with W thermionic filament, with variable vacuum pressure. It is equipped with secondary, backscattered electron detectors and an EDS (energy dispersive spectroscopy) microanalysis system.

4.2. Biotic remains

Charcoal remains were systematically recovered by combining the techniques of screening and trimming over a sediment sample from each SU excavated in this site in accordance with the usual methods in anthracology (Uzquiano, 1992; 1997). They were fractured by hand following the three anatomical observation planes: transversal, tangential and radial sections, according to the key determinations collected in both non-charred and charred wood atlases (e.g., Schweingruber, 1990; Vernet et al., 2001). The analysis was carried out with a reflected light optical microscope (Olympus BX60) assisted by SEM microscopy in some cases. Nomenclature follows the guidelines compiled in *Flora Europaea* (Tutin et al., 1964).

Vertebrate and invertebrate remains were recovered from all the excavated SUs at La Cuevona de Avín cave. In the case of large vertebrates and birds, fragments < 1 cm in size that are unclassifiable or display recent fractures have not been considered. All the remains of microvertebrates, fish and invertebrates (marine and continental molluscs and echinoderms), recovered by screening with metallic mesh sizes down to 1 cm have been analyzed.

Identifications have been made with the reference collections held by the different hosting institutions of some of the authors of this paper. Several osteological atlases have also been used, for the large mammals (e. g., Pales and Lambert, 1970; Pales and Garcia, 1981), birds (e. g., Erbersdobler, 1968; Tomek and Bochenski, 2000) and microvertebrates (e.g., Bailon 1991, Chaline et al., 1974).

In the case of large mammals, when it was not possible to assign the remains to a specific taxon, they were grouped in different size categories: large (>300 kg), medium (100 – 300 kg) or small (100 – 2 kg). To estimate the age of death of each species, criteria related to dental eruption (e.g., Bull and Payne, 1982; Brown and Chapman, 1991; Levine, 1982; Pérez Ripoll, 1988) and epiphyseal fusion (Reitz and Wing, 2003) were used. In the case of birds, some specimens could not be determined at species level and were classified according to their size as "medium-sized birds", as established by Rufà and Laroulandie (2019); the distinction between adult and immature individuals was based on the ossification of the cortical tissue and epiphyses (Hargrave, 1970).

To quantify the different remains, Number of Identified Specimens

(NISP) and Minimum Number of Individuals (MNI) were used. Additionally, the Number of Remains (NR) has also been considered (e. g., Reitz and Wing, 2003, for the mammals; e. g. Moreno, 1994, for the molluscs; Campbell, 2008 for the echinoderms).

The taphonomic observations were made with a Leica EZ4 stereo microscope (6.5–32 x). It was possible to determinate anthropic modifications (e. g., Shipman and Rose, 1983; Domínguez-Rodrigo et al., 2009; Vettese et al., 2020), thermoalterations (e. g., Nicholson, 1993; Stiner et al., 1995), carnivore damage (e. g., Haynes, 1983; Andrews, 1990; Selvaggio, 1994) and natural agents (Fernandez-Jalvo and Andrews, 2016).

Information about the biotopes of the different taxa has been taken from specific studies for large (e. g., Barone, 1966) and small mammals (International Union for Conservation of Nature (IUCN), 2022), birds (e. g., del Hoyo et al., 1992–2010), fish (e.g., Doadrio, 2002), terrestrial molluscs (e. g., Cadevall and Orozco, 2016; Ruiz Cobo and Vázquez Toro, 2019), marine molluscs (e. g., Palacios and Vega, 1997) and echinoderms (e.g., Southward and Campbell, 2005; Álvarez-Fernández et al., 2014).

The nomenclature of FAUNA EUROPAEA was followed for large mammals, birds and terrestrial molluscs (https://www.faunaeur.org; retrieved 03-03-2022; de Jong et al., 2014). In the case of small mammals, the work of Wilson and Reeder (2005) has been used, whereas the study of amphibians has followed Frost (2021). WoRMS nomenclature was used for the marine invertebrates (WoRMS Editorial Board 2022). Fish classification followed Fishbase (Froese and Pauly, 2022).

5. Results

5.1. Abiotic remains

The lithic assemblage found in the sequence at La Cuevona de Avín consists of 1,570 remains, of which those related to lithic reduction have been differentiated (80.6 %), while the others are pieces of iron oxide and sandstone (Table 3). Large quantitative differences exist between each level. SU-VI has yielded the most remains, which represent *ca*. 51.9 % of the total.

5.1.1. Lithic production

5.1.1.1. Raw materials. The lithic industry is in a good state of conservation, although some flint pieces are dehydrated, or affected by the precipitation of carbonates or heat. This has not impeded the observation of their technological characteristics.

Flint is the raw material that predominated in the older SU (49.4 %) followed by quartzite (48.7 %) whereas the latter material is most common in the more recent units. Rock crystal and quartz make up the other percentage (Table 4).

An initial study indicates that quartzite, rock crystal and quartz are local materials that would have been acquired in the form of cobblestones on the river terraces in the Güeña valley (Tables 4 and 5).

In the detailed study of flint types, indeterminate fragments and debris have been omitted. A total of 219 remains have been analyzed. A high proportion (51 %) belongs to Flysch flint. This type of flint comes from turbiditic geological formations deposited in deep environments at the foot of the slopes connecting the marine platforms with the pelagic ocean depths. While several varieties exist (Tarriño et al., 2015), they share a series of microscopic characteristics, such as a high bioclast content (sponge spicules and foraminifera). At La Cuevona de Avín, only the Kurtzia Flysch variety has been identified (Tarriño, 2006). This variety is present in the whole sequence, except in SU-IX. Its outcrops are located about 170 km away in a straight line, in the Basque Country.

It is followed in percentage by Piloña flint (18 %). This resource outcrops in the Santonian limestone formed in the marine platform (Upper Cretaceous) that is found in the valley of the River Piloña, also a tributary to the River Sella, and above all it is seen in a derived position in the continental conglomerates of the 'Posada Pudding-stone' in the Oviedo Tertiary basin (Asturias). It is characterized by a high content of terrigenous minerals and bioclasts (*Lacazina* genus) (Tarriño et al., 2013). It is found in the whole archaeological sequence. Piloña flint can be acquired at a maximum distance of 30 km away, to the west of the cave.

The Alba radiolarite, a local resource, is represented by only 2 %. Its source would have been in the 'Griotte limestone' in the Alba Formation (Lower Carboniferous), with a wide distribution in northern Spain, including in the area of the site. The raw material is easily identifiable by its characteristic reddish colour and, at microscopic level, by the presence of radiolarians (Herrero-Alonso, 2018). This local raw material is, however, only found in SU-V and SU-VI.

Although 29 % of the NR could not be assigned an exact provenance (in most cases due to greater or lesser alteration of their outer appearance because of a whitish patina or micro-fissures and porosity), many of them probably correspond to one, or at most two, different flint types that are more or less equivalent in their microscopic content, and which come from outcrops about 80 or 90 km away in a straight line, probably Monte Picota flint, whose outcrops are located to the east (Upper Cretaceous marine platform in the Bay of Santander, Cantabria) and/or Piedramuelle flint, to the west (Oviedo Tertiary basin, Asturias) (Herrero-Alonso, 2018).

5.1.1.2. Technology and typology. Out of the different technological categories that have been differentiated, the most numerous are the indeterminate pieces and debris category, and the debitage products. In general, the proportion of laminar products is low, since 90 % of the blanks belong to the flakes group and the other 10 % to the blades. The presence of cores and pieces connected with starting and managing debitage shows that lithic reduction was carried out at the site from its initial stages to the abandonment of the cores.

An interpretation of the production systems can only be proposed for SU-V and SU-VI. The low number of elements in the rest of the stratigraphic units makes it impossible to establish elements of discussion in this sense between the different phases detected.

In these two SUs we note that the objectives of the reduction of flint cores would be related to obtaining bladelets. No reduction system

Table 3
Lithic remains found in the deposit at La Cuevona de Avín.

Technological categories	Stratigraphic Units							Totals
	SU-II	SU-IV	SU-V	SU-VI	SU-VII	SU-VIII	SU-IX	
Cores	1	4	4	19	0	0	2	30
Debitage products	19	42	138	262	22	10	12	505
Management products	0	4	8	28	0	0	0	40
Retouched objects	0	3	7	14	1	0	0	25
Indeterminate pieces and debris	5	17	87	466	56	18	17	666
Iron oxide fragments	11	1	27	22	11	9	212	293
Sandstone fragments	0	0	0	4	2	5	0	11
Totals	**36**	**71**	**271**	**815**	**92**	**42**	**243**	**1570**

Table 4
Different raw materials used in lithic reduction at La Cuevona de Avín. In the case of flint, the number of remains studied in detail is given in brackets.

Raw material	Phase I	Phase II			Phase III			Totals
	SU-II	SU-IV	SU-V	SU-VI	SU-VII	SU-VIII	SU-IX	
Flint	10 (5)	31 (21)	101 (50)	411 (121)	46 (12)	12 (6)	15 (4)	**626 (219)**
Quartzite	15	39	143	369	31	8	12	**617**
Quartz/rock crystal	0	0	0	9	2	8	4	**23**
Totals	25	70	244	789	79	28	31	**1,266**

Table 5
NR of flint types identified at La Cuevona de Avín.

Type of Flint	Phase I	Phase II			Phase III			Total
	SU-II	SU-IV	SU-V	SU-VI	SU-VII	SU-VIII	SU-IX	
Flysch Flint	1	11	30	60	9	2	0	**113**
Piloña Flint	2	2	5	27	1	1	2	**40**
Radiolarite	0	0	2	2	0	0	0	**4**
Indeterminate	2	8	13	32	2	3	2	**62**
Total	5	21	50	121	12	6	4	**219**

aimed at producing blades has been observed, in either the cores or the products. The bladelets are therefore small; an average of 5.9 mm in size. The characteristics of the butts and the presence of sandstone tools suggest that flint reduction was performed with a soft mineral hammerstone. They were obtained mainly in two ways:

1.) From carinated cores, in both Piloña and Flysch type flints. Analyses of the use-wear on these pieces have made it possible to determine that they are cores and not tools, although the morphology of the debitage surface resembles that of a scraper face. The negatives that appear would fit in well with the objectives of the debitage, which would be wide and regular bladelets. Among the group of retouched bladelets, there are specimens that would correspond to these characteristics and on which an abrupt, non-invasive retouch was carried out. Management and maintenance actions are detected on these cores: flanks to fit the debitage surface and create transversal convexity, actions to create longitudinal convexity such as the opening of opposite percussion planes, and preparation of these planes. However, natural surfaces, such as the thickened butts of the flakes being exploited, were sometimes used.
2.) Reduction on the flank of thick flakes, detected on all the types of flint: Piloña, Flysch and radiolarite. The debitage was carried out on flakes which, in some cases, came from debitage management actions related to other types of exploitation. These flakes were used later for the extraction of carinated bladelets from the flank. Although few products were obtained from these flakes, the creation of crests and more invasive extractions can be detected oblique to the debitage surface or flanks to guide the extractions and create longitudinal convexity. Although natural flat surfaces were sometimes used, in some cases, preparation of the percussion plane is also detected. Therefore, there was a certain investment in the preparation of the extractions even though the yield was scarce in terms of the quantity of products obtained. This exploitation was aimed at obtaining specific products, with a very abrupt side, which means that it did not require heavy investment in the configuration phase in order to obtain backed elements.

There are therefore only two lithic operational sequences in relation to the exploitation of flint. Although the objectives pursued are different (flat bladelets and carinated bladelets), in both cases the aim was to obtain standardized products. Both operational sequences involve maintenance and management actions so that the volume is maintained with a suitable morphology and products with the desired characteristics can be obtained.

Unlike in the case of flint, the quartzite reduction was performed by hard mineral percussion. Two modes have been seen in the exploitation of this raw material:

1.) Centripetal reduction. The objective was to obtain small flakes (<3cm). In some cases the flat cortical surfaces were used as the percussion platform and in others the cores were prepared by decortication.
2.) Reduction on one or several wide unidirectional and bidirectional faces. The intention of this type of exploitation would be to obtain flakes of different sizes. The presence of maintenance or management flakes with elongated reflected negatives would suggest that this reduction also sought blade-like products. Indeed a few central blades in quartzite have been recovered, as well as elongated flakes, which might be related to this kind of reduction. The average width of the quartzite blades is larger than that of the flint bladelets; the average width of the quartzite blanks is 13.7 mm. Some elements can be linked to the initial phases of debitage in quartzite as well as examples that show how the knapping surface was opened by creating guide crests. Some elements from the management of the reduction surface can also be associated with this type of reduction. One core combines two reduction modes: centripetal and over a wide face.

In the case of the first lithic operational sequence, the objective is to obtain standardized products, i.e. of similar dimensions and characteristics. In the second type, although the debitage system follows the same dynamics throughout the reduction process, the objectives are varied: from flakes of different sizes to elongated products morphometrically close to blades.

In addition to these lithic operational sequences in quartzite, there was a minority reduction of volumes in which naturally suitable morphologies were used, or which required little preparation to be exploited, but from which few products would be obtained. In this way, a flake was found with burin-type removals, which were associated with the reduction process and not with its fabrication as a tool (burin) because the pointed shape does not seem to be optimal as a working area. This reduction aimed to obtain elongated or laminar products. The presence of elongated carinated products in quartzite is indicative of the objective of those blanks also in quartzite. This debitage system involving little preparation and use of raw material could include a core on quartzite to obtain flakes of different sizes, extracted from several faces. The faces being exploited were used as percussion planes in the successive phases, showing the utilisation of the morphologies that emerged during the debitage process.

In this phase, cores in quartz and rock crystal have also been recovered. The reduction would have been aimed at obtaining bladelets. However, not enough elements have been found to reconstruct the reduction system in those raw materials.

Retouched elements (Fig. 2) are in general scarce in the assemblage. Thus, there are insufficient elements to detect changes in the configuration of the tools at a diachronic level. Most of the examples are ascribed to SU-V, n = 8: 3 % of the total, and to SU-VI, n = 16: 4 % of the total. Armatures, all in flint, represent 38 % in SU-V (n = 3), whereas their percentage decreases in SU-VI (n = 3, 19 %). They are mostly fragmented backed bladelets, since only one in this group is complete. No pointed objects have been found. The endscraper group is mostly made of flint, except for one in quartzite. In SU-V, endscrapers make up 25 % of the tool kit (n = 2) and in SU-VI, 13 % (n = 2). Notches and denticulates are represented by a percentage of 13 % in SU-IV (n = 1) and 38 % in SU-VI (n = 6). They are balanced in terms of the raw materials, as four were made in quartzite and three in flint. Artefacts with continuous retouch make up 13 % (n = 1) and 25 % (n = 4) in SU-V and SU-VI, respectively, and all but one of them was made in flint. A single burin in quartzite was recovered in SU-VI and a truncated piece in flint in SU-V.

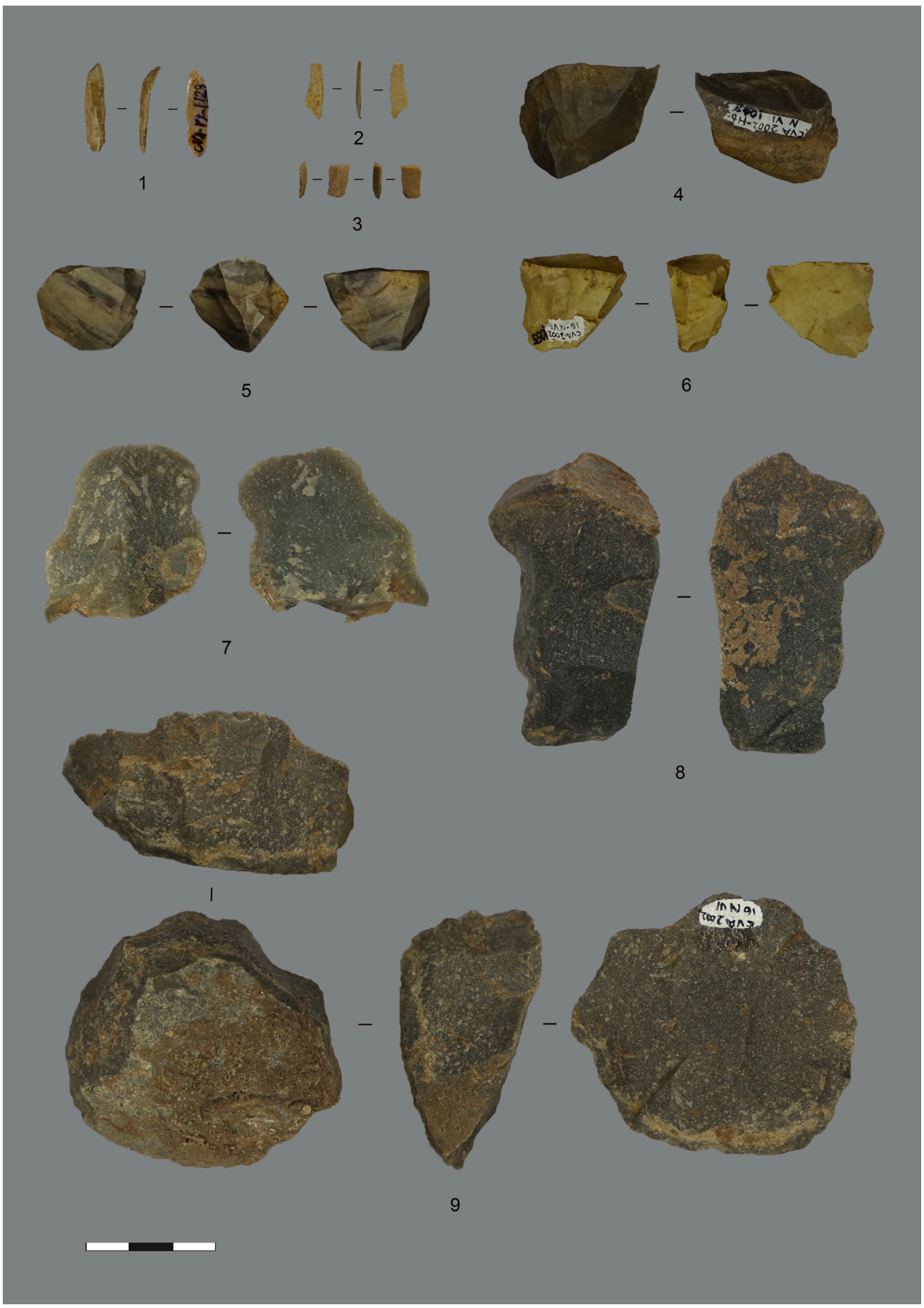


Fig. 2. Lithic industry (1–6, flint; 7–9, quartzite) from Phase II at La Cuevona de Avín. 1–3. Armatures; 4–5 Carinated cores; 6. *Débitage* on a thick flake flank; 7–8. Notches and denticulate; 9. Quartzite reduction on a wide face (all belong to SU VI, except no. 3, SU V).

5.2. Use-wear on flint and quartzite artefacts

The functional study has examined a total of 53 lithic artefacts of different typology, made on flint and quartzite.

34 flint artefacts come from SU-IV (n = 2), SU-V (n = 9) and SU-VI (n = 23). Of these 21, did not display any diagnostic marks of anthropic use (62 %), although four of them (12 %) had been damaged by post-depositional processes. The other 13 (38 %) can be discriminated into those with functional use-wear and others with technical marks caused by knapping and/or retouch processes: to be exact, seven objects displayed use-wear (microscopic wear in six cases and macroscopic in the other) and the other six had marks produced during their fabrication.

The use-wear (Table 6) was generally caused by relatively short working times, which did not allow diagnostic wear to develop. Therefore the reliability of the identification of the wear is no more than medium–high, and in most cases, medium or medium–low. The functions that have been detected are the usual ones in this kind of assemblage, involving contact with bone, hide and wood, and a use as a projectile element. The development of the wear was so slight in two cases that it was impossible to propose a particular type of task or substance that was worked with the tool.

In proportion, the technical marks are more frequent. These were caused by the impact of hammerstones and/or retouching tools on the edges of the artefacts (Fig. 3). As these marks are easily visible, the identifications are normally very reliable. Of the six artefacts with technical marks, five had previously been classified as nucleiform endscrapers, while the sixth is a denticulate object with impact marks on one of the notches. In general terms, four objects (three nucleiform endscrapers and the denticulate) display marks caused by the impact of a hammerstone, whereas it has not been possible to determine the type of hammerstones used with the other two because of the slight development of the marks. In the five cases that have been described, they are bladelet cores whose resulting morphology resembles that of a nucleiform endscraper but wear caused by their use has been detected on them. If, after their use as cores, they were employed in any other task, it was so brief that it did not leave any detectable wear.

Finally, the use-wear analysis identified traces related to perforation tasks on one piece. It was these traces of use that allowed it to be typologically assigned to the group of perforators although it had not been previously classified as such.

19 quartzite artefacts from SU-II (n = 2), SU-IV (n = 4) SU-V (n = 5), SU-VI (n = 7) and SU-VIII (n = 1) have been analyzed. Despite being fine-grained, which eased their observation, no use-related microscopic alterations were detected. Nevertheless, five of them (three large flakes and two laminar elements) show macroscopic edge damage which could be related to a task such as cutting materials of medium–high hardness (Table 6). No further precision is possible due to the lack of polish or other features at a microscopic level.

5.2.1. Other lithic remains

In the different stratigraphic units documented at La Cuevona de Avín, different iron oxides remains have been documented (Table 4). A large fragment of dark brownish-red ironstone of large size (11.23 × 8.62 × 6.3 cm) and weight (1,214 g) has been documented in SU-VI. It consists mostly of iron oxide (hematite, Fe_2O_3), which resulted from the replacement of>90 % of the original quartz-rich sandstone. The manufactured clast comes from the upper horizon (ferruginous crust) of an ancient, weathered soil (lateritic soil), whose ferruginization is characteristic of intertropical climates. Scraping facets are preserved all over its surface, produced when extracting ochre powder (Fig. 4**, details 1 and 2**). In addition, 17 ferruginized sandstone clasts with sizes of up to 3.5 cm in length were retrieved during the excavation of SU-II (n = 4), SU-IV (n = 1), SU-V (n = 2), SU-VI (n = 4), SU-VII (n = 1), SU-VIII (n = 2) and SU-IX (n = 3) at La Cuevona de Avín. They show a variable replacement by hematite and, in some cases, are faceted by wind-blown sand (dreikanter pebbles). No traces of human manipulation are observed. Fragments of ironstone clasts of a very small size (>5 mm) have also been recovered from the sediment triage; they were particularly numerous in SU-IX, although they have also been recorded in SU-V, SU-VI, SU-VII and SU-VIII (see Fig. 5).

The characterization of iron oxide remains has been made by SEM analyses on a sample from SU-IX (<5mm). Fig. 4 shows a fragment (300–500 μm wide) of hematite (Fe_2O_3), identified by the red streak and EDS analysis, with an elongated morphology consisting of a woodchip-like texture.

Eleven fragments of small sandstone pebbles were documented in SU-VI, SU-VII and SU-VIII. Traces of anthropic modification have not been observed on any of them.

5.3. Biotic remains

5.3.1. Anthracology

A total number of eight pieces of **charcoal** were collected in La Cuevona de Avín. Two fragments of *Quercus* sp. (deciduous oak) were identified in SU-II, perhaps corresponding to *Quercus robur*. Another fragment of *Quercus* sp. was also identified in SU-IV. An indeterminate charcoal was found in SU-V and finally, four pieces appeared in SU-VI: three were Indeterminable and one was identified as *Pinus* sp.,

Table 6
Main data for the artefacts, on both flint and quartzite, with functional (A) and technological (B) traces at La Cuevona de Avín. 1. Stratigraphic Unit/ID/(Phase); 2. Raw material; 3. Typology; 4. Observation Quality; 5. Functionality/Origin of the traces; 6. Identification reliability.

A	1	2	3	4	5	6
	VI/1005 (II)	Flint	Perforator	Poor	Piercing bone	Medium/high
	VI/1006 (II)	Flint	Simple endscraper	Good	Scraping bone	Medium/high
	VI/1022 (II)	Flint	Denticulate	Good	Working with hide	Medium
	VI/1065 (II)	Flint	Piece with continuous retouch on one edge	Medium	Working with wood	Medium/low
	VI/1071 (II)	Flint	Piece with continuous retouch on one edge	Medium	Indeterminate use	Medium/low
	V/1373 (II)	Flint	Concave truncation	Poor	Indeterminate use	Medium/low
	V/1411 (II)	Flint	Piece with continuous retouch on one edge	Regular	Projectile	Medium
B	**1**	**2**	**3**	**4**	**5**	**6**
	VIII/1646 (III)	Quarzite	Flake	Poor	cutting hard materials	Medium/low
	VI/1007 (II)	Flint	Bladelet core	Medium	Indeterminate impact on the percussion platform	Medium
	VI/1008 (II)	Flint	Bladelet core	Medium	Impact of a hard percussor on the percussion platform	Medium/high
	VI/1055 (II)	Flint	Bladelet core	Poor	Indeterminate impact on the percussion platform	Medium
	VI/1056 (II)	Flint	Bladelet core	Medium	Impact of a hard percussor on the percussion platform	Medium/high
	VI/1140 (II)	Quarzite	Flake	Poor	cutting hard materials	Medium/low
	VI/1275 (II)	Quarzite	Flake	Poor	cutting hard materials	Medium/high
	V/1378 (II)	Flint	Bladelet core	Good	Impact of a hard percussor on the percussion platform	Medium/high
	V/1448 (II)	Quarzite	Flake	Poor	cutting hard materials	Medium/high
	V/1471 (II)	Quarzite	Flake	Poor	cutting hard materials	Medium/high
	IV/1574 (II)	Flint	Denticulate	Poor	Impact of a hard percussor on the percussion platform	Medium/high

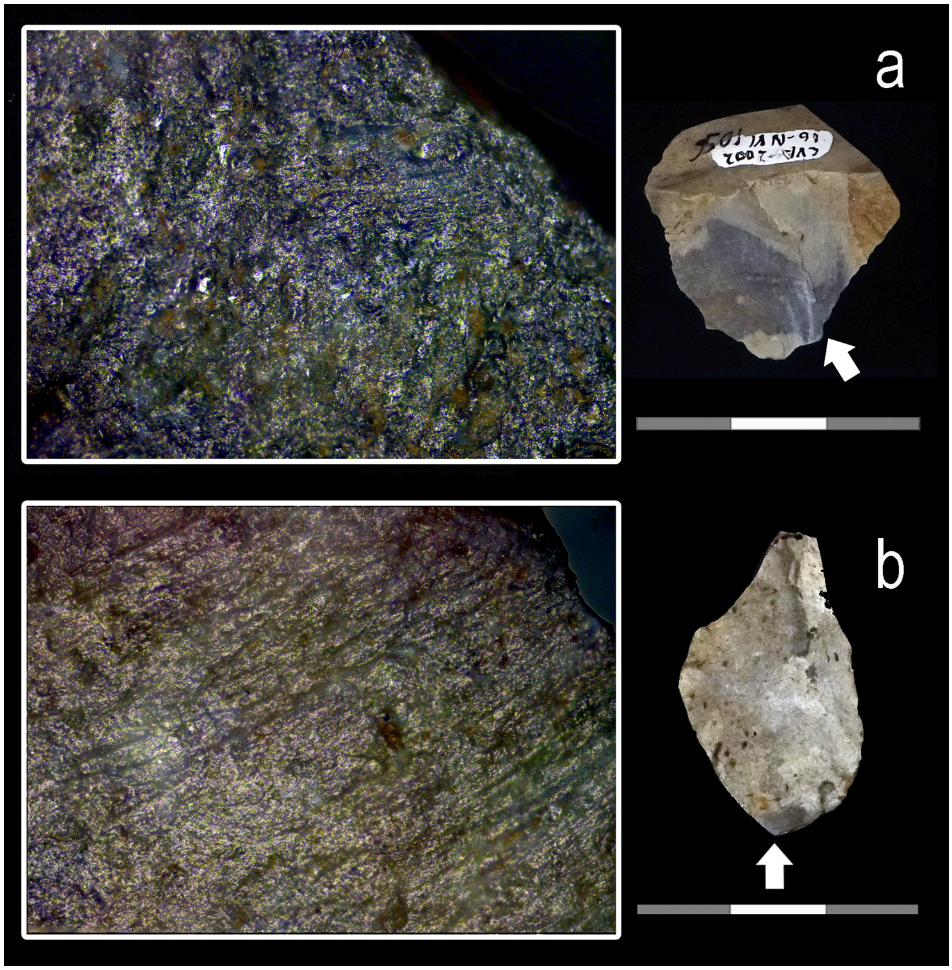


Fig. 3. A) Traces of bladelet removal by a hard hammer percussor (VI/1056, Phase II); Extensive traces of bladelet removal by a hard hammer percussor (V/1378, Phase II).

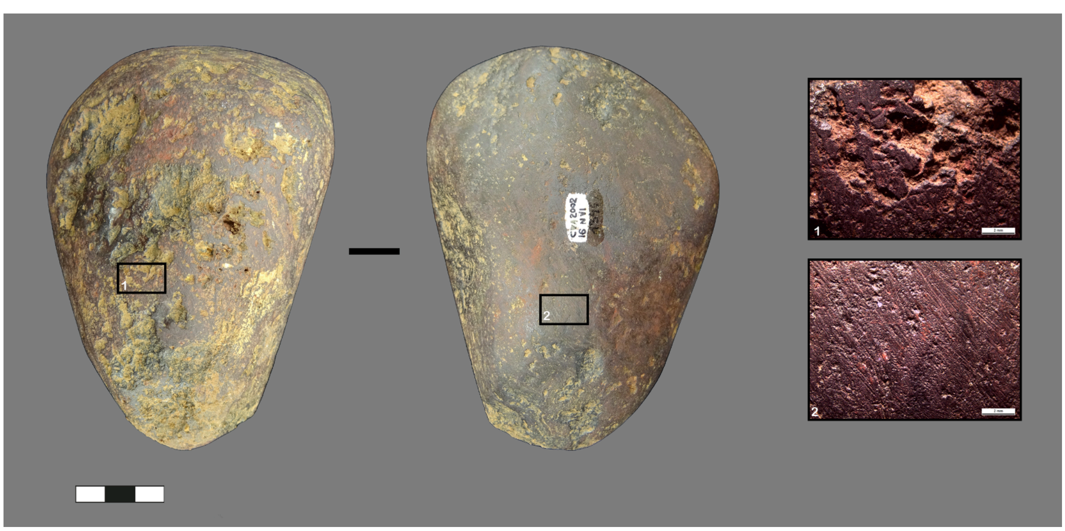


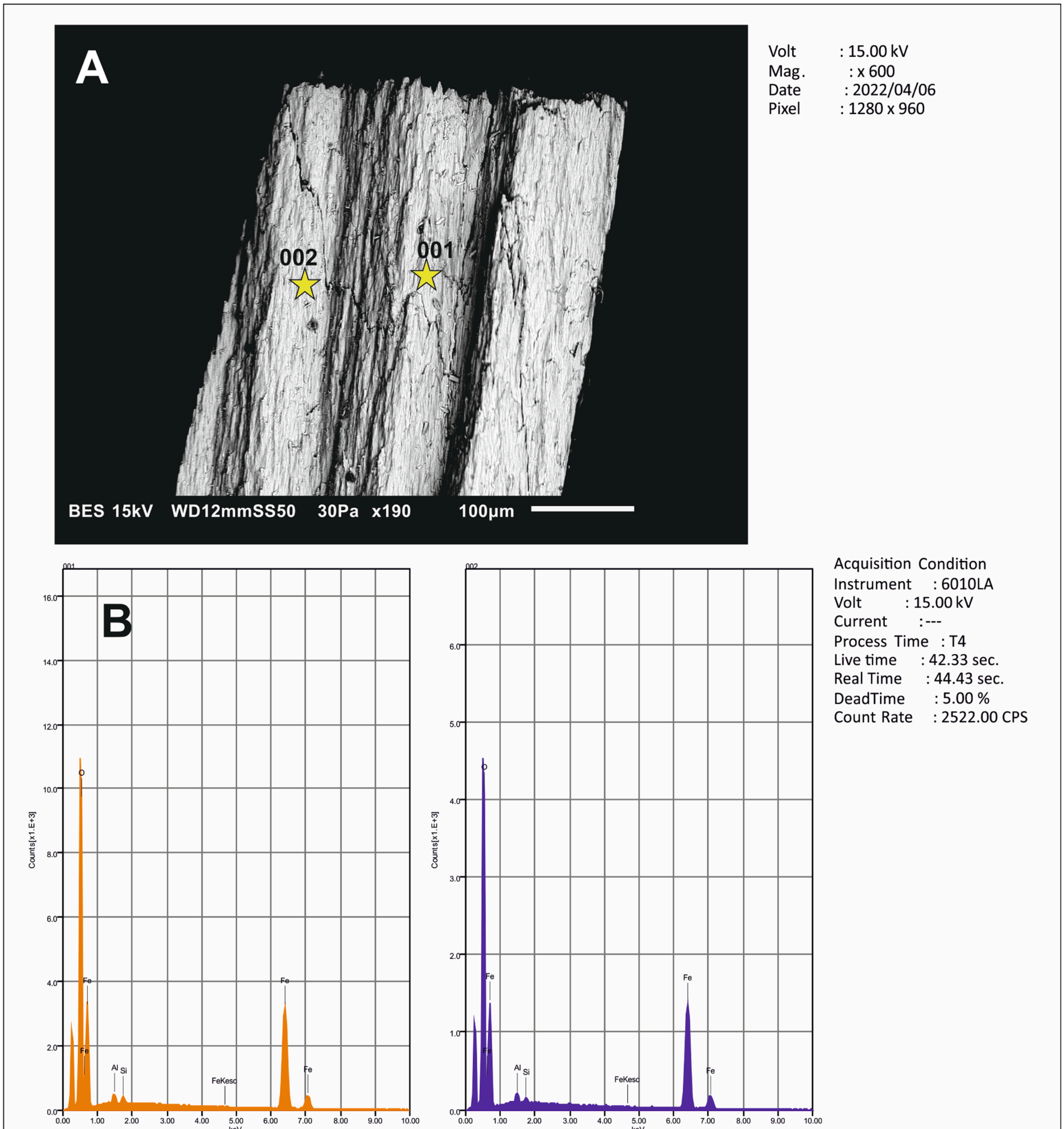
Fig. 4. Upper and lower faces and details of the scraping on a fragment of ironstone (hematite) from Phase II (SU-VI) at La Cuevona de Avín.

anatomically close to *Pinus sylvestris* (Scots pine). The ensemble of charcoal samples recovered at La Cuevona de Avín is therefore very scarce in quantitative and qualitative terms.

The animal remains documented in the sequence consist of both vertebrates (small and large vertebrates, fish and birds) and invertebrates (terrestrial and marine molluscs and echinoderms) (Table 7).

5.3.2. *Small mammals and amphibians*

The small mammal and amphibian assemblage comprises 124



	Fe	O	Al	Si
001	64.10	33.93	1.46	0.51
002	64.61	33.45	1.58	0.36
Average	64.36	33.69	1.52	0.43
Deviation	0.36	0.34	0.08	0.11

Fig. 5. A) SEM photomicrograph of hematite chip (IX/338, Phase III), indicating the location of the microanalysis (spots 001 and 002). B) Characteristic hematite spectrum and chemical analysis obtained by SEM and the instrument conditions.

identified disarticulated bone fragments (teeth, isolated mandibles, skull fragments, and postcranial bones) (Table 7). 24 of them have been identified at genus and/or species level (NISP), representing a total of 19 individuals (MNI). Of the small mammals, six taxa have been identified. Four of them belong to Order Rodentia: *Arvicola amphibius*, European Water Vole; *Microtus (Microtus) arvalis*, Common Vole; *Microtus (Terricola)* sp. Vole; *Microtus (Alexandromys) oeconomus*, Tundra Vole and two to the Order Eulipotyphla: *Talpa* sp., Mole; *SoreX araneus-coronatus*, Common Shrew-Crowned Shrew. Only four amphibian remains have been recovered; they belong to the Orders Caudata (*Salamandra salamandra*; Common Fire Salamander) and Anura (*Rana* sp., Frog). The sample is too limited to attempt an environmental interpretation, but the presence of *Microtus (Alexandromys) oeconomus* in SU-VIII would indicate the coldest moment in the sequence at La Cuevona de Avín.

Remains of micro-vertebrates are scarce in the different SUs. This scarcity may be explained in two ways. First, screens with mesh sizes < 1 mm, in which small remains are captured, were not used. However, even with a 1 mm mesh size a larger number of remains should have been recovered. Second, the cave may have been occupied intensely, as noted at other sites in Cantabrian Spain, like El Cierro Cave (Asturias), in the transition from the Upper Pleistocene to the Holocene (Álvarez-Fernández et al., 2020a) and in Peñalarga Rock-shelter, at a later time in

Table 7
Remains of vertebrates and invertebrates in the different stratigraphic units at La Cuevona de Avín. They are counted in terms of NR (Number of Remains), NISP (Number of Identified specimens) and MNI (Minimal number of Individuals).

	PHASE I								PHASE II												PHASE III											
	SU-II				SU-IV				SU-V				SU-VI				SU-VII				SU-VIII				SU-IX				SU-X			
	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI
LARGE MAMMALS																																
Equus ferus Boddaert, 1758	–	–	–	–	1	1	5.9	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2	15.4	2	–	–	–	–
Cervus elaphus Linnaeus, 1758	42	42	80.8	3	8	8	47.1	1	3	3	42.8	1	18	18	36.7	2	1	1	50	1	1	1	100	1	3	3	23.1	1	–	–	–	–
Capreolus capreolus Linnaeus, 1758	5	5	9.6	1	1	1	5.9	1	1	1	14.2	1	2	2	4.1	1	–	–	–	–	–	–	–	–	1	1	7.7	1	–	–	–	–
Capra pyrenaica Schinz, 1838	3	3	5.8	1	5	5	29.4	1	1	1	14.2	1	23	23	46.9	3	1	1	50	1	–	–	–	–	3	3	23.1	1	–	–	–	–
Rupicapra pyrenaica (Linnaeus, 1758)	–	–	–	–	2	2	11.8	1	–	–	–	–	4	4	8.2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sus **sp.**	2	2	3.8	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Vulpes vulpes Linnaeus, 1758	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3	23.1	1	–	–	–	–
Leporidae	–	–	–	–	–	–	–	–	2	2	28.8	1	•	2	4.1	1	–	–	–	–	–	–	–	–	1	1	7.7	1	–	–	–	–
Subtotal	52	52	100	7	17	17	100	5	7	7	100	4	49	49	100	8	2	2	100	2	1	1	100	1	13	13	100	7	–	–	–	–
Large size	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Medium size	44	–	–	–	18	–	–	–	11	–	–	–	31	–	–	–	8	–	–	–	3	–	–	–	13	–	–	–	–	–	–	–
Small size	42	–	–	–	15	–	–	–	13	–	–	–	94	–	–	–	16	–	–	–	3	–	–	–	15	–	–	–	–	–	–	–
Indet.	89	–	–	–	54	–	–	–	30	–	–	–	153	–	–	–	32	–	–	–	15	–	–	–	5	–	–	–	3	–	–	–
Subtotal	228	52	100	7	104	17	100	5	61	7	100	4	327	49		8	58	2	100	2	23	1	100	1	47	13	100	7	3	–	–	–
RODENTS																																
Arvicola amphibius (Linnaeus 1758)	–	–	–	–	–	–	–	–	1	1	100	1	1	1	28.6	1	–	–	–	–	2	2	50	**1**	–	–	–	–	–	–	–	–
Microtus (Microtus) arvalis (Pallas, 1778)	–	–	–	–	–	–	–	–	–	–	–	–	5	5	71.4	1	2	2	100	1	2	2	50	**1**	–	–	–	–	–	–	–	–
Microtus (Terricola) **sp.**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**–**	1	1	100	1	–	–	–	–
Microtus (Alexandromys) oeconomus (Pallas, 1776)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**–**	–	–	–	–	–	–	–	–
Subtotal									1	**1**	100	**1**	6	6	100	**2**	2	2	100	**1**	4	4	100	**2**	1	1	100	**1**				
EULIPOTYPHLA																																
Talpa **sp.**	–	–	–	–	–	–	–	–	–	–	–	–	1	**1**	50	**1**	–	–	–	–	–	–	–	**–**	–	–	–	–	–	–	–	–
SoreX araneus-coronatus Linnaeus, 1758: Millet, 1928	–	–	–	–	–	–	–	–	–	–	–	–	1	1	50	1	–	–	–	–	–	–	–	**–**	–	–	–	–	–	–	–	–
Subtotal													2	**2**	100	**2**																
ANPHIBIANS																																
Rana **sp.**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	100	**1**	–	–	–	–	–	–	–	–	–	–	–	–
Salamandra salamandra (Linnaeus, 1758: Boulenger, 1879)	1	**1**	100	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Subtotal	1	**1**	100	**1**													1	**1**	100	**1**												
BIRDS																																
Tetrao/Lyrurus cf. ***Tetrix*** (Linnaeus 1758)	1	**1**	–	**1**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Streptopelia **sp.**	1	**1**	–	**1**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Corvus corone Linnaeus, 1758	1	**1**	–	**1**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Corvus **sp.**	–	–	–	–	–	–	–	–	1	**1**	–	**1**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Medium size	–	–	–	–	–	–	–	–	1	**1**	–	**1**	1	**1**	–	**1**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Subtotal	**3**	**3**		**3**					**2**	**2**		**2**	**1**	**1**		**1**																
FISH																																
Salmonidae	–	–	–	–	–	–	–	–	–	–	–	–	1	1	50	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Actinopterygii	–	–	–	–	–	–	–	–	–	–	–	–	6	1	50	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Subtotal													**7**	**2**	**100**	1																

(*continued on next page*)

Table 7 (*continued*)

	PHASE I				PHASE II																PHASE III											
	SU-II				SU-IV				SU-V				SU-VI				SU-VII				SU-VIII				SU-IX				SU-X			
	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI	NR	NISP	%	MNI
ECHINODERMS																																
Paracentrotus lividus (Lamarck, 1816)	7	1	100	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Subtotal	**7**	**1**	**100**	**1**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MARINE MOLLUSCS																																
***Littorina* sp.**	–	–	–	–	–	–	–	–	–	–	–	–	1	1	100	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Subtotal													**1**	**1**	**100**	**1**																
CONTINENTAL MOLLUSCS																																
Cepaea nemoralis (Linnaeus 1758)	–	–	–	–	1	1	4.8	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Vitrea contracta (Westerlund 1871)	–	–	–	–	–	–	–	–	–	–	–	–	1	1	100	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cryptazeca subcylindrica Folin & Bérillon, 1877	–	–	–	–	15	15	71.4	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
***Oxychilus* sp.**	–	–	–	–	7	5	23.8	5	2	1	100	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indet.	1	1	100	1	20	0	0	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Subtotal	**1**	**1**	**100**	**1**	**43**	**21**	**100**	**21**	**2**	**1**	**100**	**2**	**1**	**1**	**100**	**1**																

the Holocene (Rofes et al., 2013). However, the relative scarcity of archaeological remains that have been documented at La Cuevona de Avín does not support that hypothesis.

5.3.3. Large mammals

Remains of large mammals have been found in all the stratigraphic units (n = 851) although two units, SU-II and SU-VI, contain over 65 % of them (Table 7). Only 141 have been identified to taxonomic level (16 %). Red deer is the best represented species based on both NISP and MNI in the units with most remains, particularly in SU-II and SU-IV, except in SU-VI, where the most abundant species is Iberian ibex. Roe deer are present in all the units, except in SU-VIII and SU-VII, but always represented by a single individual and with percentages < 10 % of the NISP. Other ungulates are poorly represented, especially horse (SU-IV and SU-IX), chamois (SU-IV and SU-VI) and wild boar (SU-II). Leporids are scarcely present in SU-V, SU-VI and SU-IX. The only remains of fox in the cave have been documented in the latter unit.

In terms of the size categories, small mammals predominate in the lower part of the sequence (SU-IX to SU-IV), except in SU-VII, whereas the remains of medium-sized mammals are more abundant in the upper units (SU-IV and SU-II). Large mammals are very scarce, with a single remain in SU-II and SU-IX.

Regarding the age of death of the animals, only juvenile red deer individuals have been documented in SU-VI and SU-II, while the other animals are adults of which their precise age could not be determined. A juvenile Iberian ibex individual younger than two years of age was documented in SU-VI. One of the wild boars (SU-II) would be the same age, while the other one was an adult. An immature horse individual younger than one year came from SU-IX and a juvenile roe deer whose age could not be specified further was found in the same stratigraphic unit. The other individuals documented in the sequence were adults.

Despite the small number of remains, the taphonomic analysis has identified anthropic activity in all the levels of the sequence (except in SU-X where the number of remains is very small) (Table 8; Fig. 6).Thus butchery and fracture marks (impact, counter-blows and negatives of flaking on long bones, flakes, breakage by flexion, etc.) can be observed in the different stratigraphic units on both the red deer and Iberian ibex bones, as well as the other large, medium and small mammals. Thermoalteration has also been documented, with a predominance of the double brown-black and black-grey tones that correspond to Degrees 2 and 4 in the classification of Stiner et al. (1995). Much less abundant are the marks caused by carnivores (scores, depressions, pits, punctures and crenulated edges), seen on red deer, Iberian ibex, roe deer and leporids, as well as on the small and medium-sized animals. Other alterations that have been recorded are due to natural causes, mainly manganese, precipitation of calcium carbonate and the action of roots (11.2 %). Weathering, mostly of Stages 1 and 2 in the classification of Behrensmeyer (1978), and trampling are much less frequent (<9%).

Only one remain from SU VI displays evidence of **technical modification**. This is a distal fragment of an antler rod with a flat-convex cross-section, 46.67 × 20.07 × 8.93 mm in size. It displays pearling on its dorsal face and spongy tissue on the ventral face, which has hardly been smoothed. It was possibly extracted from the deer antler by combining the double-grooving procedure and splitting. This resulted in a step between the compact and spongy tissue. The double-grooving technique can be identified by the flat facets and longitudinal striations that only affect one side of the implement. It is not clear if wedges were used to extract the rod, but inflections can be seen in the upper line of the groove on the opposite side. The distal part is pointed, tending towards rounding. Despite the recent fracture of the point, limited smoothing possibly by planning can be appreciated at least on the dorsal face. The proximal end displays an irregular fracture caused by flexion, either when the object was being extracted or later when it was being shaped (Fig. 7).

Table 8
Taphonomic alterations recorded in the different SUs and Phases in La Cuevona de Avín.

SU	Anthropic marks			Carnivore damage				Natural agents		Phase
	Cutmarks	Fracture marks	Burned	Pits/ pitting	Scores	Punctures	Crenulated edges	Biological	Physical-mechanical	
II	11	10	5	2	1	–	–	23	99	**I**
IV	5	5	1	2	1	1	–	19	26	**II?**
V	6	6	4	1	–	–	–	12	26	**II**
VI	32	61	20	7	4	1	–	33	55	
VII	2	4	–	–	–	–	–	4	22	**III**
VIII	2	2	–	–	–	–	–	6	4	
IX	4	3	6	1	–	–	1	11	10	
Total	**62**	**91**	**36**	**13**	**6**	**2**	**1**	**108**	**242**	

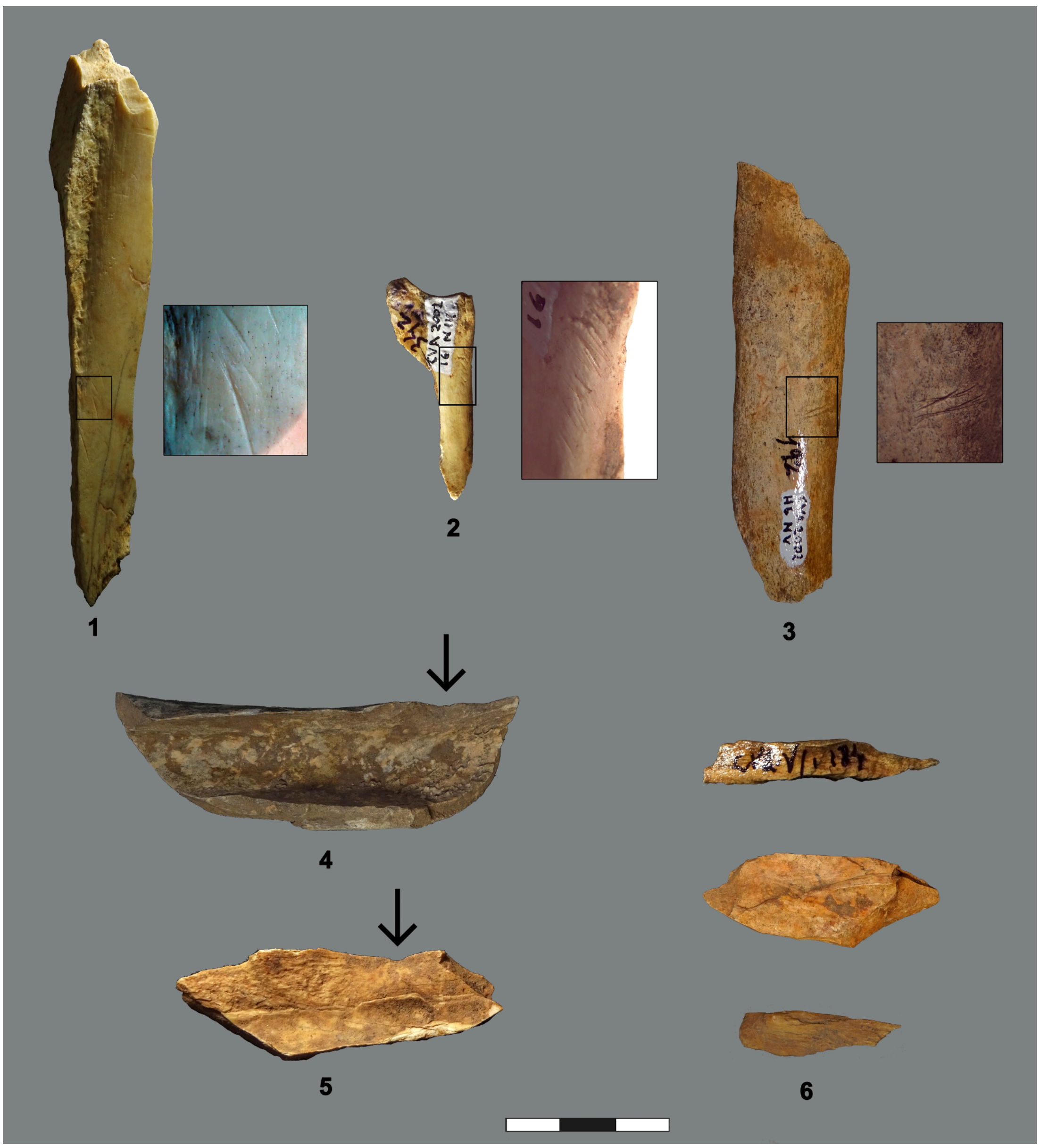


Fig. 6. Anthropic marks on macromammal bones from La Cuevona de Avín. 1) Cut marks on a medium-sized mammal radius from SU-II (Phase I). 2) Skinning on a Iberian ibex first phalanx from SU-IX (Phase III). 3) Skinning on a rib of a medium-sized mammal from SU-V (Phase II). 4) Impact point on an Iberian ibex femur from SU-VI (Phase II). 5) Impact point on a small-sized mammal diaphysis from SU-VI (Phase II). 6) Impact flakes from SU-VI (Phase II).

5.3.4. Fish

Remains of fish (nearly all of them vertebrae) were found exclusively in SU-VI (n = 7) (Table 7). A caudal vertebra belongs to a small individual (<15 cm) in the Salmonidae Family, which includes trout and salmon. Its small size suggests a non-anthropic accumulation. No evidence of anthropic alterations has been documented on them.

Fig. 7. Deer antler rod from Phase II (SU-VI).

5.3.5. Birds

At La Cuevona de Avín, bird remains have been recovered in SU-II (NR = 3), SU-V (NR = 2) and SU-VI (NR = 1) (Table 7). A proximal tarsometatarsus of an undetermined immature corvid was found in SU-V, together with a small distal fragment of a coracoid attributed to a medium-sized bird. In addition, a posterior phalanx of a medium-sized bird was identified in SU-VI. No further palaeoecological information can be obtained from them. In Level II, however, some of the taxa deserve to be mentioned. Three humeri of adult individuals were found corresponding to a carrion crow (*Corvus corone*), a columbid of the genus *Streptopelia* (probably the European turtle dove, *Streptopelia turtur*) and a phasianid specimen that, according to morphometric analysis, could be included in the black grouse (*Lyrurus tetrix*) range. Moreover, from these taxa, we can draw some palaeoecological inferences. The black grouse usually inhabits open areas on upland moors and heathlands near conifer woods. The turtle dove and the carrion crow are also found in wooded and semi-open areas with hedges, moorlands, and scattered trees, which indicates a mixed habitat with highlands and coniferous forests and some open spaces in the region. None of the bones exhibits surface modifications consistent with human or carnivore activity.

5.3.6. Invertebrates

The invertebrates that have been documented are molluscs and echinoderms (Table 7).

Terrestrial mollusc shells are scarce and come mostly from SU-IV, although they have also been found in SU-II, SU-V and SU-VI. The two most abundant taxa, *Cryptazeca subcylindrica* and *Oxychilus* sp., frequently live in caves without being strict troglobites, so their presence in the cave would be due to natural causes. Moreover the translucent state of the shells indicates that they were deposited recently. *Cryptazeca subcylindrica* lives exclusively in limestone areas in northern Spain and this archaeomalacological assemblage currently inhabits the cave as a result of the dominant environmental factors at the present time.

Shells of marine molluscs are equally scarce. Molluscs that live on a rocky substrate in the inter-tidal zone were found in the surface layer SU-I, and a specimen of *Littorina* sp. (probably *L. obtusata* or *L. fabalis*) was documented in SU-IV. Its surface is eroded by water and sand action, so this snail may have been taken to the cave as an object of adornment after being picked up on a beach. Apart from this mollusc documented in a stratigraphic context, it is worth noting the discovery of two *Phorcus lineatus* and two limpets (one of them the species *Patella ulyssiponensis*) in Level I (superficial).

The echinoderm remains all come from SU-II, where a level with seven spines from a *Paracentrotus lividus* individual was documented. They have been identified by their bases, as these have small tubercles from which the striations emerge. The purple sea urchin lives today on rocky substrates in the inter-tidal zone.

6. Discussion

Information recorded during the excavation of La Cuevona de Avín enabled the differentiation of nine stratigraphic units. Based on the descriptions made in the fieldwork, the sample sediments taken in the course of the excavation, the study of archaeological material and radiocarbon dates, three occupation phases (Phases I to III) can be established in the sequence.

6.1. Phase I: Azilian

Phase I refers to the occupation in SU-II, between two episodes of powerful water action in the cave. This phase would be dated in about 13,100 cal. BP, that is to say during the transition from Greenland Interstadial 1 to Greenland Stadial 1, a time when Azilian industry was being produced in northern Spain.

6.1.1. Abiotic resources

Even though in Phase I, information about the provenance of the lithic production remains is very scarce (Tables 5 and 6), both flint and quartzite have been documented (represented by 40 % and 60 %, respectively). Distant (Flysch flint from > 150 km away) and regional (Piloña) flint types have been identified, attesting long and medium-distance contacts. The presence of distant types (Monte Picota, Urbasa, Treviño and Chalosse) has recently been documented, for example, in the Azilian levels in El Cierro Cave (Álvarez-Fernández et al., 2020a). The quartzite would have been acquired in the form of cobblestones on the terraces of the River Güeña.

As regards the technological and typological study, the data obtained are not abundant (Table 3), which means that comparisons cannot be made with other Cantabrian sites where this phase is well represented, as at Los Azules I (Fernández-Tresguerres, 1980; 2007). Traces of use have not been recognized on any of the documented lithic remains (in flint or in quartzite).

Apart from the lithic production remains, some pieces of iron oxide have been found in the Azilian phase (Table 3).

6.1.2. Biotic resources

The information available for environmental reconstruction during the Azilian at La Cuevona de Avín is very limited, because charcoal is scarce and microvertebrates have not been documented.

The presence of deciduous oak might reflect a preference for this type of wood during the beginning of the Younger Dryas. However, for this period, some anthracological information has been provided by other Azilian occupations in northern Spain (Uzquiano, 1992; 2018) and especially for the Sella valley area (e.g., El Cierro; Álvarez-Fernández et al., 2020a), where deciduous oak woodland became the main source of firewood for those human communities. Scots pine (*Pinus sylvestris*), although absent in Phase I, is dominant in the transition to the Holocene in Azilian occupations at eastern Asturias inland sites (Uzquiano, 2018).

Rather more information was provided by the large mammals. In Phase I, red deer predominates (>80 % of the NISP), followed by roe deer, Iberian ibex and wild boar, with percentages < 10 %. Remains of medium-sized animals are more abundant than smaller ones. Large mammals are barely present. Juvenile red deer and wild boar, in the latter case younger than 2 years of age, have been documented; the other individuals were adult animals.

The taphonomic study of the remains in the Azilian period has documented different kinds of anthropic marks, both cutmarks (n = 9) (disarticulation of red deer and Iberian ibex, filleting in red deer and medium and small mammals, scraping in a medium-sized mammal) and the intentional breakage of the remains to extract the marrow (n = 10) (impact points on nine long bones of red deer and small and medium mammals, and a flake broken from a bone when breaking it). Thermal alterations have been noted on an Iberian ibex astragalus, a fragment of a red deer femur, and two tibiae, one of a medium-sized animal, as well as two indeterminate remains. The first two are brown in colour, the two tibiae display double brown-black tones, and the indeterminate bones are black.

Carnivore action has only affected two bones (a red deer ulna and a fragment of an ischium of a small mammal displaying pits). These animals would have come to scavenge on the waste generated by the human groups once the cave was no longer occupied.

Natural agents (n = 122) have also been recorded in this phase. The most common is precipitation of calcium carbonate (72.1 %), and to a lesser extent, precipitation of manganese oxides (5.7 %), root marks (18 %), weathering (13.9 %) and trampling (0.8 %). The abundance of calcium carbonate and manganese oxides indicates the presence of humidity at the time of formation of these levels, while the root marks are related to the penetration of light into the cave. Some remains were exposed to environmental conditions for a relatively long period before deposition, as indicated by the documented weathering rates.

Therefore, hunting specialised in red deer in Phase I. The presence of wild boar and roe deer may indicate more woodland, which would favour those ungulates. In Cantabrian Spain, woodland species are characteristic of Azilian deposits, at both inland (e.g., El Mirón; Marín, 2010) and coastal sites (e.g., El Cierro; Álvarez-Fernández et al., 2020a; Portero, 2022).

Bird remains are scarce and lack alterations that might show they were consumed by the humans. Among the species documented in the Phase I (that inhabit both open/semi-open areas and wooded areas), the black grouse should be noted. This bird species has only been documented at one other prehistoric site in the Iberian Peninsula: Urtiaga, ascribed also to the Azilian (Elorza, 1990; Sánchez Marco, 2018). The consumption of birds has been proven in North Spain in the late Pleistocene, for example in the Azilian level in Santa Catalina (Elorza, 2014).

Finally, invertebrate remains are very scarce at La Cuevona de Avín. In Phase I, note the presence of sea urchin spines. This is an indication of more or less sporadic contacts of hunter-gatherer groups with the coast. This animal has been recorded at coastal Azilian sites, for example in Levels C and D at El Cierro (Álvarez-Fernández et al., 2020a), where it was foraged as food in the inter-tidal zone.

6.2. Phase II: Upper Magdalenian

Phase II corresponds to SU-V and SU-VI while a few archaeological materials were collected in the first centimetres of SU-VII, which is a sterile layer. The central stratigraphic unit in this phase (SU-VI), the richest in the sequence from the archaeological viewpoint, is dated in 14,500 cal. BP, that is to say, in the beginning of Greenland Interstadial 1, the time of Upper Magdalenian industries in Cantabrian Spain. Little is known about SU-IV; which may belong to Phase II.

6.2.1. Abiotic resources

In Phase II, information about the provenance of the lithic remains (Tables 5 and 6) indicates that flint predominates (50.1 %), followed by quartzite (48.8 %) and quartz (the remaining percentage). Quartzite and quartz would again be local raw materials. Among the flint types (without considering indeterminate fragments and debris), Flysch flint is the most abundant (54 %), making up the bulk of the lithic assemblage with Piloña flint (18 %), whereas Alba radiolarite only amounts to 2 %. The rest of the assemblage is formed by indeterminate flint types (26 %), among which Piedramuelle and/or Monte Picota flint are probably represented. Therefore, a distant type (Flysch) and, to a much lesser extent, regional (Piloña) and local varieties (Alba radiolarite) were procured in this phase; the latter probably on the local river terraces.

This phase can be compared with the evidence documented at other Upper Magdalenian sites with similar radiocarbon dates to those obtained for La Cuevona de Avín, particularly Coímbre (a site about 30 km to the east). There, in Level B1, as in Phase II at La Cuevona de Avín, quartzite (57 %) predominates over flint (40 %). The study of the flint provenance is also similar and shows that Flysch flint (>60 %) was the most common flint type, followed by Piloña flint (10–20 %) and Alba radiolarite (<2%). In Coímbre B1, however, black chert is represented by < 10 %, while in La Cuevona de Avín this raw material has not been identified. In Coímbre, the latter three types could be acquired within a radius of 20 to 50 km in a straight line (Tarriño and Elorrieta, 2017).

The data from La Cuevona de Avín contrast, however, with the information for other Magdalenian sites closer to the Basque-Cantabrian Basin, where a predominance of flint is observed. This is the case of Cueva del Horno (Levels 1, 2 and 3) in Cantabria, for example, where 98 % of the lithic assemblage was made in flint. At that site, the study of retouched and non-retouched artefacts (omitting fragments and debris) showed the great variability in the frequency of the siliceous rocks, which were predominated by Flysch flint (70 km), whose outcrops are about 60 km from this cave. Also found were Monte Picota flint (8 %) from about 50 km away, and Urbasa and Treviño flint (2 % each), from outcrops about 160 km and 100 km away in a straight line, respectively (Fano et al., 2016).

Phase II, from technological and typological points of view, is characterised by the presence of different elements, from the initial preparation products to debris in both flint and quartzite, which shows that all the phases of the operational sequences that have been identified were carried out there. However, there are differences in terms of operational sequences. On the one hand, in the case of quartzite reduction, the objectives were more varied: small flakes, others of larger dimensions, even more elongated products. In the case of flint, only two objectives can be distinguished among the reduction objectives. On the other hand, within the same operational system in quartzite, different objectives can be distinguished. This is not the case for flint, where the objectives are the same from the beginning of the exploitation until the end.

Two types of reduction to obtain bladelets have been detected in Cantabrian Spain in the Upper Magdalenian; a more careful one and the other with flakes (González Sainz and González Urquijo, 2007). This is also observed in La Cuevona de Avín, where the presence of reduction of carinated cores, with which a large number of products would be obtained, has been described, as well as the reduction of the flanks of thick flakes, although also with some investment in their preparation and management. This behaviour has been described for Level 1a + b at Coímbre (Álvarez Alonso et al., 2017) and in Level 2 in El Horno (Fano et al., 2020), where flakes were used to obtain bladelets with a burin-type extraction. No pressure existed on the raw material at the latter site because of its greater availability in the area, and therefore this type of production might also have aimed to obtain specific carinated blanks. Most of the reduction techniques at La Cuevona de Avín were unipolar, as occurred in the cited levels at Coímbre (Álvarez Alonso et al., 2017) and El Horno (Fano et al., 2020), as well as in the Magdalenian levels in Las Caldas-Chamber II (Corchón and Ortega, 2017). Thus, in Level I in that deposit, a low laminar index is observed, contrasting with lower levels (Levels II and III). This may have been a tendency in later moments of the Upper Magdalenian.

In general, there was a predominance of microliths and burins over endscrapers in Upper Magdalenian levels in Cantabrian Spain, as in the levels cited above in Coímbre and Las Caldas-Chamber II. However, a change is seen in the Recent Magdalenian-Azilian (González Sainz and González Urquijo, 2007); an increasing number of blanks of poor quality were retouched. It has been observed that this phenomenon is detected at an earlier moment and more noticeably in the western sector of the region. In this area, the tools that require more regular blanks, such as burins, would become less abundant and simpler. There are too few remains in La Cuevona de Avín to make comparisons with typological groups at each site, which might be due to the reduced excavated area of the deposit and/or the type of occupation. However, this cave appears to follow the tendency detected in the last stages of the Magdalenian in the western part of Cantabrian Spain, in which the number of retouched microliths decreases, burins are scarce, and tools on retouched flakes become more frequent.

All of the flint tools studied in the functional analysis come from Phase II (Table 6). The functions detected are those that might be expected in an assemblage of this kind, and involved contact with bone, hide and wood, as well as one use as a projectile element. Regarding the technical marks, in the case of the five cores, all used to obtain bladelets, three of them display marks clearly caused by the impact of a stone percussor. Therefore, they cannot be interpreted as 'nucleiform endscrapers' since no traces showing their use in any tasks has been observed on them.

In the case of the quartzite tools with functional analysis**,** all but one come from Phase II (Table 6). Only macro-damage has been considered to determine their functionality, given the severe complications derived from the use of optical microscopy to distinguish wear traces in the highly reflective surfaces that characterize quartzite grains. Therefore, it has only been possible to identify pieces employed in demanding tasks that cause scars in the edges (such as cutting hard materials).

A few functional studies have been carried out for other Upper Magdalenian assemblages. For example, at Santa Catalina, blades and tools on blades (endscrapers and burins) were used to work with dry hide and make bone implements (González and Ibáñez 1999). Regarding the so-called 'nucleiform endscrapers', the only information comes from the regional Lower Magdalenian. For instance, in El Cierro (Level F), while one example was used to scrape hard animal matter and another displayed indeterminate traces, the rest had marks caused by removing bladelets by percussion (Álvarez-Fernández et al., 2016).

Apart from the lithic production remains, mostly pieces of iron oxide have been found in the Magdalenian phase at La Cuevona de Avín (Table 3). One fragment with signs of anthropic modification, a cobblestone over a kilogram in weight, came from Phase II. It would have been used to produce ochre powder by abrasion. Oxide fragments with striations and faceted by scraping have been documented at other sites, like in Level 1a + 1b at Coímbre (García Madariaga et al., 2017). In Level D at Lumentxa in Biscay, a plaque was found that had also been engraved with animal motifs (Garate Maidagan et al., 2013).

6.2.2. *Biotic resources*

As in the Azilian phase, the information on the environmental reconstruction that is available on the Upper Magdalenian of La Cuevona de Avín is very poor. Charcoal and microvertebrates are not abundant.

The presence of Scots pine (*Pinus sylvestris*) during this phase dated in Greenland Interstadial 1 could indicate a possible origin of the firewood in calcareous outcrops which proliferate throughout the Güeña valley. Scarce presence of Scots pine has been documented in other Upper Magdalenian Cantabrian coastal sites such as La Pila in Cantabria (Uzquiano, 1992; 2014) whereas pines are more characteristic at inland upper Magdalenian Cantabrian sites such as Arangas Cave in eastern Asturias (Álvarez-Fernández et al., 2020b).

The scarce remains of Rodentia, Eulipotyphla, and Amphibia orders do not allow an environmental reconstruction for Phase II in the cave.

The remains of large mammals are quite abundant during the Upper Magdalenian period.

Iberian ibex is the best represented animal (43.1 % of the NISP), although followed immediately by red deer (37.9 %). Chamois, roe deer and leporids complete the record. In the size categories, small mammals predominate over medium ones, while large animals are absent. A juvenile red deer and Iberian ibex, in the latter case younger than two years of age, have been differentiated while the other individuals were adults.

The taphonomic study of the remains from Phase II has documented cutmarks (n = 40) (skinning of red deer, disarticulation of red deer, Iberian ibex, and medium and small animals; filleting in red deer, Iberian ibex and a medium-sized mammal; scraping in red deer, Iberian ibex and a small mammal) and fractures (n = 71) (impact points on 37 remains of red deer, Iberian ibex and medium and small mammals; counter-blows and negatives of flaking on the long bones of Iberian ibex and a small mammal; breakage by flexion of a rib from a medium mammal; and 30 flakes broken from bones when they were fractured). This demonstrates that human groups not only consumed red deer and Iberian ibex meat, but also fractured their bones to access the medullary contents.

The abundance of double brown-black shades indicates that the bones were exposed to temperatures below 400 °C. However, we also have documented bones with black-grey shades, corresponding to Grade 4 of Stiner et al. (1995), so they must have been exposed to temperatures between 400 and 600 °C (Nicholson, 1993).

Carnivores have affected a small number of bones (three Iberian ibex bones, two of red deer and one leporid bone). Three remains of small mammals display scores, depressions, pits, punctures and crenulated edges. As in the previous phase, their scarce presence may be related to the scavenging of waste generated by human groups.

Phase II also contains remains with natural deterioration (n = 152), mainly manganese oxide precipitation (51.3 %), but also calcium carbonate precipitation (2 %), root marks (29.6 %), weathering (9.9 %), trampling (3.9 %), and bone rounding (1.3 %). The great abundance of manganese oxides and the presence of rolled bones indicate that at the time of deposition the remains were exposed to water and humidity. The vermiculations indicate the entry of light into the cave, causing the proliferation of plants.

In Phase II, crag animals (Iberian ibex and chamois) are common, but not to the extent that they can be related to specialised hunting, characteristic of the Upper Magdalenian (Altuna, 1992; Yravedra, 2002). Typical species of open valleys and woodland, like red and roe deer are also present. This tendency towards diversified hunting has been observed at other sites in the same period, at both inland (e.g., Coímbre; Yravedra et al., 2017) and coastal sites (e.g., La Riera; Altuna, 1986).

Apart from hunting based on ungulates, during the Late Magdalenian there is evidence indicating that groups of hunter-gatherers from La Cuevona de Avín might also have fished. Fish bones were only found in Phase II (SU VI) where an individual belonging to the Salmonidae Family was found. There is no evidence demonstrating that their presence is due to anthropic action. Nonetheless, fishing has been documented at sites in North Spain in the Upper Magdalenian. Thus, salmonids (trout and salmon) have been found in inland deposits, like Coímbre B (Level 1a + 1b) in Asturias (Gabriel, 2017) and at coastal sites like Santa Catalina (Level III) in the Basque Country (Roselló and Morales, 2014).

The few remains of birds documented in Phase II, which inhabit both open/semi-open areas and wooded areas, lack traces of human manipulation, so it is doubtful that they were consumed by the inhabitants of the cave. However, the consumption of birds is documented in other Upper Magdalenian contexts, e.g. Santa Catalina (Elorza, 2014).

Invertebrate remains are very scarce at La Cuevona de Avín during the Upper Magdalenian occupations.

The terrestrial snails in the cave are a natural occurrence.

Marine molluscs are similarly scarce. The small *Littorina obtusata/fabalis* individual is an indicator of contacts with the coast, as observed at other sites in the interior of North Spain in the Upper Magdalenian. Small gastropods, often with traces of marine abrasion and anthropic perforations, have been documented, for example, at Coímbre (Level 1a + 1b) (Álvarez Fernández and Aparicio Alonso, 2007) and El Horno (Levels 1, 2 and 3) (Fano and Álvarez-Fernández, 2010). This is an indication of more or less sporadic contacts of hunter-gatherer groups with the coast (Álvarez-Fernández, 2006).

Finally, osseous industry has only been documented in Phase II (SU VI): an antler sagaie point in the process of being made. Since it is the only antler object in the phase, it might be argued that it is a preform brought from somewhere else. The use of deer antler as a raw material is well documented at numerous Upper Magdalenian sites in Cantabrian Spain, like Chamber II in Las Caldas (Levels II and III) (Corchón and Ortega, 2017) and in Coímbre B (Level 1a + 1b) (Álvarez-Alonso, 2017), where a large number of sagaies of different typologies were found.

6.3. *Phase III: Magdalenian?*

The lower stratigraphic units in the sequence at Cuevona de Avín (SU-VII, SU-VIII and SU-IX) can be ascribed to a Phase III, probably a time of sedimentary activity in the cave, although occasional anthropic occupations (Magdalenian?) cannot be ruled out.

6.3.1. *Abiotic resources*

Information about the provenance of the lithic remains is very limited in this Phase (Tables 5 and 6).

Flint (Flysch and Piloña types) and quartzite have been documented, but also quartz and rock crystal.

From the technological and typological points of view it impossible to reach precise conclusions. The scarcity of elements recovered in both this phase and Phase I precludes a comparison. We can only establish some trends that will need to be confirmed with an increase in the number of remains. Reduction of flint cores focusing on the flanks of flakes for the production of carinated bladelets is also detected in Phase I. But no carinated cores have been detected in this first phase or in Phase III. This may therefore be a resource, behaviour or tradition characteristic of this chrono-cultural episode. On the other hand, the presence of centripetal debitage in quartzite is also present in both Phase I and Phase III. In this last phase we have also detected debitage on quartzite volumes focused on a wide face, very similar to those described for Phase II. Therefore, it seems that the quartzite lithic production systems underwent few changes throughout the sequence. However, we insist that due to the scarcity of material we can only establish certain trends that will have to be confirmed.

Only one of the lithic remains retains traces of use (a quartzite flake use to cut hard materials).

It is interesting to note that Phase III concentrates 79.1 % of the total iron oxide fragments in the sequence. Particularly SU-IX concentrates the largest number of small ochre fragments (>200); most of them are > 8 mm in size. None of them have signs of obvious human manipulation.

6.3.2. *Biotic resources*

The information on the environmental reconstruction that is available for Phase III is very limited, because charcoal does not exist and microvertebrates are scarce (only a few rodent remains have been identified).

As far as the rest of the archaeozoological evidence is concerned, the only remains documented in Phase III belong to large mammals. Although only seventy remains have been recovered, this is the phase with the greatest diversity of species (horse, deer, chamois, Iberian ibex, fox and Leporidae, represented by a single specimen, except for horse, by two). Regarding the age of death of the animals, the horse is an immature individual less than a year old, and there is a juvenile roe deer whose age cannot be specified further. The rest of the documented individuals belong to adult animals. From the taphonomic analysis of the remains we have been able to identify evidences of anthropic activity in Phase III, among them cut marks (n = 6) (skinning of Iberian Ibex, and defleshing in red deer and medium and small mammals), and marks of intentional fracture of the bone to access the medullary content (n = 5) (impact points in a metapodial, a humerus and a long bone of small mammal, and peeling on ribs of red deer and medium mammal). Thermoalteration has affected the diaphysis of a long bone of a small mammal and five undeterminable remains. All of them show black colorations of the bone surfaces, which would indicate exposure temperatures above 400 °C (Nicholson, 1993).

Carnivores have only intervened on an Iberian ibex phalanx with pits and on a flat bone fragment of a medium mammal with pitting traces. Their scarce presence may be related to the scavenging of waste generated by human groups.

Natural agents (n = 21) have also been recorded in this phase. Vermiculations generated by roots are the most abundant (76.2 %), and to a lesser extent manganese oxide precipitation (52.4 %), trampling (4.7 %), weathering (4.7 %), and calcium carbonate (4.7 %). The presence of root marks indicates the penetration of light into the cave, while the abundance of manganese oxides indicates the presence of humidity at the time of formation of these levels.

7. Conclusions

The archaeological excavation performed in the cave of La Cuevona de Avín in 2002 documented a total of nine stratigraphic units. The full study of the archaeological remains discovered in that excavation has differentiated three occupation phases, two of which are dated at the end of the Upper Pleistocene.

A first phase (Phase I) in the occupation of the cave is attributed to the transition from Greenland Interstadial 1 to Greenland Stadial 1 (Younger Dryas). Azilian industries developed in North Spain during that time. However, the remains found at La Cuevona de Avín are not too characteristic of that period since the typical 'index fossils', like Azilian points and thumbnail endscrapers or Azilian harpoons, have not been found in the deposit. Instead, it has been shown that local (quartzite) and distant (several flint types) raw materials were used. Together with the presence of marine invertebrates (sea urchins), this is indicative of both east–west and north–south contacts. Flysch flint attests the continuity of long-distance contacts, inherited from the Magdalenian. The data provided by charcoal and archaeozoological remains (especially the large mammals and birds) are too limited to draw palaeoenvironmental conclusions. Despite this, they seem to indicate the presence of mixed wooded and open/semi-open areas. In Phase I, hunting specialised in red deer, although remains of wild boar, Iberian ibex and chamois have also been identified. There is no proof that the bird remains found in this phase are evidence of fowling. Marine remains are present, but so scarce that it is difficult to determine their possible role in the diet of the humans who inhabited the cave *ca*. 13,100 cal. BP.

Much more characteristic is the second phase (Phase II) dated in the beginning of Greenland Interstadial 1, a time when Upper Magdalenian industries were present in Cantabrian Spain. Of the abiotic resources, local and non-local raw materials were used in percentages close to 50 %. The former were mostly quartzite and, to a lesser extent, Alba radiolarite. The flint types identified include semi-local varieties (especially Piloña flint) but above all a distant type, Flysch flint, which represents 54 % of the total flint that has been classified. As at other Upper Magdalenian sites in Cantabrian Spain, in Phase II it has been possible to reconstruct the operational sequences aimed at obtaining both small blades (from carinated cores and from the flank of thick flakes), which were used to make backed bladelets, and flakes from quartzite cores, which were turned into tools by retouching on one edge (e.g., denticulates). Although few tools have been documented (a little over twenty), they represent the types described at other Upper Magdalenian sites in the region (backed bladelets, etc.). Some of the flint tools were used to work with semi-soft substances (bone, hide and wood) or were projectile points, while some of the quartzite flakes seem to have been used to cut hard materials. A large fragment of hematite should also be highlighted. One of its edges displays facets that indicate processing; it was accompanied by twenty fragments > 8 mm, showing the production of ochre *in situ*. Perhaps at this time the cave was a place where ochre was worked. To date, no evidence of parietal art has been documented in La Cuevona de Avín, so this dye would have been used mainly by the hunter-gatherer groups that inhabited the cave to decorate their bodies or to decorate other objects.

As in Phase I, the anthracological and micro-vertebrate data are too limited to reach environmental conclusions. Greater intensity is seen in the subsistence strategies than in the more recent phase. Hunting concentrated on two species, Iberian ibex and red deer although another crag animal (chamois) is also present. The bird and fish bones lack anthropic modification and it is therefore unlikely that they were consumed by the hunter-gather groups. Other evidence of human activity, such as the fabrication of artefacts (in antler and perhaps in shell) is poorly represented. Altogether, the finds in Phase II show that medium and long-distance contacts were maintained, as observed at other regional Upper Magdalenian sites. Evidence of the former includes a *Littorina obtusata/fabalis* shell (a shell bead?) and, for example, Piloña flint. The latter is demonstrated by the Flysch flint, which outcrops 150 km to the east of La Cuevona de Avín, in the Basque-Cantabrian basin.

Finally, the information obtained for Phase III is anecdotal owing to the little archaeological evidence that was recovered, of either abiotic or biotic nature. This phase would have been dated in the Upper Magdalenian or an older period. This phase, however, is noteworthy because of the abundance of hematite fragments (>8 mm), testimony that this mineral was also worked at that time.

Research carried out at La Cuevona de Avín and at other sites, where it is still in progress, is succeeding in filling a gap in our knowledge of local prehistoric occupations, in particular in the valley of the River Güeña, a tributary of the River Sella on its right. Evidence of occupation in this area goes back to the Middle Palaeolithic (Mousterian in Sopeña), and consolidated in the late Pleistocene: Early Upper Palaeolithic and Gravettian in Sopeña (Pinto-Llona el al. 2022), Solutrean in Joullobu (Quintanal 1991), and now Magdalenian and Azilian in La Cuevona de Avín. The cave art recently made known in Molín Rock-shelter (Avín, Onís), 200 m from La Cuevona de Avín (Martínez-Villa 2020), and Cueva de La Pruneda (Benía, Onís) (Martínez-Villa 2022; in press) are attributed to different pre-Magdalenian times in the Upper Palaeolithic. This research will enable a comparison between Late Pleistocene occupations on larger scales, both meso-regional (the River Sella valley, particularly near its present estuary; Álvarez-Fernández and Jordá Pardo 2018; Jordá Pardo et al., 2022) and macro-regional (Asturias and the rest of northern Spain).

CRediT authorship contribution statement

Esteban Álvarez-Fernández: Conceptualization, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Sergio Martín-Jarque:** Investigation, Methodology, Writing – review & editing. **Rodrigo Portero:** Investigation, Methodology, Writing – review & editing. **Margarita Vadillo Conesa:** Investigation, Methodology, Writing – review & editing. **Alberto Martínez-Villa:** Methodology, Writing – review & editing. **Mª Teresa Aparicio:** Investigation, Methodology, Writing – review & editing. **Ildefonso Armenteros:** Investigation, Methodology, Writing – review & editing. **Rosana Cerezo-Fernández:** Investigation, Methodology, Writing – review & editing. **Rafael Domingo:** Investigation, Methodology, Writing – review & editing. **Naroa García-Ibaibarriaga:** Investigation, Methodology, Writing – review & editing. **F. Javier González:** Investigation, Methodology, Writing – review & editing. **Laura Llorente:** Investigation, Methodology, Writing – review & editing. **Anna Rufà:** Investigation, Methodology, Writing – review & editing. **Antonio Tarriño:** Formal analysis, Writing – review & editing. **Paloma Uzquiano:** Investigation, Methodology, Writing – review & editing. **Ana C. Pinto-Llona:** Formal analysis, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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References

Adán, G.E., 1997. De la caza al útil: la industria ósea del Tardiglaciar en Asturias. Oviedo, Principado de Asturias, Consejería de Cultura.

Altuna, J., 1992. Asociaciones de macromamíferos del Pleistoceno Superior en el Pirineo occidental y el Cantábrico. In: Cearreta, A., Ugarte, F.M. (Eds.), the Late Quaternary in the Western Pyrenean Región. Servicio Editorial Universidad del País Vasco, Bilbao, pp. 15–28.

Altuna, J., 1986. The mammalian faunas from prehistoric site of La Riera. In: Straus, L.G., Clark, G.A., (Eds.), La Riera Cave: Stone Age Hunter-Gatherer Adaptations in Northern Spain. Arizona State University, (Anthropological research papers, 36), Tempe, pp. 237-273.

Álvarez-Alonso, D., 2017. La Industria ósea de la zona B de la cueva de Coímbre (Asturias, España). In: Alvarez-Alonso, D., Yravedra, J. (Eds.), La Cueva De Coimbre (Penamellera Alta, Asturias): Ocupaciones humanas en el valle Del Cares durante el

Paleolitico superior. Fundación María Cristina Masaveu Peterson, Madrid, pp. 428–457.
Álvarez Alonso, D., de Andrés, M., Fuente, O.; García, E., Rojo, J., Arrizabalaga, A. 2017. Los métodos de talla y la producción lítica durante el Magdaleniense superior en la cueva de Coímbre-Zona B (Asturias, España). In: Alvarez-Alonso, D., Yravedra, J. (Eds.), La Cueva De Coimbre (Penamellera Alta, Asturias): Ocupaciones humanas en el valle Del Cares durante el Paleolitico superior. Fundacion María Cristina Masaveu Peterson, Madrid, pp. 382–395.
Álvarez-Fernández, E., 2006. Los objetos de adorno-colgantes del Paleolítico Superior y del Mesolítico en la Cornisa Cantábrica y en el Valle del Ebro: Una visión europea. Universidad de Salamanca (Colección Vítor 195), Salamanca.
Álvarez-Fernández, E., Álvarez-Alonso, D., Bécares, J., Carral, P., Carriol, R.-P., Chauvin, A., Cubas, M., Cueto, M., Domingo, R., Douka, K., Elorza, M., Jordá Pardo, J.F., Murelaga, X., Portero, R., Rivero, O., Tapia, J., Tarriño, A., Teira, L.C., 2016. Nouvelles donnes sur le Magdalénien inférieur de la Region Cantabrique: le Niveau F de la grotte de El Cierro (Ribadesella, Asturies, Espagne). L'Anthropologie 537–567.
Álvarez-Fernández, E., Aparicio Alonso, M.T., 2017. Los moluscos de la zona B de la cueva de Coímbre (Asturias, España). In: Álvarez-Alonso, D., Yravedra, J. (Eds.), La cueva de Coimbre (Penamellera Alta, Asturias): Ocupaciones humanas en el valle del Cares durante el Paleolítico superior. Fundación María Cristina Masaveu Peterson, Madrid, pp. 278–285.
Álvarez-Fernández, E., Iriarte, M.J., Arrizabalaga, A., Barrera, I., Carriol, R.-P., Fernández, M.J., Gabriel, S., 2014. Entre lapas: Primera valoración de los restos de origen marino del yacimiento de J3 (Hondarribia, Guipuzcoa). Munibe 65, 67–78.
Álvarez-Fernández, E., Bécares, J., Jordá Pardo, J.F., Agirre-Uribesalgo, A., Álvarez-Alonso, D., Aparicio, M.T., Barrera-Mellado, I., Carral, P., Carriol, R.-P., Cubas, M., Cueto, M., Douka, K., Elorza, M., Fernández-Gómez, M.-J., Gabriel, S., García-Ibaibarriaga, N., Iriarte-Chiapusso, M.-J., Llave, C., Maestro, A., Martín-Jarque, S., Portero, R., Suárez-Bilbao, A., Tarriño, A., Teira, L.C., Uzquiano, P., Arias, P., 2020a. Palaeoenvironmental and chronological context of human occupations at El Cierro cave (Northern Spain) during the transition from the late Upper Pleistocene to the early Holocene. J. Archaeolog. Sci.: Rep. 29, 102138. https://doi.org/10.1016/j.jasrep.2019.102138.
Álvarez-Fernández, E., Cubas, M., Aparicio, M.T., Cueto, M., Elorza, M., Fernández, P., Gabriel, S., García-Ibaibarriaga, N., Portero, R., Suárez-Bilbao, A., Tapia, J., Teira, L. C., Uzquiano, P., Arias, P., 2020b. New data for the late Upper Palaeolithic in the Cantabrian region: Arangas Cave (Cabrales, Asturias, Spain). J. Archaeolog. Sci.: Rep. 29, 102092. https://doi.org/10.1016/j.jasrep.2019.102092.
Álvarez-Fernández, E., Jordá Pardo, J.F. (Eds.), 2018. El poblamiento prehistórico en el valle del Sella. UNED, Universidad de Salamanca y aSociación Cultural Amigos de Ribadesella, Ribadesella.
Anderson-Gerfaud, P., 1981. Contribution méthodologique à l'analyse des microtraces d'utilisation sur les outils préhistoriques. Thèse de 3 ème cycle. Université de Bordeaux I.
Andrews, P., 1990. Owls. University of Chicago Press, London, Caves and Fossils.
Arias, P., Pérez, C., 1990. Las excavaciones en la cueva de Los Canes y otros trabajos en la depresión prelitoral del Oriente de Asturias (1981–1986). In: Excavaciones Arqueológicas en Asturias (1987–1990), 2. Gobierno del Principado de Asturias, Oviedo, pp. 135–151.
Bailon, S., 1991. Amphibiens et reptiles du Pliocene et du Quaternaire de France et Espagne. Université, Paris VII. Ph.D. dissertation.
Barone, R., 1966. Atlas de mammifères domestiques. Masson, Paris.
Behrensmeyer, A.K., 1978. Taphonomic and ecological information from bone weathering. Paleobiology 4 (2), 150–162.
Berganza, E., Arribas, J. L., 2014. La cueva de Santa Catalina (Lekeitio, Bizkaia): intervención arqueológica.Restos vegetales, animales y humanos. Diputación Foral de Bizkaia (BAI 4), Bilbao.
Bernaldo de Quirós, F., Gutiérrez Saez, C., de Las Heras, C., Lagüera, M. A., Pumarejo, P., Uzquiano Ollero, P., 2000. Excavación arqueológica en la cueva de La Pila (Cuchía, Miengo). In: Ontañón Peredo, R. (Coord.), Actuaciones Arqueológicas en Cantabria, 1984-1999. Gobierno de Cantabria. Consejería de Cultura, Santander, pp. 53-56.
Blatt, H., Middleton, G.V., Murray, R.C., 1980. Origin of Sedimentary Rocks, 2nd ed. N. J, Prentice Hall, Englewood Cliffs.
Brown, W.A.B., Chapman, N.G., 1991. The dentition of red deer (Cervus elaphus): a scoring scheme to assess age from wear of the permanent molariform teeth. J. Zool. 224 (4), 519–536.
Bull, G., Payne, S., 1982. Tooth eruption and epiphyseal fusion in pigs and wild boar, In: Wilson, B., Grigson, C., Payne, S. (Eds.), Ageing and Sexing Animal Bones from Archaeological Sites. British Archaeological Reports Series 109, Oxford, pp. 55–71.
Cadevall, J., Orozco, A., 2016. Caracoles y Babosas de la Península Ibérica y Baleares. Nuevas guías de campo Omega, Ediciones Omega SL, Barcelona.
Campbell, G., 2008. Sorry, Wrong Phylum. A Neophyte Archaeomalacologists ́ Experiences in Analyzing a European Atlantic Sea Urchin Assemblage. Archaeofauna 17, 77–90.
Chaline, J., Baudvin, H., Jammot, D., Saint Girons, M.C., 1974. Les Proies des rapaces: petits mammifères et leur environnement. Doin, Paris.
Corchón, M.S., Ortega, P., 2017. Las industrias líticas y óseas (17,000–14,500 BP). Tipología, tecnología y materias primas. In: Corchón, M.S. (Ed.), La cueva de Las Caldas (Priorio. Oviedo) Ocupaciones magdalenienses en el Valle del Nalón. Ediciones Universidad de Salamanca, Salamanca, pp. 247–555.
de Jong, Y., Verbeek, M., Michelsen, V., de Place Bjor, P., Los, W., Steeman, F., Bailly, N., Basire, C., Chylarecki, P., Stloukal, E., Hagedorn, G., Wetzel, T., Glöckler, F., Kroupa, A., Korb, G., Hoffmann, A., Häuser, C., Kohlbecker, A., Müller, A., Güntsch, A., Stoev, P., Penev, L., 2014. Fauna Europaea - all European animal species on the web. Biodivers. Data J. 2, e4034 https://doi.org/10.3897/BDJ.2.e4034.
Hoyo, J. del, Elliott, A., Christie, D.A., Sargatal, J.E. (Eds.), 1992-2010. Handbook of the Birds of the World. 15 Vols. Lynx Editions, Barcelona.
Doadrio, I. (Ed.), 2002. Atlas y Libro Rojo de los Peces Continentales de España. Ministerio de Agricultura, Alimentación y Medioambiente, Madrid.
Domingo, R., Mazo, C., Utrilla, P., 2012. Hunting camps and nucleiform endscrapers in the Cantabrian Lower Magdalenian: A lithic microwear analysis. Quat. Int. 272-273, 105–110.
Domingo, R., 2005. La funcionalidad de los microlitos geométricos. Bases experimentales para su estudio, Monografías Arqueológicas, 41. Universidad de Zaragoza.
Domínguez-Rodrigo, M., de Juana, S., Galán, A.B., Rodríguez, M., 2009. A new protocol to differentiate trampling marks from butchery cut marks. J. Archaeol. Sci. 36 (12), 2643–2654.
Elorza, M., 1990. Restos de aves en los yacimientos prehistóricos vascos. Munibe 42, 263–267.
Elorza, M., 2014. Explotación de aves marinas en el Tardiglaciar del Golfo de Bizkaia: las aves de Santa Catalina. In: Berganza, E. y Arribas, J. L. (Eds.), La cueva de Santa Catalina (Lekeitio, Bizkaia): intervención arqueológica. Restos vegetales, animales y humanos. Diputación Foral de Bizkaia (BAI 4), Bilbao, 297-330.
Erbersdobler, K., 1968. Vergleichend morphologische Untersuchungen an Einzelknochen des postcranialen Skelettes in Mitteleuropa vorkommender mittelgrosser Hühnervögel. Universität München, Munich.
Fano, M.A., Álvarez-Fernández, E., 2010. Magdalenian marine shells from El Horno Cave (Ramales, Cantabria, Spain) in the regional context. In: Álvarez-Fernández, E., Carvajal, D.R. (Eds.), Not Only Food. Marine, Terrestrial and Freshwater Molluscs in Archaeological Sites. Sociedad de Ciencias Aranzadi (Munibe, Suplemento 31), San Sebastián, pp. 58–68.
Fano, M.A., Chauvin Grandela, A., Clemente-Conte, I., Tarriño, A., Teira, L.C., 2020. Mgdalenian knappers in the Asón Valley: level 2 at El Horno Cave (Ramales de la Victoria, Cantabria, Spain). J. Archaeolog. Sci.: Rep. 30, 102230.
Fano, M.A., García-Moreno, A., Chauvin, A., Clemente-Conte, I., Costamagno, S., Elorrieta-Baigorri, I., Pascual, N.E., Tarriño, A., 2016. Contribution of landscape analysis to the characterization of Palaeolithic sites. A case study from El Horno Cave (northern Spain). Quat. Int. 412 (Part. A), 82-98.
Fernandez-Jalvo, Y., Andrews, P., 2016. Atlas of Taphonomic Identifications. Springer, Dordrecht.
Fernández-Tresguerres, J.A., 1980. El Aziliense en las Provincias de Asturias y Santander. Centro de Investigación y Museo de Altamira. Ministerio de Cultura, Santander, p. 2.
Fernández-Tresguerres, J.A., 2007. El final del Paleolítico en los espacios cantábricos. In: Fano, M.A. (Ed.), Las Sociedades del Paleolítico en la Región Cantábrica. Anejo de Kobie, 8. Diputación Foral de Bizkaia, Bilbao, pp. 337–402.
Froese, R.; Pauly, D. (Eds). 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (02/2022).
Frost, D., 2021. Amphibian Species of the World 6.1: an Online Reference. http://research.amnh.org/herpetology/amphibia/index.html.
Gabriel, S., 2017. La ictiofauna de la zona B de la cueva de Coímbre (Asturias, España). In: Alvarez-Alonso, D., Yravedra, J. (Eds.), La cueva de Coimbre (Penamellera Alta, Asturias): Ocupaciones humanas en el valle del Cares durante el Paleolitico superior. Fundación María Cristina Masaveu Peterson, Madrid, pp. 226–277.
Garate Maidagan, D., Ríos Garaizar, J., Ruiz Redondo, A., 2013. El Arte parietal paleolítico de la cueva de Lumentxa (Lekeitio, Bizkaia). Kobie Serie Paleoantropología 32, 5–28.
García Guinea, M.A., 1985a. Descripción de niveles y utillaje de ellos en la cueva de Piélago II. In: García Guinea, M.A. (Ed.), Las cuevas azilienses de El Piélago (Mirones, Cantabria) y sus excavaciones de 1967–1969. Sautuola, IV, pp. 25–79.
García Guinea, M.A., 1985b. Descripción de niveles y su utillaje de sílex y hueso en la cueva de Piélago I. In: García Guinea, M.A. (Ed.), Las cuevas azilienses de El Piélago (Mirones, Cantabria) y sus excavaciones de 1967–1969. Sautuola, IV, pp. 80–99.
García Madariaga, M., García-Díez, M., Álvarez-Alonso, D., 2017. Los materiales colorantes del depósito arqueológico de la zona B de la cueva de Coímbre (Asturias, España). In: Alvarez-Alonso, D., Yravedra, J. (Eds.), La cueva de Coimbre (Penamellera Alta, Asturias): Ocupaciones humanas en el valle del Cares durante el Paleolitico superior. Fundación María Cristina Masaveu Peterson, Madrid, pp. 518–523.
González, J.E., Ibáñez, J.J., 1999. Fabricación et utilisation de ĺoutillage à dos à la fin du Paléolithique supérieur au Pays Basque. In: Thevenin, (dir), ĹEurope des derniers chasseurs. Epipaléolithique et Mésolithique. CHTS, Paris, pp. 109–114.
González Sainz, C. ; González Urquijo, J. J. (2007): El Magdaleniense reciente en la región Cantábrica. In: Fano, M.A. (Ed.), Las Sociedades del Paleolítico en la Región Cantábrica. Anejo de Kobie, 8. Diputación Foral de Bizkaia, Bilbao, pp. 275-308.
Hargrave, L.L., 1970. Mexican Macaws. Comparative Osteology and Survey of Remains from the Southwest. Anthropol. Pap. Univ. Arizona 20, 1–67.
Haynes, G., 1983. Frequencies of spiral and green-bone fractures on ungulate limb bones in modern surface assemblages. Am. Antiq. 48, 102–114.
Herrero-Alonso, D., 2018. La gestión de las materias primas y cadenas operativas líticas en el Mesolítico de la vertiente sur de los Picos de Europa: la cueva de La Uña (León). Universidad de Salamanca, Salamanca. PhD thesis.
Ibáñez, J.J., González, J.E., 1996. From Tool Use to Site Function: Use-Wear Analysis in Some Final Upper Palaeolithic Sites in the Basque Country. BAR International Series, 658. Archaeopress, Oxford.
Inizian, M.-L., Reduron, M., Roche, H., Tixier, J., 1995. Préhistoire de la pierre taillée 4 - Technologie de la pierre taillée. CNRS-Université Paris 10. Meudon-Nanterre.
International Union for Conservation of Nature (IUCN), 2022. The IUCN Red List of Threatened Species. Version 2021.3. http:// www.iucnredlist.org.
Jordá Pardo, F. J.; Martín-Jarque, S.; Portero, R., Álvarez-Fernández, E. (2022) (eds.). Descendiendo el río Sella. Una (re)visión de la arqueología prehistórica en el Valle del Sella (Asturias, España). Gijón: UNED (Entemu XIX).

Keeley, L.H., 1980. Experimental determination of stone tool uses: A microwear analysis. The University of Chicago Press, London.
Levine, M.A., 1982. The use of crown height measurements and eruption-wear sequences to age horse teeth, In: Wilson, B.; Grigson, C.; Payne, S. (Eds.), Ageing and Sexing Animal Bones from Archaeological Sites. Oxford: BAR Publishing, (British Series, 109), pp. 223-250.
Marín, A., 2010. Arqueozoología en el Cantábrico Oriental durante la transición Pleistoceno/Holoceno. Ediciones Universidad de Cantabria, Santander, La Cueva de El Mirón.
Martínez-Villa, A., 1986. La carta arqueológica de los concejos de Cangas de Onís y Onís. Universidad de Oviedo, Memoria de Licenciatura. Departamento de Prehistoria y Arqueología.
Martínez-Villa, A., 2020. Avance sobre la interpretación de algunas evidencias artísticas paleolíticas en la cueva'l Molín (Avín, Onís, Asturies): zoomorfos e ideomorfos. Un pequeño conjunto de figuras rojas. Cuadernos de Arte Prehistórico 10, 78–106.
Martínez-Villa, A., 2022. Cien años de investigaciones en la cueva de la Lloseta (Ribadesella/Ribeseya, asturias/asturies, españa). Revisión e identificación de los trabajos arqueológicos. planteamiento y objetivos del nuevo proyecto. In: Jordá Pardo, J.F., Martín-Jarque, S., Portero, R., Álvarez-Fernández, E. (Eds.), Descendiendo el Río Sella, una revisión de la arqueología prehistórica del Valle del Sella. Gijón, UNED (Entemu XIX), pp. 267–301.
Martínez-Villa, A. Pruneda, grotte. Benia de Onís, Asturies. Bouquetins et Pyrénées. Inventaire des représentations du Paléolithique Pyrénéen. Tome 2 de l'hommage à Jean Clottes. *Inventaire des représentations de bouquetins du Paléolithique pyrénéen*, édité aux Presses Universitaires de Provence - Aix-en-Provence. In press.
Moreno, R., 1994. Análisis arqueomalacológicos en la Península Ibérica. Ph D. Departamento de Biología, Univ. Autónoma de Madrid, Madrid, Contribución metodológica y biocultural unpublished.
Nicholson, R.A., 1993. Morphological Investigation of Burnt Animal Bone and an Evaluation of its Utility in Archaeology. J. Archaeol. Sci. 20, 411–428.
Palacios, N., Vega, J.J., 1997. Guía de conchas de las playas y rías de Cantabria. Consejería de Medio Ambiente de la Diputación Regional de Cantabria, Santander.
Pales, L., Garcia, A., 1981. Atlas osteologique des mammiferes. Editions du C.N.R.S, París.
Pales, L., Lambert, P., 1970. Atlas ostéologique pour servir à l'identification des mammifères du Quaternaire. Herbivores. Editions du C.N.R.S., París, Les membres.
Pelegrin, J., 2000. Les techniques de débitage laminaire au Tardiglaciaire: critères de diagnose et qualques réflexions. In: Valentin, B., Bodu, P., Christensen, M., (Dir.)., L'Europe Centrale et septentrionale au Tardiglaciaire, Table-ronde de Nemours, 13-16 mai 1997, Mémoires de Préhistoire d'Ile de France, pp. 73-86.
Pérez Ripoll, M., 1988. Estudio de la secuencia del desgaste de los molares de *Capra pyrenaica* de los yacimientos prehistóricos. Archivo de Prehistoria Levantina 18, 83–128.
Perlès, C., 1991. Économie de la màtiere premières et économie du débitage: deux conceptions opposées? In: XI Rencontres Internationales, d'Archeologie et d'Historie d'Antibes. 25 ans d'études technologiques en préhistoire. Actes des rancontres, 1990. Éditions APDCA, Juan-les-Pins, pp. 35–45.
Pinto-Llona, A.C., 2007. El yacimiento arqueopaleontológico de Jou'l Llobu (Onís, Asturias). In: Excavaciones arqueológicas en Asturias (1999–2002), 5. Gobierno del Principado de Asturias, Oviedo, pp. 87–90.
Pinto-Llona, A.C., 2018. Sopeña, un ejemplo bien datado de presencia neandertal reciente en el norte de la Península Ibérica. In: Excavaciones Arqueológicas en Asturias (2013-2016), 8. Gobierno del Principado de Asturias, Oviedo, pp. 39-48.
Pinto-Llona, A., Clark, G., Karnakas, P., Blackwell, B., Skinner, A.R., Andrews, P., Reed, K., Miller, A., Macías-Rosado, R., Vakiparta, J., 2012. The Sopeña Rockshelter, a new site in Asturias (Spain) bearing evidence on the Middle and Early Upper Palaeolithic in Northern Iberia. Munibe (Antropologia-Arkeologia) 63, 45–79.
Pinto-Llona, A.C., Grandal D'anglade, A., 2019. Conflicting 14C scenarios in the Sopeña cave (northern Iberia): Dating the Middle-Upper Palaeolithic boundary by non-ultrafiltered versus ultrafiltered AMS 14C. Quat. Int. 522, 1–11.
Pinto-Llona, A.C., Grandal D'anglade, A., Uzquiano, P., 2022. Veinte años desde el descubrimiento del yacimiento paleolítico de la cueva de Sopeña (Onís, Asturias, España). In: Jordá Pardo, J.F., Martín-Jarque, S., Portero, R., Álvarez-Fernández, E. (Eds.), Descendiendo el Río Sella, una revisión de la arqueología prehistórica del Valle del Sella. UNED (Entemu, XIX), Gijon, pp. 59–99.
Portero, R. 2022. Estrategias de subsistencia a finales del Pleistoceno superior y comienzos del Holoceno en el valle del Sella: la cueva de El Cierro (Ribadesella, Asturias, España). PhD, Departamento de Prehistoria, Historia Antigua y Arqueología, University of Salamanca, Salamanca (unpublished).
Quintanal, J.M., 1991. Nuevos lugares prehistóricos de Asturias: descubiertos por los grupos de espeleología "Polifemo" y "Oviedo. J. M, Quintanal, Oviedo.
Ramsey, C.B., 2009. Bayesian analysis of radiocarbon dates. Radiocarbon 51 (1), 337–360.
Reimer, P.J., Austin, W.E.N., Bard, E., Bayliss, A., Blackwell, P.G., Ramsey, C.B., Butzin, M., Cheng, H., Edwards, R.L., Friedrich, M., et al., 2020. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). Radiocarbon 62 (4), 725–757. https://doi.org/10.1017/RDC.2020.41.
Reitz, E.J., Wing, E.S., 2003. Archaeozoology. Cambridge University Press, Cambridge.
Rofes, J., Zuluaga, M.C., Murelaga, X., Fernández-Eraso, J., Bailon, S., Iriarte-Chiapusso, M.J., Ortega, L.L., Alonso-Olazabal, A., 2013. Paleoenvironmental reconstruction of the early Neolithic to middle Bronze Age Pena Larga rock shelter (Alava, Spain) from the small mammal record. Quat. Res. 79, 158–167.
Roselló, E., Morales, A. 2014. Las ictiofaunas de Santa Catalina (Lequeitio, Vizkaia): un registro singular para la Prehistoria cantábrica. In: Berganza, E. and Arribas, J. L. (Eds.), La cueva de Santa Catalina (Lekeitio, Bizkaia): intervención arqueológica. Restos vegetales, animales y humanos. Diputación Foral de Bizkaia (BAI 4), Bilbao, pp. 161-262.
Rufà, A., Laroulandie, V., 2019. Prey size as a critical factor for bird bone taphonomy in Eagle Owl (Bubo bubo) pellets. Sci. Rep. 9, 19200.
Ruiz Cobo, J., Vázquez Toro, F., 2019. Caracoles continentales de Cantabria. Atlas de especies y ambientes. Ed. Tantín, Santander.
Sánchez Marco, A., 2018. Distribución de los galliformes (Aves) en la región mediterránea occidental al final del Pleistoceno. Boletim Do Centro Português de Geo-História e Pré-História 1 (1), 21–33.
Schweingruber, F., 1990. Anatomie europäischer Hölzer. WSL/FNP, Haupt, Zücher.
Selvaggio, M.M., 1994. Carnivore tooth marks and stone tool butchery marks on scavenged bones: archaeological implications. J. Hum. Evol. 27, 215–228.
Semenov, S.A., 1981. Tecnología prehistórica: estudio de las herramientas y objetos antiguos a través de las huellas de uso. Akal, Madrid.
Shipman, P., Rose, J., 1983. Early hominid hunting, butchering and carcass-processing behaviors: approaches to the fossil record. J. Anthropol. Archaeol. 2, 57–98.
Sonneville-Bordes, D., Perrot, J., 1953. Essai d'adaptation des méthodes statistiques au Paléolithique supérieur: premiers résultats. Bulletin de la Société Préhistorique Française 50 (5–6), 223–233.
Sonneville-Bordes, D., Perrot, J., 1954. Lexique typologique du Paléolithique supérieur outillage lithique I, grattoirs, II, outils solutréens. Bulletin de la Société Préhistorique Française 52 (1–2), 76–80.
Sonneville-Bordes, D., Perrot, J., 1956a. Lexique typologique du Paléolithique supérieur outillage lithique IV, burins. Bulletin de la Société Préhistorique Française 53 (7–8), 408–413.
Sonneville-Bordes, D., Perrot, J., 1956b. Lexique typologique du Paléolithique supérieur outillage lithique (suite et fin). Bulletin de la Société Préhistorique Française 53 (7–8), 547–559.
Southward, E.C., Campbell, A.C., 2005. Echinoderms. The Linnean Society of London and The Estuarine and Coastal Sciences Association by Field Studies Council, London.
Stiner, M.C., Kuhn, S.L., Weiner, S., Bar-Yosef, O., 1995. Differential burning, recrystallization, and fragmentation of archaeological bone. J. Archaeol. Sci. 22 (2), 223–237.
Straus, L.G., Clark, G., 1986. La Riera Cave: Stone Age Hunter-Gatherer Adaptations in Northern, no. 36). Arizona State University (Anthropological Research. Papers, Spain. Tempe.
Tarriño, A., Elorrieta, I., 2017. Estudio de los sílex recuperados en la Zona B de la cueva de Coímbre (Asturias, España). In: Álvarez-Alonso, D., Yravedra, J. (Coords.), La cueva de Coímbre (Peñamellera Alta, Asturias). Ocupaciones humanas en el valle del Cares durante el Paleolítico superior. Fundación María Cristina Masaveu Peterson, Madrid, pp. 354-359.
Tarriño, A., Elorrieta, I., García-Rojas, M., 2015. Flint as raw material in prehistoric times: Cantabrian Mountain and Western Pyrenees data. Quat. Int. 364, 94–108.
Tarriño, A., Duarte, E., Santamaría, D., Martínez, L., Fernández de la Vega, J., Suárez, P., Rodríguez, V., Forcelledo, E., Rasilla, M. de la, 2013. El Sílex de Piloña. Caracterización de una nueva fuente de materia prima lítica en la Prehistoria de Asturias. In: Rasilla, M. de la (Coord.), F. Javier Fortea Pérez. Universitatis Ovetensis Magister. Estudios en Homenaje. Ediciones de la Universidad de Oviedo y Ménsula Ediciones, Oviedo, pp. 115-132.
Tarriño, A., Terradas, X., 2013. Materias primas líticas. In: García-Díez, M., Zapata, L. (Eds.), Métodos y Técnicas de análisis y estudio en arqueología prehistórica. Universidad del País Vasco (UPV/EHU), Bilbao, De lo técnico a la reconstrucción de los grupos humanos, pp. 439–452.
Tarriño, A., 2006. El sílex en la Cuenca Vasco-Cantábrica y Pirineo Navarro: caracterización y su aprovechamiento en la Prehistoria. Ministerio de Cultura (Monografías del Museo Nacional y Centro de Investigación de Altamira 21), Madrid.
Tomek, T., Bochenski, Z.M., 2000. The comparative osteology of european corvids (Aves: Corvidae), with a key to the identification of their skeletal elements. Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków.
Tutin, T. G., Heywood, V. H., Burges, N. A., Valentine, D. H., Walters, S. M., Webb, D. A., 1964. Flora europaea vol I: Lycopodiaceae to Platanaceae. Cambridge University Press, Cambridge.
Utrilla, P., Mazo, C., Domingo, R., 2003. Les structures d'habitat de l'occupation magdalenienne de la grotte d'Abauntz (Navarre, Espagne). L'organisation de l'espace. In: Vasil̂ev, S. A., Soffer, O. and Kozlowski, J. (Eds.), Perceived Landscapes and Built Environments. The cultural geography of Late Paleolithic Eurasia BAR International Series 1122. Oxford, pp. 25-38.
Uzquiano, P., 1992. Recherches anthracologiques dans le secteur Pyréneo-cantabrique (Pays Basque, Cantabria et Asturias): environnements et relations homme-milieu au Pléistocène supérieur et début de l'Holocène. Unpublished PhD Environnements et Archéologie, Université de Montpellier II.
Uzquiano, P., 1997. Antracología y métodos: implicaciones en la Economía prehistórica. Etnoarqueología y Paleoecología. Trabajos de Prehistoria 54 (1), 145–154.
Uzquiano, P., 2014. Wood resource exploitation by Cantabrian late Upper Palaeolithic groups (N Spain) regarding MIS 2 vegetation dynamics. Quat. Int. 337, 154–162.
Uzquiano, P., 2018. Vegetation, firewood exploitation and human settlement in northern Spain in relation to Holocene climate and cultural dynamics. Quat. Int. 463, 414–424.
Vadillo, M., Aura, J.E., 2020. Lithic production in the centre and south of the Iberian Mediterranean region (Spain) throughout the Pleistocene-Holocene transition (14.5-10.5 ky cal BP). Quat. Int. 564, 83–93.
Vaughan, P., 1985. Use-Wear Analysis of Flaked Stone Tools. University of Arizona Press, Tucson.
Vernet, J.L., Ogereau, P., Figueiral, I., Machado, C., Uzquiano, P., 2001. Guide d'identification des charbons de bois préhistoriques et récents. Sud-Ouest de l'Europe : France, Péninsule Ibérique, Îles Canaries. Editions du C.N.R.S., París.

Vettese, D., Blasco, R., Cáceres, I., Gaudzinski-Windheuser, S., Moncel, M.-H., Thun Hohenstein, U., Daujeard, C., 2020. Towards an understanding of hominin marrow extraction strategies: a proposal for a percussion mark terminology. Archaeological and Anthropological Science 12 (48), 1–19.

Wilson, D.E., Reeder, D.M., 2005. Mammal Species of the World. A Taxonomic and Geographic Reference. John Hopkins University Press, Baltimore, MD. WoRMS Editorial Board, 2022. World Register of Marine Species. http://www.marinespecies.org de VLIZ. (accessed 05 February 2022).

Yravedra, J., 2002. Especialización o diversificación. Una nueva propuesta para el Solutrense y el Magdaleniense cantábrico, Munibe Antropologia-Arkeologia 54, 3–22.

Yravedra, J., López-Cisneros, P., de Andres-Chaín, M., Estaca, V., Moreno, M., Rodrigo, D., 2017. Estrategias de subsistencia sobre macrovertebrados y lagomorfos en la cueva de Coimbre (Penamellera Alta, Asturias): los patrones de ocupacion en el valle del Cares durante el Paleolitico superior. In: Alvarez-Alonso, D., Yravedra, J. (Eds.), La cueva de Coimbre (Penamellera Alta, Asturias): Ocupaciones humanas en el valle el Cares durante el Paleolitico superior. Fundacion María Cristina Masaveu Peterson, Madrid, pp. 302–347.