UNIVERSITY OF OXFORD

A COMPARATIVE STUDY OF THE LITHIC TECHNOLOGY, SUBSISTENCE AND BIOCLIMATIC SETTLEMENT PATTERNS OF NEANDERTHALS IN THE IBERIAN PENINSULA (CANTABRIAN AND BETIC REGIONS)

MARCO ANTONIO BERNAL

LINACRE COLLEGE - SCHOOL OF ARCHAEOLOGY

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ABSTRACT

This thesis investigates Neanderthal lithic technical, subsistence practices and bioclimatic settlement patterns behaviour comparison between two different bioclimatology and biogeografically regions of the Iberian Peninsula - the Cantabrian region to the north, and the Betic region to the south-, during the late Pleistocene Period. The principal aim is to test whether or not hominid groups of the same species (*Homo neanderthalensis*) behave, exploit and occupy their territory in similar or different ways under different environmental conditions.

Three different approaches were undertaken to test the proposition. The first was a technological study of eight lithic assemblages from the latest Mousterian levels in the Cantabrian region: Axlor, Esquilleu, Morin, El Castillo; and the Betic region: Abrigo 3, Carihuela, Zafarraya, Gorham´s Cave, in order to establish whether any distinctive patterns emerge in both areas of study.

Subsistence practices, through a study of faunal remains, was the second dataset for this comparative study. A faunal database was constructed from the literature pertaining to Middle Palaeolithic sites in both regions focusing on large and small game, cannibalism practices and evidence for the consumption of plants. The aim is to establish the variability in Neanderthal subsistence behaviour.

The third approach was an analysis of settlement patterns through bioclimatic mapping, created by temperature and rainfall climate data from weather stations in both regions. The aim of this work was to explore whether or not Neanderthals inhabited both Cantabrian and Betic regions in different or similar ways.

The result of this thesis suggests that Neanderthals reacted to changes in local ecology and climate in similar ways in both study regions, highlighting their great adaptive ability and commonality in their behavioural response

To the memory of my mother, father and siblings

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CHAPTER 1

INTRODUCTION

1.1. INTRODUCTION

The research topic of this thesis lies within the general framework of prehistory. The objective is the study of human behaviour amongst Neanderthal populations, in particular aspects that influence behaviour (technical behaviour, subsistence practices, biogeography, climatology, palaeoecology, and human evolution). By formulating testable hypotheses, the study of empirical data from an interdisciplinary point of view is the only way we can try to understand the evolution of human behavioural diversity and lifeways in prehistory in relation to ecological conditions, climate change, and landscape evolution.

This thesis considers the important role of lithic technology in human evolution in relation to ecological behaviour models. Climate, vegetation and biodiversity are essential to understanding the ecological context in which human populations developed their technological lithic complex for the exploitation of environmental resources. Thus, through the interdisciplinary study of the archaeological record and the reconstruction of various biotopes in relation to the ecosystems in which they lived, we can develop a more nuanced understanding of the natural environment in which human groups developed and were forced to adapt.

The focus of this dissertation is the Iberian Peninsula and two regions that will be compared with each other in detail. The Iberian Peninsula plays an important role in the world of Eurasian Neanderthals Thirty-three sites with Neanderthals remains have been documented around the Iberian Peninsula, and a total of 699 Middle Palaeolithic sites with Mousterian techno-complexes are found here.

The data included in this analysis have been produced by a large number of research projects and found in dozens of scientific publications from the 19th century to today. In spite of the methodological shortcomings of many investigations carried out until the middle of the 20th century, from the end of the 20th century several important aspects such as documentation and recovery of all the remains found, coordination of each piece in three-dimensional space, and absolute dates (applying a variety of dating techniques) as the integration of multidisciplinary studies have been taken into account by the many research projects that have worked and are currently working on the Iberian Peninsula in order to

study with scientific precision each archaeological site. As far as we know, at present in the Iberian Peninsula, there are a large number of Middle Palaeolithic sites with good archaeological contexts, systematic excavations, and reliable dating.

Specifically for this study, two areas inside of the Iberian Peninsula with a large number of sites with Middle Palaeolithic levels have been selected. These are the Cantabrian Mountains system in the north and the Betic Mountains system in the southeast. These are two very similar orographical areas (coast, piedmont, and high mountains), but with different bioclimatology and ecology. This will enable us to understand whether hominid groups of the same species (*Homo neanderthalensis*) technically behaved, exploited, and occupied the territory in similar or different ways, under different environmental conditions.

Eight sites within these regions, where the stratigraphic sequences have been documented and systematic excavation and dating have been carried out, have been selected. Mousterian lithic assemblages of the last Middle Palaeolithic levels of these eight sites, without any mixture with Aurignacian material or Initial Upper Palaeolithic, have been selected for study.Châtelperronian assemblages have not been included.

The four sites and archaeological levels studied in the north are: Axlor (Bizkaia): levels III and IV; EL Esquilleu (Cantabria): Level VIf; Morín (Cantabria): Level XI; El Castillo: Level 20. In the southeast: Abrigo 3 (Málaga): Z4-Z3, sectors C33-C45; Carihuela (Granada): level V; Zafarraya (Málaga): UA to UG; Gorham's Cave (Gibraltar): Area I, II, III Levels UBSm.6 to SSLm (Lsm).6.

The Mousterian lithic assemblages from the layers of these sites will be the first type of data to be analysed. These assemblages will be studied through of a morpho-technical and operational chains analysis in order to know the technical criteria used in the production and configuration sequences by Neanderthals, i.e. gestures, strategies, methods, management, selection, adaptation, etc.

Once performed, the analyses of different assemblages will be compared to each other. First, a comparison between the sites of the Cantabrian region will be carried out. Next, a comparison between the sites of the Betic region will be undertaken. Finally, a comparison between the two regions using statistical analysis of comparison will be carried out.

The second type of data that will be analysed is faunal data. An extensive database of the faunal remains excavated from the relevant levels was constructed from the literature. Of particular focus were large game (including: horses, bovids, goats, chamois, deer, reindeer, roe deer, wild boars, woolly rhino, giant deer, and mammoths), and small game (including: rabbits, tortoise, marine resources, fishes, and birds), as well as possible cannibalism practices and the consumption of plants. This is important in allowing an insight into whether Neanderthal diet was diverse or specialised, the range of animal species that were consumed and their quantity and frequency, and the ability to hunt small animals and collect marine resources, nuts or others types of resources. This research is intended to test the variability of Neanderthal subsistence behaviour in both regions.

The third type of data that will be analysed as part of this comparative study is Neanderthal settlement patterns in the bioclimatic belts. Two different databases were constructed. The first concerns climate data, temperature and rainfall annual mean values from modern weather stations. The second focuses on archaeological sites (caves, rock-shelters, open air sites) from different chronocultural periods: Mousterian, Aurignacian, Gravettian and Solutrean, in both regions, collected from the scientific literature. This data forms the basis for various bioclimatic modelling maps created with the ArcGIS 10.3 program on a STRM 90 m Digital Elevation Models map of Iberia Peninsula. These were created in order to explore a series of questions; is there a difference in Neanderthal settlement patterning between both regions?; is there a preferred pattern of occupation in specific bioclimatic zones?; is there a difference in the bioclimatic settlement pattern between Anatomically Modern Humans groups and Neanderthals.

The aim is to generate empirical data to help us understand Neanderthal behaviour more objectively. The archaeological record, of course, is sadly incomplete and there are limitations in the available information we have. I am aware that this means it is difficult to cover or clarify the total mode of behaviour of a population or group of people. However, I think that it is worth the effort. The three key issues that I aim to explore are topics that are currently under more or less constant debate; some of them seem to be settled, and then they are re-addressed again. Studies of Neanderthals seem to involve constant changes in interpretation, thanks to new discoveries in recent years. The image that science and society created about Neanderthals is in a process of transformation and my hope is that the new research described in this dissertation will provide even more data which will be

relevant to this process. Our epistemological starting point is far from image of Neanderthals as aberrant and rude beings and simply extinguished by the primacy of our species. My study will be carried out with the premise that Neanderthal behaviour is essentially modern.

Neanderthals also will be analysed by themselves, without being compared to *Homo sapiens sapiens*, although sometimes in this thesis reference to bibliographic aspects may emerge. However, the aim of this thesis is to identify what it is that is specific to Neanderthals.

1.2. STRUCTURE OF THE THESIS:

Chapter 1: Introduction. It is the starting point where the nature and structure of this research is presented.

Chapter 2: Theoretical Framework. This chapter presents the epistemological framework in which this research is framed. It will begin with Neanderthal behaviour from a general perspective. Next, the distribution of fossil Neanderthals in Iberia, then a discussion on the Middle Palaeolithic technological variability in general, and in particular the case of the Iberian Peninsula are presented. Finally, the paleoenvironmental context and the geological context of the Iberian Peninsula are presented.

Chapter 3: Objectives. This chapter presents the purpose of conducting the research for this thesis. First, the hypothesis to be test is presented and then a series of research questions in several general categories of study are presented. These include technical behaviour, subsistence practice and bioclimatic settlement patterns.

Chapter 4: Research Design and Methodology. This chapter presents the selection criteria for the period; the regions and sites under study; the method of data collection from the creation of three databases (sites, fauna and climate); and the method of data analysis: lithic assemblages, fauna, bioclimatic settlement patterns.

Chapter 5: Neanderthal Technical Behaviour. This chapter presents the state of research at each of the sites selected for the study of lithic assemblages belonging to the Middle Palaeolithic through publications by various research studies. Also, it presents the results of the morpho-technical analyses of the lithic assemblages, comparisons between assemblages of the same region, and between assemblages of the two regions of study by using statistical analysis. Finally, a general contextualization with Mousterian lithic assemblages of the main sites of the each region will be performed.

Chapter 6: Neanderthal Subsistence Practices. This chapter presents the analysis of subsistence modes and diet of Neanderthals in each region, and a comparison between both regions.

Chapter 7: Bioclimatic Settlement Pattern. This chapter presents and compares the occupation of territory in relation to the different bioclimatic belts in both regions during the Mousterian, Châtelperronian, Aurignacian, Gravettian and Solutrean periods.

Chapter 8: Discussion/Conclusions: This chapter presents a comprehensive and summary reflection about the results, data processed at different points during this research and considers lines of future research.

CHAPTER 2

THEORETICAL FRAMEWORK

2.1. BACKGROUND ON NEANDERTHAL BEHAVIOUR

Since their fossil remains were discovered and recognized in a limestone quarry in the Neander Valley (Germany) in 1856, Neanderthals have been the subject of a great deal of study and controversy. However, these remains were not the first discoveries made of this new and unknown species. In 1829 in Engis Cave (Belgium) and in 1848 in the Forbes' Quarry (Gibraltar) appeared fossil human remains that later together with the remains found at Feldhofer, and after years of debate, would be confirmed as part of an ancient human lineage (Büchner 1984, Keith 1911, Duckworth 1912). The taxon was established as *Homo neanderthalensis* by the Irish anatomist William King at a meeting of the British Association in 1863, and published in 1864 (King 1864).

Although accepted as an archaic predecessor of Anatomically Modern Humans, the relationship of Neanderthals with moderns continued to be debated. In the first decades of the last century their "primitiveness" and presumed inferiority was emphasised (Boule 1913) and the word Neanderthals became a recognized synonym for "brutishly primitive".

It is true that the skeletal morphology of *Homo sapiens* is distinct enough for *Homo neanderthalensis* to be classified as a separate species. The mitochondrial DNA evidence too suggests that the initial evolutionary separation of the Neanderthals and the populations which gave rise to genetically modern populations must reach back to at least 300,000 years ago (Krings *et al* 2000), although this continues to be a subject of controversial debate. Under the paradigmatic view that distinct biological species must differ in behaviour as much as in morphology, consequently the two groups have been defined as Neanderthal and Modern human cultures; *Homo sapiens* with modern humans behaviour, and *Homo neanderthalensis* with Neanderthal behaviour. Neanderthal behaviour appears to have lacked certain things: a limited capacity for innovation, less efficient hunting behaviour, inferior technology, a narrower diet and smaller social networks, in comparison with Anatomically Modern Humans.

Problems arise when one starts defining what modern behaviour is. After one hundred years of inquiry, researchers continue to debate the origin and spread of modern human behaviour (Clark & Lindly 1989, McBrearty & Brooks 2000, Henshilwood & Marean

2003, Klein 2008, Shea 2011). Initially, "modern behaviour" was associated with Anatomically Modern Humans and was considered to have arisen abruptly about 40 ka in Europe. This was named the "Human Revolution" (Mellars & Stringer 1989); new discoveries revealed that both "Anatomically Modern Humans" and "modern behaviour" developed gradually in Africa in the last 300 ka during the Middle and Late Stone Age. The main characteristics of this behaviour are held to be: burial of the dead as an indicator of ritual; art, ornamentation, and decoration; symbolic use of ochre, worked bone and antler; blade technology; standardization of artefact types; artefact diversity; complex hearth construction; effective large-mammal exploitation, seasonally focused mobility strategies; use of harsh environments; fishing and fowling (Henshilwood & Marean 2003). However, recent empirical archaeological data show that Neanderthal and moderns featured similar levels of cultural achievement (Zilhão 2011)

Many of the questions that remain about Neanderthal behaviour: their technology, their subsistence practices, their settlement systems, will be discussed in this thesis. Research recent into Neanderthal behaviour has altered our previous views greatly, as we will see.

Neanderthal fossil remains have been found across a large part of Eurasia, from the Iberian Peninsula to Siberia, encompassing many different types of environments. The climate during their existence in the Upper Pleistocene was very variable with cyclical alternation of glacial and interglacial periods. The range of environments in which they lived covered a variety of climates, cold, warm, and occasionally semi-arid and arid. A rich fossil assemblage of hundreds of individuals has been found across Eurasia roughly dating from 350,000 to 40,000 years ago. Chronologically, Neanderthal fossils have traditionally been classified into the following groups (Pettitt 2009, Hublin 2009):

Classic Neanderthals: thought to date from the late Pleistocene between 150 and 40 ka (Neanderthal 1, Ehringsdorf (Germany), Spy (Belgium), Saccopastore, Guattari (Italy), Zafarraya, El Sidrón, Sima de las Palomas, Cova Negra, Foradá (Spain); Gibraltar 1, 2 (Gibraltar); Kaprina C, Vindija (Croatia), Le Moustier, Saint Césarie, La Ferrassie, La Chapelle-aux-Saints (France), Tabun, Amud, Kebara (Israel), Dederiyeh (Syria), Shanidar (Iraq), Teshiktash (Uzbekistan), etc.

Early Neanderthals: dating between 350 and 150 ka (Bilzingsleben B4, Steinheim, Mauer (Germany), Swanscombe (United Kingdom), La Chaise S, Biache-Saint-Vaast 1 and 2 (France), etc.

Pre-Neanderthals: from >300 ka (Atapuerca Sima de los Huesos (Spain), Arago/Tautavel (France), Petralona (Greece)).

The demise of Neanderthals around 40.000 years ago appears to have coincided with the spread into Eurasia of *Homo sapiens.* The reason for their extinction is one of the most widely debated topics in Eurasian prehistory. Many hypotheses have been raised: violence (Boule 1920, Churchill *et al* 2009, Ko 2016); unstable climate during MIS 3 (Leroyer & Leroi-Gourhan, 1983, Leroyer 1988, Dalén *et al* 2012); ecological restrictions (Finlayson 2004, Finlayson & Carrion 2007); competitive exclusion (Banks *et al* 2008); cannibal practices amongst Neanderthals (Agustí & Rubio-Campillo 2016); parasites and pathogens carried by *Homo sapiens* (Houldcroft & Underdown 2016); natural catastrophe such as the Campanian Ignimbrite Eruption (Fedele *et al* 2008, Black *et al* 2015); division of labour (Kuhn & Stiner 2006); and nutritional ecology and demography (Hockett & Haws 2005). In addition, the disappearance of Neanderthals is explained in terms of the cultural or biological advantage of Anatomically Moderns Humans (Pettitt 2000, Mellars 2004, Svoboda 2005).

In terms of when Neanderthals became extinct there are probably two most likely scenarios: first that it happened when *Homo sapiens* arrived in the same region, or second they became extinct before *Homo sapiens* arrived. According to Higham *et al* (2014), Anatomically Modern Humans and Neanderthals overlapped in some regions of Europe for between 2,600 and 5,400 years, and the disappearance of Neanderthals occurred at different times in different regions, consequently another scenario could be that populations of Anatomically Modern Humans entered regions already abandoned by Neanderthals or where they had previously become locally extinct, and the pattern of overlap was in the form of a mosaic. Both groups did meet, because there is genetic evidence of interbreeding (Fu *et al* 2015, Kuhlwilm *et al* 2016). The extinction of Neanderthals was probably a complex process involving many causal factors. The real situation may only be revealed with combined evidence from palaeontological, archaeological and genetic studies.

Neanderthals became associated with European Middle Palaeolithic lithic assemblages, named Mousterian in the 1870s by Gabriel Mortillet after their excavation at the rockshelter of Le Moustier (France). Their lithic technology is based in the use of the Levallois and Discoidal methods of knapping, which they shared with *Homo sapiens* in North Africa and Near East. The aim was the predetermined extraction of blanks such as flakes, blades and points though a careful preparation of the core. Stone tool production is a series of conscious decisions and processes, which require extensive planning, abstract thought, knowledge of the surrounding territory, as well as cultural transmission and particular skill sets. An understanding of what raw materials are best suited for the tool´s intended use; how much time and energy would be spent acquiring it; which knapping method is best suited; whether to produce flakes or blades; knowledge of how to resharpen, reuse and when to finally discard the tool are all processes that require great cognitive skill. For these reasons, if technological sophistication is an indicator of cognitive abilities there is not much difference between Anatomically Modern Humans and Neanderthals.

From the subsistence point of view, it was once thought that Neanderthals lacked the ability to pursue and kill big game compared with early Moderns, and that scavenging, not hunting, was preferred (Binford 1983, 1989, Stiner and Kuhn 1992). However, Neanderthals appear to have produced specialized mass hunting sites of reindeer, horse, aurochs in different places (Maren and La Borde (France) (Brugal & Jaubert 1996); Salzgitter-Lebenstedt (Germany) (Gaudzinski & Roebroeks 2000). Also, the discovery of many sites with pointed artefacts with impact scars on their surfaces, shows that they were used to hunt (Shea 1988, 1998, 2001, Meignen & Bar-Yosef 1992, Galván *et al* 2007, Hovers 2009, Ríos-Garaizar 2012a,b, Groucutt 2014). In addition, Neanderthals were considered to have a lack of ability to hunt small fast game, however several sites have documented a broader diet, including rabbits (Blasco *et al* 2011, Brown *et al* 2011, Blasco & Fernández 2012a,b, Yravedra *et al* 2013a, Pérez 2014), birds (Finlayson *et al* 2001, 2012, Laroulandie 2005, Blasco *et al* 2014), marine resources (Garrod *et al* 1928, Stiner 1994, Antunes 2000, Barton 2000, Ferreira Bicho 2004, Ferreira Bicho & Haws 2008, Richards *et al* 2008, Stringer *et al* 2008, Zilhão *et al* 2010) and plant resources (Madella *et al* 2002, Lev *et al* 2005, Barton 1999, 2000, 2008, 2012, Jones 2009, Hardy 2010, El Zaatari 2011, Henry *et al* 2011, Salazar *et al* 2013, Sistiaga *et al* 2014).

Spatial organization is held to reflect behavioural capabilities. Some authors (Mellars 1996, Pettit 1997) have suggested that Neanderthal spatial patterns, at both inter-site and intra-site levels, are monotonous and less complex than those of Anatomically Modern Humans. However, Neanderthals had a high degree of mobility and a wide spatial range, important in order to procure raw materials and undertake their subsistence strategies. Miller & Barton (2008) in their settlement pattern study of Middle and Upper Palaeolithic sites in the eastern part of the Iberian Peninsula argued that there is not a consistent difference between Middle and Upper Palaeolithic use of landscape. At Abric Romaní (Capellades, Spain), Vaquero (1999) argued that there is variability in Middle Palaeolithic occupation strategies, and suggested that the lithic evidence from the site does not imply a qualitative difference between Middle Palaeolithic and Upper Palaeolithic spatial patterning. At the Tor Fara site in Israel, Henry *et al* (2004) reached similar conclusions.

The capacity for symbolic thought is another controversial issue that has attracted much debate (Chase *et al* 1987, Zilhão 2007, Langley *et al* 2008, Mellars 2010). Recent research suggests that there is some archaeological evidence for Neanderthal symbolic culture. According to Zilhão *et al* (2010), several shells, some of them perforated and with dye residue on their surfaces, were recovered in Aviones Cave (Spain) and were used ornamentally by Neanderthals. In Fumane Cave (Italy) an ochered fossil marine shell was recovered and interpreted as a personal ornament (Peresani *et al* 2013). At Qafzeh cave (Israel), several shells with ochre stains on some of them were documented (Bar-Yosef *et al* 2009), and interpreted as indicators of modern behaviour. Other evidence in the form of engravings have been documented in several sites including Tata (Hungary) (Vértes 1964, Moncel 2003), Axlor (Spain) (Garcíaz-Díez *et al* 2013) and Gorham´s Cave (Gibraltar) (Rodríguez-Vidal *et al* 2014), although these examples have been criticised and much debated. Another debated issue is the use of feathers or the terminal pedal phalanges of large raptors and other birds as ornaments (Peresani *et al* 2011, Morin & Laroulandie 2012, Finlayson *et al* 2012, Romandini *et al* 2014, Radovčić *et al* 2015).

There is also debate regarding the treatment of the dead and the behavioural complexity that this implies. Several sites have been interpreted as sites in which Neanderthals buried their dead, for example at Tabun C1 (Garrod & Bate 1937), Amud (Suzuki & Takai 1970), Kebara (Bar-Yosef *et al* 1992) (Israel), St-Césaire (Backer 1993, Vandermeersch 1993), La Chapelle-aux-Saints (Bouyssonie *et al* 1909, Roche 1976), La Ferrassie (Capitan &

Peyrony 1912a,b, 1921) (France), Shanidar (Solecki 1963, 1972, Trinkaus 1983) (Iraq), Foradá (Aparicio 2014, *et al* 2014) and Sima de las Palomas (Walker *et al* 2008, 2014) (Spain), etc. and these remains suggest at least some inter, and even intra, regional variability in Neanderthal mortuary practices (Pettitt 2011).

The debate regarding Neanderthal cultural capacity has tended to have two separate explanations; the first that the Neanderthals invented or innovated several features independently of Anatomically Modern Humans, and the second that contacts, exchanges and acculturation occurred between Neanderthals and Anatomically Modern Humans (Mellars 2010) at the same or different times in different places. This debate is very much ongoing.

For many decades some authors (Binford 1985; Stringer & Gamble 1993; Stiner 1994; Mellars 1998b) considered that in adaptive terms Neanderthals were inferior to Anatomically Modern Humans. It is now apparent that this is not the case. Bone tools, personal ornaments and ochre appear to have been used by Neanderthals before the arrival of Anatomically Modern Humans so it has become increasingly difficult to associate them with any degree of intellectual inferiority. Their habits and culture are fully human, their lifeways are elaborate, they had a very varied diet, they manufactured tools with skill and variability, they made ornaments on occasion, they controlled and produced fire, they organized the space in their habitats and they buried their dead. Taken together this points towards a much greater degree of 'modernity' and similarity with Anatomically Modern Humans.

2.2. DISTRIBUTION OF NEANDERTHAL FOSSIL EVIDENCE IN IBERIA

It is clear from the archaeological record that between 200,000 BP to 40,000 BP the Iberian Peninsula was occupied by *Homo neanderthalensis*. There are 33 sites with Neanderthal remains and the lithic assemblages found co-mingled with them in numerous sites are of the Mousterian technocomplex. In other parts of Eurasia and North Africa, the Mousterian is also associated with *Homo sapiens sapiens*, but in the Iberian Peninsula only *Homo neanderthalensis* is present in the fossil record, so one can propose that they were the authors of these techno-complexes with some degree of confidence. Of the 33 sites with Neanderthal remains documented, 22 have Neanderthal remains dated between 60,000 BP and 40,000 BP. This is therefore the best chronological period to investigate the behaviour of this species because of the large number of sites with Neanderthal remains and the fact that the archaeological materials found in these levels were almost certainly produced by them.

Below I present a summary of the Neanderthal Iberian evidence by geographic area; from north to south.



Figure 2.1. Distribution of Neanderthal fossils of the Iberian Peninsula.

NORTH REGION

El Sidrón (Piloña, Asturias): Currently a total of 2,100 Neanderthal remains associated with the Mousterian lithic assemblage have been recovered from this cavity. The fossil remains correspond to a minimum of 13 individuals: one child, seven adults (3 males, 3 females) and five juveniles (2 males). Several human remains have been dated by 14C and provided an average date of 48,400 ± 3,200 BP. The remains were discovered in a secondary position so there was no funeral activity in the cavity (De la Rasilla *et al* 2014).

El Esquilleu (Cantabria): a juvenile canine tooth classified as Neanderthal was found within Level XIF. 14C dating for level XIF gave a result of 36,500 ± 830 BP (Baena *et al* 2001, 2004).

El Castillo (Puente Viesgo, Cantabria): Three remains of Neanderthals have been documented in different Mousterian levels. Teeth: Castillo 1466 in level 20, second upper premolar (P4) (undet.), and Castillo 594 in level 22, right upper incisor (I1) (undet.). Also, an incomplete distal epiphysis of the proximal phalanx, Castillo 416 in level 21 (adult). In the Aurignacian level several remains were recovered that are considered Neanderthal: Castillo B in level 18, right upper M2 (adult); Castillo 292 right, lower dm2 (child); Castillo 492 crown of left, upper dm2 (child); Castillo 924 left, upper di1 (child). Several other remains of unknown taxon were also identified from Aurignacian level 18: the "Castillo A" adult individual (three cranial remains) and the "Castillo C" infant individual (7 cranial remains, parts of a mandible, and 4 fragments of vertebrae) (Cabrera *et al* 2005; Garralda 2005, 2006).

Radiocarbon dates for level 18 fall between 40,000 and 45,000 BP. For level 20 the 14C dates range between 41,000 and 49,000 BP. For level 22 there is one ESR date of 59,100 BP (Bernaldo de Quiros *et al* 2014)

Covalejos (Piélagos, Cantabria): Two teeth (M2, M3) were found in level J (level 8) associated with the Mousterian lithic assemblage, a hearth and Pleistocene fauna remains. A TL date of 38,344 ± 3,560 BP was also obtained. The M2 tooth has been attributed to a child, while the M3 is undetermined (Sanguino & Montes 2005).

Axlor (Dima, Vizcaya): Five human teeth from level III (Barandarian excavation) were found at this site. Basade (1973a) attributed them to an adult Neanderthal. Level III and IV of the Barandarian excavation correspond with current levels B-C-D. For level D there is an AMS date of 42,010 ± 1,280 BP (Beta-144262) (González-Urquijo *et al* 2005).

Lezetxiki (Mondragón, Gipuzkoa): A human humerus was documented at the bottom of level VIII (Baldeón, 1993), also two teeth: Lezetxiki 2 in level III – an upper right first molar (M1), and Lezetxiki 3 in level IV - a second lower premolar (P4) (Arrizabalaga 2006). The remains belong to three individuals. The humerus belongs to an adult and the teeth belong to juveniles (Basade 1966, 1970). The dates from level III where the teeth in square 16 A were found are: >46,500, 34,550 and >46,700 BP (Higham *et al* 2014).

Arrillor (Murua, Álava): A human tooth (second molar) at level H-Amk has been documented accompanied by Pleistocene fauna and a Mousterian techno-complex. The radiocarbon dating of this level has provided two dates: >45,200 and 48,500 ± 3,200 BP (Higham *et al* 2014). The tooth was assigned to a child between 9 and 13 years old (Bermúdez de Castro & Sáenz de Buruaga 1999).

Los Moros de Gabasa (Ribagorza, Huesca): Level E (dated to 46,500 +4,400/-2,200 BP (GrN-12809)), level F (dating to >51,900 BP (OxA-5674)) and level G have provided Neanderthal remains. The remains are thought to be of three individuals, two adults and one juvenile. They consist of three teeth, a first right metatarsal, the first phalanx of the left foot, and an incomplete clavicle (Lorenzo & Montes 2001; Montes *et al* 2001; Utrilla *et al* 2010).

Valdegoba (Huérmeces, Burgos): The site has yielded two fragments of an incomplete jaw (VB1, Level 5), ten milk teeth (VB2, level 6), two metatarsals (VB4 in level 6 and VB5 in level 8), and an incomplete anterior proximal phalanx (VB 3, level 5). The fragments of the jaw belong to a teenager and the ten teeth to a child. The other remains have been identified as those of one juvenile and two adults. The dating from one bone from Level 5 by 14C (with ultrafiltration) is 48,400 ± 3,300 BP (Quam *et al* 2001; Díez *et al* 2014).

CENTRAL REGION

Los Casares (Riba de Saelices, Guadalajara): In level XII (stratum C3) a metacarpal of the right hand of an adult Neanderthal, probably female, was found (Basabe 1973b).

Cueva del Camino (Pinilla del Valle, Madrid): In 1982 and 1984 two teeth (M1 and M3), belonging to the same individual, were discovered in level 5. This level has been dated with TL dates of 90.9 ± 7.8 and 91.6 ± 8.1 ky BP. The Neanderthal remains are associated with remains of Pleistocene fauna, probably deposited by carnivores. The lithic industry found at this site is the result of it entering the cave via natural processes (Baquedano *et al* 2014).

Cueva de la Buena Pinta (Pinilla del Valle, Madrid): Two Neanderthal teeth have been found at this site in level 3, TL dated to 63.4 ± 5.5 ky BP. These teeth belong to one individual. Like the Camino Cave, hyenas used the cavity as a den, but in this cave evidence of human activity has been detected based on the presence of lithic artefacts (Huguet *et al* 2010; Baquedano *et al* 2014).

Jarama VI: A fragment of a left first metatarsal from an adult individual was discovered in the 1990s in level 2 at the site. It was associated with a Mousterian lithic assemblage, a small hearth with charcoal, burnt bones, and Pleistocene fauna remains with dating value of 47,000 and >50,200 BP, 49,400 ± 3,700 BP. The surface shows signs of the action of carnivores (depressions and grooves) (Lorenzo *et al* 2012; Wood *et al* 2013; Jordá *et al* 2014).

EASTERN REGION

Mollet I (Serinyà, Girona): A human molar (first molar M1 upper right) of large size and archaic features was identified during the cleaning and classification of the fauna during the 1972 campaign. The fossil comes from level 5 with an approximate U-Th dating age of 215 ky BP and is associated with some quartz lithic remains and abundant fauna contributed by carnivores. The tooth is a premolar of a juvenile (Maroto 2014).

Banyoles (Girona): A mandible was discovered in a travertine block from a quarry in 1887 by P. Alsius without archaeological context (Hernández-Pacheco & Obermaier 1915). The travertine in which it was found has been dated to 45,000 ± 4,000 BP (Julià & Bischoff 1991). The last dating from an enamel fragment removed from a molar of the mandible was carried out by ESR, and the U-series gave a date of 66,000 ± 7,000 BP (Grün *et al* 2006). It has been assigned to an adult female (Maroto 1993).

Cova del Gegant (Sitges, Barcelona): Three Neanderthal remains were recovered from this site. A survey in 1952 discovered an incomplete mandible composed of three fragments (Gegant-1). The fossil has been dated directly using U-Th dating and resulted in a date of 52.3 ± 2.3 ky BP. The sediment (GL1) from the location where the mandible was discovered has been dated to between 49.4 ± 1.8 and 60.3 ± 3.8 ky BP. The mandible has been assigned to a juvenile. A permanent lower side incisor (Gegant-2), also from GL1, was assigned to a child, and a germ of an incisor (Gegant-3) from GL2 was assigned to another child. These remains are associated with the Mousterian techno-complex and associated fauna (Daura *et al* 2005, 2010; Daura & Sanz 2014).

Teixoneres (Moià, Barcelona): a lower canine and a fragment of parietal bone pertaining to an individual of 7 to 9 years old were documented in the Mousterian Unit IIIb (Rosell com.pers.)

La Cova de Dalt del Tossal de la Font (Vilafamés, Castellón): Three human remains were recovered in the section of the old level E, actually unit IIa. These remains are: a distal fragment from a left humerus, a fragment of a right coxal, and a tooth fragment. The tooth fragment corresponds to a maxilar molar from a child. The U-Th dates from the top of Unit IIa are: 61,846 ± 585 and 56,014 ± 484 BP (Ollé *et al* 2014).

Bolomor (Tavernes de Valldigna, Valencia): Several Neanderthal remains have been documented in this cavity, including three teeth (HCB 02 from level IV (corresponding to a child), HCB 04 from level I sub (very similar to modern humans), and HCB 03 (corresponding to a child) recovered from the sediment modified by quarry work). Also found were a fibular shaft (HCB 01) (probably from an adult) in level III and two fragments of parietal bones (HCB 06 and HCB 07; both parietals were recovered from the

sediment modified by quarry work, but HCB 07 had carbonated sediment from level VI). The dating of level II by TL is 121,000 ± 18,000 BP and Level VI dates to around 130 ky BP. Another tooth was recovered in level XIII and it is thought this might be attributed to the *Homo heidelbergensis-Homo neanderthalensis* lineage (Fernández *et al* 2014).

Cova Foradá (Oliva, Valencia): In level 28 and charts C-14 and C15 in different campaigns (2000 and 2010), several Neanderthal remains were found. A piece of jawbone and a piece of skull were discovered in the 2000 campaign. The pieces match two individuals: an adult and a child. In the 2010 campaign the upper part of a skeleton (skull to the first sacral vertebra rose) belonging to an adult in anatomical connection were excavated (Aparicio 2014; Aparicio *et al* 2014).

Cova Negra (Xativa, Valencia): Several Neanderthal remains have been found at this site, but many are lacking a clear stratigraphic context. According to Villaverde *et al* (2014), the human remains comprise cranial fragments (n=14), teeth (n=7), a jaw, a radius, a fibula, and two metatarsals. They correspond to a minimum number of seven individuals: two adults, a teenager, and four children. Regarding the archaeological context, all of the remains could fall between OIS 6 and 3.

El Salt (Alcoi, Alicante): Six teeth remains were discovered by B. Galván in 1987: I1 right, P3 right, P4 right, M1 right, M2 right, and third right molar remains located in the same square - C11, at the base of SU V lower in a Middle Paleolithic archaeological context. These remains have been attributed to an adult Neanderthal and its chronology falls between 47,200 ± 4,400 BP (base of SU V lower) and 45,200 ± 3,400 BP (roof SU V lower) (Galván *et al* 2014; Garralda *et al* 2014).

Sima de las Palomas del Cabezo Gordo (Torre Pacheco, Murcia): Three Neanderthal partial skeletons in anatomical connection (SP96, SP92, SP97) and associated with Mousterian Palaeolithic artefacts and fauna have been documented in this cavity. SP6's skeleton is about 85% complete and is attributed to an adult female, SP92 is an adult, and SP97 a child. Other remains were discovered, e.g., miners sieving rubble found three mandibles and other remains were found in new excavations, such as mandibular fragments of a baby, a child, and an adolescent female. A total of nine Neanderthals are

represented at the site. The dating of these remains corresponds to a period of about 50,000 years ago (Walker *et al* 2008, 2014).

WESTERN REGION

Figueira Brava (Sesimbra): A tooth (P4 left**)** attributed to a Neanderthal adult was discovered in level C.2. However, the taphonomic processes of the context in which it appeared remain to be resolved (Antunes *et al* 2000).

Columbeira (Bombarrral): A Neanderthal tooth (M1 lower left) was found at the top of level C.9, associated with Mousterian Palaeolithic artefacts and fauna remains. This has been assigned to a child (Antunes *et al* 2000).

Salemas (Ponte de Lusa): A tooth (M1) assigned to a Neanderthal child around six years old was documented in a lower level (4) associated with a small and atypical Mousterian assemblage (Antunes *et al* 2000).

Gruta da Oliveira (Almonda): Four fragmentary Neanderthal remains were documented in the Middle Palaeolithic levels of this site: a manual phalanx and an ulna from levels 9 and 10, as well as a humerus and tibia from levels 18 and 19. The first two remains date to 39,000 BP (43,500 cal BP) by radiocarbon. The tibial diaphysis shows evidence of carnivore gnawing (Trinkaus *et al* 2007).

SOUTHERN REGION

Carigüela (Píñar, Granada): Several Neanderthal remains associated with Middle Palaeolithic levels were discovered at this site. Píñar 1-2 (parietal fragments) were found in chamber 3 and Píñar 3 (frontal) was found in chamber 2. Píñar 1-2 are likely from two adults and Píñar 3 is from a child (García 1960; De Lumley & García 1971). Six teeth (Píñar 7) were found in level 4 of chamber 1. These teeth were also assigned to a child (García *et al* 1994).

Horá (Darro, Granada): A frontal bone from level III associated with a typical Mousterian lithic horizon was discovered in 1956. This was assigned to an adult, probably a female (Haber 2002).

Zafarraya (Alcaucín, Málaga): A total of nine Neanderthal individuals have been documented in this cavity associated with the Mousterian Palaeolithic assemblage and Pleistocene fauna, dating between 38,700 and 49,300 BP. Anatomically, the fossils include cranial elements: two mandibles and five teeth; upper limbs: one scapula, one humerus; lower limbs: three femurs, one tibia, one coxis, and one foot phalanx; thorax: one rib. These remains were assigned to seven adults, two to children, and one was undetermined (Barroso 2003, Barroso *et al* 2014).

Forbes Quarry (Gibraltar): In 1884 a human skull was discovered at the Forbes Quarry, located in the north face of Gibraltar, without archaeological context. This skull is called Gibraltar 1 and has been attributed to an adult female due to its relative slimness in comparison to other Neanderthal skulls (Duckworth 1911, 1912).

Devil's Tower (Gibraltar): In the excavations carried out by Dorothy Garrod in 1925 and 1926, several fragments of Neanderthal fossils were documented within level 4 associated with the Mousterian Palaeolithic assemblage and Pleistocene fauna. These remains include a calotte fragment, fragments of the facial/maxilar area, right temporal, and an almost complete mandible. The reconstruction and reconstruction of these fragments almost form a skull assigned to a child (Garrod *et al* 1928). The only dating undertaken was the 14C method on a sample of charcoal from a hearth in level 3 and resulted in a date of ca. 30,000 BP (Grn-2888) (Vogel & Waterbolk 1964).

Table 2.1. Neanderthal fossils remains of the Iberian Peninsula.

NEANDERTHAL FOSSILS REMAINS OF THE IBERIAN PENINSULA																	
AREA	SITES	NISP	NMI	CRANIAL ELEMENTS	UPPER LIMBS	LOWER LIMBS	ADULT	JUVENILE	CHILD	MALE	FEMALE	UNDET.	LEVEL CONTEXT	ANAT. CONNECTION	ANTR. MARKS	DATING
North	El Sidrón	2.100	13				7	5	1	5	3	5	Sector 2-3	no	yes	14C 48,4 ± 3,2 ky cal BP
	El Esquilleu	1	1	1 tooth					1				XI	no	no	36,500 ± 830 BP
	El Castillo	21	9	6 teeth, 10 cranian remains	phalanx, 4 fragments of vertebrae		3		4			2	18, 20,21,22	no	no	L18: 14C 40 & 45 ky BP; L20: ESR 41 & 49 ky BP; L22: ESR 59 ky BP
	Covalejos	2	2	2 teeth					1			1	J (8)	no	no	TL 38,4 ± 3,9 ky BP
	Axlor	5	1	5 teeth			1					1	III= B-C-D	no	no	LD:14C 42 ± 1,280 ky BP
	Lezetxiki	3	3	2 teeth	1 humerus		1	2					VII, III, IV	no	no	Level III 14C >46,500 & >46,700 BP
	Arrillor	1	1	1 tooth					1				H-Amk	no	no	L Amk: 14C >45,200 and 48,500 ± 3200 BP
	Valdegoba	15	5	2 fragments of jaw, 10 teeth	1 phalanx	2 metatarsals	2	2	1				5, 6, 8	no	no	L5: 14C 48,400 ± 3,300 BP
	Gabasa	6	3	3 teeth	1 clavicle,1 phalanx	1 metatarsal	2	1					e, f,g	no	no	Le:46,5; Lf: >51,9 ky BP
Central	Los Casares	1	1		1 metatacarpal		1				1		XII	no	no	
	Camino	2	1	2 teeth					1		1		5	no	no	TL 90,9 ±7,8 & 91,6 ± 8,1 ky BP
	Buena Pinta	2	1	2 teeth									3	no	no	TL 63,4 ± 5,5 ky BP
	Jarama VI	1	1			1 metatarsal	1						2	no	no	49,4 ± 3,7 ky BP
East	Mollet I	1	1	1 tooth				1				1	5	no	no	U/Th 215 ky BP
	Teixoneres	2	1	1 tooth, 1 fragment parietal					1			1	III b	no	no	
	Banyoles	1	1	1 jaw			1				1		no	no	no	ESR and U-series 66 ± 7 ky BP
	Gegant	3	3	1 jaw, 2 tooth				1	2			3	GL1, GL2	no	no	U/Th 60.3 ± 3.8 & 49.4 ± 1.8 ky BP
	Del Tossal de la Font	3	1	1 tooth	1 fragment of humerus	1 fragment of coxal			1			2	IIa	no	no	U/Th 61,8 ± 585 & 56 ± 484 ky BP
	Bolomor	6	3	2 fragments parietal, 3 teeth		1 fibular shaft	1		2			3	III, IV, VI	no	no	TL 121± 18 ky and 130 ky BP
	Foradá	28	3	1 jaw, 1 piece of skull, 1 skull	25 vertebrae		2		1				28	yes	no	
	Cova Negra	26	7	14 cranial fragments, 7 teeth, 1 jaw	1 radius	fibula, 2 metatarsal	2	1	4				no/ C or D	no	no	OIS 6 - 3
	El Salt	6	1	6 teeth			1			1			SU V	no	no	47,2 ± 4,4 ky BP
	Las Palomas	89	9				2	1	3	2	2		2 f, l, i, e, k	yes	no	54,700 ± 4,700 cal BP
West	Figueira Brava	1	1	1 tooth			1			1			C.2	no	no	30 ky BP
	Columbeira	1	1	1 tooth					1	1			C.9	no	no	
	Salemas	1	1	1 tooth					1	1			4	no	no	
	Oliveira	4			1 phalanx, 1 humerus, 1 ulna	1 tibia							9,10,18,19	no	no	39 ky BP
South	Carigüela	3	3	2 parietal, 1 frontal			2		1				Camera 3; Camera 2	no	no	
	Horá	1	1	1 frontal			1				1		3	no	no	
	Zafarraya	11	9											no	yes	between 38,7 & 49,3 ky BP
	Las Palomas Teba	1	1			1 fragment of tibia	1			1			8 or 9	no	no	
	Forbes Quarry	1	1	1 skull			1				1		no	no	no	50,000 BP
	Devil´s Tower	5	1	5 fragmnets of skull					1			1	4	no	no	Level 3 > 30,000 BP
TOTAL	33	2.354	91				33	14	28	12	10	20		2	2	

2.4. THE MOUSTERIAN VARIABILITY DEBATE

Technological variability is a central theme when studying Mousterian assemblages, with the Middle Palaeolithic usually regarded as a period of technological monotony as opposed to the Upper Paleolithic, which is often viewed as highly dynamic (De la Torre *et al* 2013). The idea of low variability has been one of the arguments in the debate about the adaptive capacity of the Neanderthals. Some authors have argued that this reflects a lack of foresight, planning and adaptation to changing environmental conditions (Kuhn 1995; Mithen 1999, Noble & Davidson 1993). This apparent uniformity of the Mousterian in Europe could, however, be due to insufficient attention having been paid to the processes of production and the typological simplification by Bordes (Bordes 1961).

What is meant by variability? Technological variability is defined as the variation in the forms of organization technology, understood as the selection and integration of strategies for making, using, transporting and abandoning tools and materials needed for manufacturing and maintenance (Nelson 1991).

Many of the statistical differences observable when analysing variability in Middle Palaeolithic assemblages can be explained by contextual circumstances that fragment and scatter the chain of manufacture or use. The homogeneity in the assemblages is further accentuated if we focus on the most significant features of production (Baena *et al* 2006).

The degree of variability within the Mousterian is limited by:

1. The operational schemes available.
2. The typological production derived from them.

From a technological point of view, the concept of variability can be understood from the following perspectives (Geneste 1991, Delagnes 1995):

1. Structural variations: Levallois, Quina, Discoid systems.
2. Variations resulting from specific solutions: Levallois recurrent centripetal, unifacial discoid, kombewas, etc.
3. Circumstantial variations:
   i. External: lack or quality of raw material, manufacturing urgency.
   ii. Internal: learning processes, technical skills (Baena 1998, *et al* 2006)

A number of models have been put forward to explain Mousterian variability: the typology of Bordes (Bordes 1961) and cultural interpretation (Bordes y Sonneville 1970; Bordes 1973); the functional models (Binford 1973); the tool-reduction and lithic economy models (Dibble 1988; Dibble and Rolland 1992); the climatic model (Rolland 1981); ecological factors in technological behaviour (Kuhn 1995); and diachronic factors (Mellars 1969, 1970, 1988a).

The Typological and Cultural models

Bordes (1961) defined the typology for the Lower and Middle Palaeolithic during the end of the 1940s and the 1950s in order to provide a system to describe and compare lithic assemblages (Bordes 1953, 1961, 1968, 1973). Regarding Mousterian variability he defined it using two criteria:

1. Typological criteria: depending on the percentages of different types of tools, predominantly sidescrapers and denticulates. This methodology was embodied in his "liste typologique", consisting of 63 types. A large part of this typology was made up of 21 sidescraper variants.
2. Technological criteria: depending on the frequencies of Levallois products, blades and facetted striking platforms.

Using these criteria, Bordes (1961) analysed the lithic assemblages from rock-shelters and caves of the southwest of France and from the loess and terraces of the north of France, and divided the Mousterian lithic assemblages into five groups:

1. *Charentian Quina Mousterian:* characterised by a high proportion of sidescrapers and a dominance of non-Levallois techniques, together with the presence of short and thick flakes and tools with stepped retouch.

2. *Charentian Ferrassie Mousterian:* characterised by high proportions of sidescrapers and points, in addition to the dominance of Levallois techniques.

3. *Denticulate Mousterian:* characterised by a high proportion of denticulates (with or without a Levallois method) and few sidescrapers.

4. *Typical Mousterian:* no type predominates in these assemblages.

5. *Mousterian of Acheulian Tradition:* characterised by the presence of small cordiforms and triangular handaxes, together with artefacts on flakes.

Bordes concluded that each type of Mousterian represented the remains of a different group of culturally differentiated people (or different Neanderthal "tribes"), which coexisted in the same areas but did not influence each other to any considerable extent. In addition Bordes talked about regional variations in the lithic assemblages, differentiating the following groups: Vasconiense, Asinipodiense (Bordes 1981) and Pontiniense (Taschini 1979).

Functional variability

This model, put forward by Binford & Binford (1966, 1969), and Binford (1973), proposes that the variability can be explained in functional terms resulting from different activities by the different uses of an archaeological site. A site may have had different functions for particular human groups, such as hunting stations, a workshop, or a campsite, with each function having different requirements and probably different types of tools.

On the other hand Binford & Binford (1966) criticized Bordes´ model, affirming that the different Mousterian facies appear inter-stratified in many archaeological sites so that the branched evolution of facies is worthless. Although Binford continued using the typology of Bordes, he performed a factor analysis of the artifacts, grouping them into 5 groups or factors, each of which had a different function: cut, drill, burn bone and wood, hunting and butchering, cutting and preparing food, and handling plants. He concluded that the Mousterian variability reflects the varying character of the activities carried out in the different sites.

The tool-reduction models and lithic economy

Jelinek (1976) defined this model when explaining Mousterian variability through the concept of the "Frison effect". George Frison (1968) described the process by which the morphology of artefacts is continuously modified from their initial form to that which we find in the archaeological record, due to continued reduction and use. Subsequently, Rolland and Dibble (1990, 1992) suggested that the majority of tool types do not correspond to mental templates. As such, they were never conceived from the outset as discrete separate forms, and only attained the form in which they are encountered as a result of a process of reworking and sharpening. The types of scrapers that Bordes proposed are different only because they correspond to different stages of the reduction sequence.

This model suggests that Mousterian variability reflects a difference in the intensity of use of lithic resources; therefore lithic assemblages with many tools and a high presence of sidescrapers could indicate a high intensity of use and, consequently, lithic assemblages with few tools and a low presence of sidescrapers would in turn suggest a low intensity of use. In addition "reduction models" have emphasised the significance of behavioural patterns, especially settlement strategies, for explaining inter-assemblage variability:

1. Types of sites, according to the length of occupation (short-term vs. long-term) and function (residential vs. non-residential).
2. Transport strategies:
    - According to Geneste (1988, 1989), two kinds of artefacts can be differentiated, those commonly transported by humans (sidescrapers), and those that tend to remain within the sites (denticulates).
    - According to S. Kuhn (1995), there are two provisioning strategies:
        1. *Provisioning individuals:* artefacts commonly on hand (personal gear). These artefacts have specific characteristics; predetermined reduction strategies would therefore be more appropriate.

        2. *Provisioning of places:* to supply the places where tools are likely to be needed with the appropriate raw materials or implements. Reduction strategies will be directed to produce as many flakes as possible, regardless of their shape or size.

The climate model

Rolland (1981) intended to address two aspects of Mousterian variability and for this reason asked the following questions:

1. Why do some assemblages have many scrapers and others many denticulates?
2. Why are some assemblages dominated by retouched pieces but others are not?

When addressing the dichotomy between lithic assemblages with high frequencies of scrapers but few denticulates, and vice versa, Rolland (1981) proposed a climatic model to account for this variability.

He suggested that during cold periods, the availability of raw material was limited for Neanderthals and they therefore had to reshape flakes repeatedly until they were completely exhausted, resulting in lithic assemblages with a predominance of scrapers. During warmer periods, an increase in tree cover results in an increase in demand for tools adapted to the processing of vegetation, and, as such, more notches and denticulates are required, as these are associated with woodworking activities such as scraping, sawing and grooving. He went further by relating Mousterian variability with the convergence of the other factors, such as the availability of raw materials, settlement patterns, the duration of site occupation, and subsistence strategies, all of which are conditioned by climate (Rolland 1990,1996).

The technological model

Kuhn (1991, 1992, 1995) suggested that typological variability may be related to technological variability, and that Mousterian variability is only possible to understand once the particular technology and different core reduction strategies employed by Neanderthals in different situations are known.

Stiner and Kuhn (1992) analysed the lithic variability caused by different core reduction strategies combined with the faunal assemblages from four Middle Palaeolithic sites in the

Latium area (Italy). They concluded that prior to 55,000 BP, during the early Mousterian, the faunal assemblages strongly resembled those produced by scavengers, with the human occupants practising centripetal core reduction with high levels of retouch. After 55,000 BP, ungulates were ambush hunted, and lithic assemblages appeared with the platform core reduction method used to make the blanks, with a low level of retouch. There appeared to be less residential mobility, with no need to preserve raw materials, seemingly because the resources were predictable, therefore resulting in less retouch and reworking of stone tools.

Kuhn (1995) links raw material availability and use, mobility along the territory and technology strategies to understand Mousterian variability. As mentioned above, Kuhn suggests two main technological provisioning strategies - "provisioning of people" and "provisioning of places" - and argues that these depend on the extent of residential mobility. In addition, he aimed to distinguish two kinds of residential mobility depending on the distance to raw materials:

1. Low residential mobility when the raw materials are far away.
2. High mobility when the raw materials are nearby. He also notes that when mobility increases, duration of occupation decreases.

The "provisioning of people" strategy occurs when an individual person or group carries their tool kits, seeing an increase in this strategy when residential mobility also increases. The "provisioning of places" occurs when an individual person or group is involved in provisioning particular places in the landscape with raw materials, this strategy increasing when residential mobility decreases. Kuhn therefore suggests that all of these factors influence Mousterian variability.

The chronological model

Mellars (1988a, 1992) proposed the existence of a distinct chronological sequence for three of the five Mousterian facies of Bordes within southwestern France: Ferrassie, Quina, and the Mousterian of Acheulean Tradition. A chronological model rejects the hypothesis that contemporaneous groups of Neanderthals made various assemblages simultaneously. For this reason, Mellars (1970) argues against Binford´s functional model, without, in turn, rejecting the idea that some of the Mousterian variability may be due to differences in site use.

Today it is readily accepted that Middle Palaeolithic variability is more associated with behavioural and economic factors, but this hardly allows us to define chronocultural entities. In addition, current lithic technology studies tend to focus more on understanding the methods of knapping and the *chaîne opératoire* than on the typologies of tools. Mousterian variability cannot be explained in terms of a single factor, rather there are multiple causes that influence the development of the technical behaviour (subsistence, raw materials, environment). The cultural, functional, chronological, reduction, climatic and technological models, although different in terms of explaining Mousterian variability, were not strictly opposed, but rather complementary, to each other. Therefore, variability should be interpreted as the result of different adaptations by Neanderthals in their environmental context.

The Mousterian variability debate in the Iberian Peninsula

The model, as proposed by Bordes (1953, 1961) concerning cultural evolution, was the predominant school of thought for Spanish researchers during the late 1960s.

There are different interpretations of the term Mousterian: a culture, a complex with stratigraphic value (Utrilla and Montes 1993), and a technocomplex characterized techno-typologically. Some authors, however, such as Carbonell and Mora (1985) believe that this term holds no value in really defining anything, other than describing the lithic assemblages from Le Moustier in France, and referring to the chrono-complex of the Middle Palaeolithic. Lithic analyses during the 1980s could not clearly distinguish assemblages from the Lower and the Middle Palaeolithic. There were no absolute dating systems for these chronologies and references to the Alpine system were subjective as there were no reliable biogeographic sequences.

The facies or Mousterian Types would be conventional separations, only of descriptive value, with no real meaning of chronology (Vega Toscano 1983). The subjectivity in its classification and the mathematical comparison of the cumulative graphs responded only to personal preconceptions. But despite this, many researchers were still looking for these French references, instead of testing the hypotheses from a regional perspective.

In the north, within the Cantabrian region, there was no coherence in the facies between sites, with the following typologies being identified: Denticulate Mousterian; Charentian; Quina; and a Mousterian rich in scrapers. Also, within the northeast of Catalonia there was no homogeneity, where a Typical Mousterian with Charentian aspect predominated. In the east there was a presence of Quina, Ferrassie, Typical Mousterian, and Mousterian of Acheulean tradition facies, with Quina, denticulate and the Acheulean tradition facies present within the Murcia area (Montes 1984). In the south the Typical Mousterian predominated in most of the sites and in some of the Charentian and the Acheulean tradition facies.

BORDES MOUSTERIAN GROUPS IN THE IBERIAN PENINSULA SITES							
	SITE	Quina	Ferrassie	Typical Mousterian	Denticulate	MTA	Vasconian
NORTH	Lezetxiki	IV		VII-V			V-VI
	Axlor						
	Amalda			VII			
	Abauntz						
	Gatzarría						
	El Esquilleu						
	Morin	12		17a-17b1,16-13	17b2, 11-5		13/14,15-17
	La Flecha						
	El Castillo	Beta 22					Alfa 20
	Covalejos						
	El Pendo	5		12-jun	4		XIII
	Hornos de la Peña						
	La Viña	XIV					
	La Cuevona						
	El Conde				6		
NORTH-EAST	Els Ermitons						
	L`Arbreda						
	Romaní						
	Mollet						
	Eudoviges						
	Peña Miel						
	Castellón del Plá						
	Fuente de San Cristobal						
	Moros de Gabasa						
CENTRAL	La Ermita						
	Millán						
	Valdegoba						
	Los Casares						
EAST	Pechina						
	Beneito						
	El Salt						
	Cova del Corb						
	Cova Negra	Vii-VII; XIV-IX		VI-I; XI		V	
WEST	Columbeira						
	Figueira Brava						
SOUTH	Zafarraya						
	Carihuela			XII-XI,VII -VI	V		
	Horá						
	Las Grajas						
	Los Murciélagos						
	Bajondillo						
	Devil´s Tower						
	Gorham			K,M Area I,II,III	G		
	Zájara I						
	Perneras						

Table 2.2. Bordes Mousterian Groups in the Iberian Peninsula. Sources. Baldeón (1993, 1999); Butzer (1981); Cabrera (1984); Estévez & Vila (2006); Freeman (1966), Ripoll & De Lumley (1965); Vega Toscano (2003); Villaverde (1984).

The heterogeneity of records, lack of dating, and few well-studied archaeological sequences did not allow the creation of a unified sequence, nor a coherent geographical distribution.

Nevertheless, during the 1980s some researchers began to publish works arguing that the facies were not applicable generically to the regions studied (Montes 1998, Barandiarán & Montes 1991-1992). Some researchers concluded that Spanish Mousterian variability was based on a dichotomy between assemblages with scrapers and assemblages with denticulates (Vega Toscano 1983, Utrilla & Montes 1987), and the Levallois technique would be of secondary importance. Examples of these works were carried out on the Ebro basin (Montes, 1988), the synthesis of the Cantabrian region by Altuna (1992), and Barton´s thesis (1988) on the analysis of covariances at several sites in the southeast of the Iberia Peninsula, as well as the works of Freeman, Cabrera and Neira (1994). They concluded that the Mousterian facies did not exist and that variability could be explained in terms of the proportions of denticulates versus scrapers.

At present, typological characterization for understanding the Middle Palaeolithic is avoided, as is research carried out by the Logical Analytical System (Carbonell *et al* 1985), with general studies ignoring the traditional approach or taking the typological ascription as an added qualifier.

In order to better understand Neanderthal technological behaviour, we need to go beyond merely focusing on understanding the *chaîne opératoire*, the production processes and the analysis of manufacture traces and use. More regional analyses must be carried out, taking into account the availability and quality of raw materials, climatic aspects, group mobility, functionality and duration of the occupation, as all these factors are interrelated, coupled with a well framed chronological framework, tested by a reliable method of dating, which would result in a much more accurate interpretation of Neanderthal technological behaviour. The aim of this thesis is therefore to continue this line of enquiry, studying the operational sequences and conducting a morpho-technical analysis of the lithic assemblages selected, in order to identify and compare the Mousterian variability within two regions of the Iberian Peninsula – the Cantabrian and Betic regions – within an ecological and climatic context.

2.5. IBERIA PALEAOENVIRONMENTAL FRAMEWORK DURING UPPER PLEISTOCENE

The study of Palaeolithic hunter-gatherers` adaptations to climate change is essential to better understand their lifestyles and behaviours. Investigating the relationship between climate evolution and the history of human populations is a challenging task. However, recent advances in palaeoclimatology, using a plethora of indicators, such as ice and sediment cores, are able to produce much more precise palaeoclimatic reconstructions. The use of Marine Isotope Stages based on variation in oxygen isotopes provides the greatest and most detailed data. This timescale, derived from pollen and foraminifera deposits in marine sediment cores, provides details of the alternating warm and cool periods in the Earth´s palaeoclimate (Emiliani 1955, Shackleton 2002) and is commonly used to date climatic changes in the Quaternary period.

In the Upper Pleistocene, from 126,000 to 11,700 BP (Gibbard & Head 2009, Walker *et al* 2009), there are five distinct stages (MIS 5, 4,3,2,1), which were dominated by glacial (Early 115-58.5 ka; Middle 58.5-24ka and Late 24-11.7 Ka) and interglacial periods (Eemian (126-118 ka). Additional events occur within this period; Dansgaard-Oeschger events, which are a series of rapid cold-warm air temperature oscillations (Dansgaard *et al* 1993); and Heinrich events, which mark large iceberg discharges in the North Atlantic Ocean during the last glacial (Heinrich 1988). These events had a notable effect on sea surface temperatures (SSTs) and atmospheric circulation patterns, affecting the vegetation and wildlife of the Iberian Peninsula during its Neanderthal occupation.

MIS 5: This stage, spanning from 126 to 75 ka BP, has been divided into five sub-phases (a-e). MIS 5e (126-118 ka BP) is known as the “Eemian”. The conditions during this stage were very mild and similar to current climate conditions in terms of temperatures and sea levels. The rest of MIS 5 (118-75 ka BP), sub-phases (a-d) represents alternating colder and warmer periods.

MIS 4: This stage, spanning from 74 to 60 ka BP, was a very cold and severe phase of the last glacial. Even in southern Europe the temperatures fell between 8°and 10° C, resulting in an open and dry steppic environment. The north of Europe was covered by glaciers and likely uninhabitable during this stage. It was characterized by the alternation of rapid and

abrupt climatic events, both cold and warm (oscillations of Dansgaard-Oeschger), which allowed thermophilic vegetation to expand from refuges.

MIS 3: This stage, spanning from 60 to 25 ka BP, was an oscillatory phase with often fairly short-lived climatic changes. The interstadials of MIS3 were mild and humid, however the Heinrich events increased during this stage, with a total of five taking place: HE6 (62.6-59 ka BP), HE5 (48.8-47.5 ka BP), HE4 (40.5-39.2 ka BP), HE3 (39.2-30.2 ka BP), HE2 (25-24 ka BP). During the alternating climate changes, Mediterranean species expanded during warm phases and contracted during cold phases. It was during this stage that the Neanderthals became extinct, with several authors (Finlayson 1999, Van Andel & Davies 2003, d´Errico & Sánchez Goñi 2003, Finlayson, 2004, Finlayson & Carrión 2007) concluding that the rapid and abrupt climatic changes could have been the cause of their extinction.

The International Marine Global Change Study Project has carried out several oceanographic studies and recovered large amount of pollen grains and spores from marine sediments, providing a wealth of palaeoclimatic information for the Iberian Peninsula. Summaries of their published data for each region are presented below (Sánchez Goñi *et al* 1999, 2000a, b, 2002; d´Errico & Sánchez Goñi 2003; Sánchez Goñi & d´Errico 2005).

North Region

Data are derived from the following cores: Atlantic Ocean Cores: MD99-2331 (NW) and MD95-2039.

MIS 5e (126-110 ka BP): This period was characterized by a warm climate, with an expansion of open forest of juniper (*Juniperus*), birch (*Betula*), oak (*Quercus* deciduous) and hornbeam (*Carpinus betulus*). Both the coastline and sea surface temperatures were similar to present day. Furthermore, the mean annual rainfall increased from 600mm to 1000mm, almost matching present day values.

MIS 5a, b, c, d (110-74 ka BP): This stage was characterized by four cold phases, with steppe components (grasses and ericaceae), alternating with warm phases, which allowed

the expansion of open forest (oak and hornbeam). The temperature dropped to 0°C during its coldest month with the mean annual rainfall dropping to 400mm.

MIS 4 (74-60 ka BP): The onset of MIS 4 corresponded with the Early Glacial Maximum, during which the maximum extension of the polar ice caps took place and the sea level dropped, with sea temperatures dropping 10°C below present day. Throughout the Cantabrian region the vegetation was dominated by steppe species, with small refuge pockets of oak, which were consistently present in the pollen record.

MIS 3 (60-24 ka BP): Dominated by Heinrich events, with cold phases characterized by a dominance of open species, such as grasses and ericaceae, such as was the case during MIS 5 and 4, while warm periods saw the expansion of oak, pine and other thermophilic vegetation.

South Region

Data are derived from the following cores: Atlantic Ocean Core MD95-2042 (SW Iberian Peninsula) and Alboran Sea core MD95-2043 (SE).

MIS 5e (126-110 ka BP): This period was characterized by interglacial conditions, with temperate woodland (deciduous *Quercus, Carpinus betulus, Alnus, Betula, Abies, Ulmus, Fraxinus* and *Acer*), grasses, and Mediterranean woodland (*Olea, Pistacia, Cistus* and envergreen *Quecus*) predominating.

MIS 5a,b,c,d (110-74 ka BP): Cooler and drier climatic conditions saw the disappearance of most Mediterranean species, with only evergreen *Quercus* existing alongside an increase in steppe species. These cold phases alternated with warm phases, during which Mediterranean species would recover and increase once again.

MIS 4 (74-60 ka BP): A decrease in both temperatures and rainfall gave way to a decrease in Mediterranean species and an increase in steppe species throughout this region. However, four climate oscillations with warm intervals occurred during this period, which saw the expansion of Mediterranean species and the contraction of steppe species.

MIS 3 (50-24 ka BP)**:** During the Heinrich events 5,4 and 3, the annual rainfall decreased to 400mm with SSTs 6° to 13° C lower than present day. This produced cold and arid phases causing steppe vegetation, such as *Artemisia, Chenopodiaceae* and *Ephedra,* to spread and descend from the Supra-Mediterranean belts. During the warmer phases, both the annual rainfall and sea temperatures indicate that the climate was similar to that of present day, with the expansion of Mediterranean species.

2.6. THE GEOGRAPHIC AND GEOLOGICAL FRAMEWORK OF THE IBERIAN PENINSULA

To understand the biocenosis of the Iberian Peninsula, it is necessary to know the geographical and geological context that conditioned the different biotopes to coexist, using geographical, geological and morphogenetic data. Although many publications have been published on this subject, I have focused on the works of Hernández Pacheco (1932); Vilá Valentí (1968); Terán *et al* (1987); and Meléndez (2004) to compose this framework.

The Iberian Peninsula is located in the south-west of Europe, between latitude 40º N and longitude 4º W. It is surrounded on the east by the Mediterranean Sea and by the Atlantic Ocean to the west, joined to the rest of the continent by the Pyrenees to the northeast and separated from the African continent by the Strait of Gibraltar to the south. It has an area of approximately 583,254 km^2, forming a large quadrilateral, with a north-south extension of approximately 850 km and of west-east an average of 840 km.

Situated between two seas and two continents, the Iberian Peninsula can be characterised as a bridge or *cul de sac*. It has great geographical diversity, with strong contrasts in vegetation and soil components, as well as climates, and physical relief. The average altitude is 600m due to the large extension of the Central Plateau, with mountain ranges having a peripheral arrangement, with the exception of the Central Mountains System, which forms a mountain belt that surrounds it. This has a significant effect on the climate of the peninsula, as these outlying mountains hinder the movement of humid maritime air inland. Only the Ebro and Guadalquivir Valleys facilitate the movement of humid air masses from the coastline inland.

Geology

The Iberian Peninsula can be divided into three distinct zones, based on the lithic division criteria described by Hernández Pacheco (1932): 1. The siliceous; 2. The limestone; and 3. The clayey.

1. **The siliceous:** corresponds with areas of the peninsula with an abundance of quartz and eruptive formations such as granite, as well as metamorphic formations such as gneiss, quartzite, metamorphic slates, and marbles. Sedimentary material includes greywackes, sandstones, and shale, although in lesser quantities. This area corresponds to the old Iberia, with the presence of Palaeozoic and Precambrian materials.

2. **The limestone:** corresponds with areas where sedimentary formations are exclusively found, the majority of marine origin. The most abundant materials are Triassic to Eocene limestones, followed by conglomerates, sandstones, and marls. The limestone deposits form three large zones within the Peninsula: 1. The Cantabrian Mountain System; 2. The Iberian Mountain System; 3. The Betic Mountain System. The karst areas have an abundance of underground formations (chasms and caves) as well as surface formations (lapiés (karren), sinkholes, poljes), with many of these linked to Neanderthal habitation.

3. **The clayey:** formed by sedimentary materials of both continental and marine origin, with a predominance of margo-clay material with the presence of sedimentary rocks, such as limestone, sandstone, and conglomerate. The Quaternary record within these zones is characterized by alluvial deposits, with the main areas located within the Central Plateau, the Ebro Valley, the Guadalquivir Valley as well as areas of the Tajo and Sado Rivers.

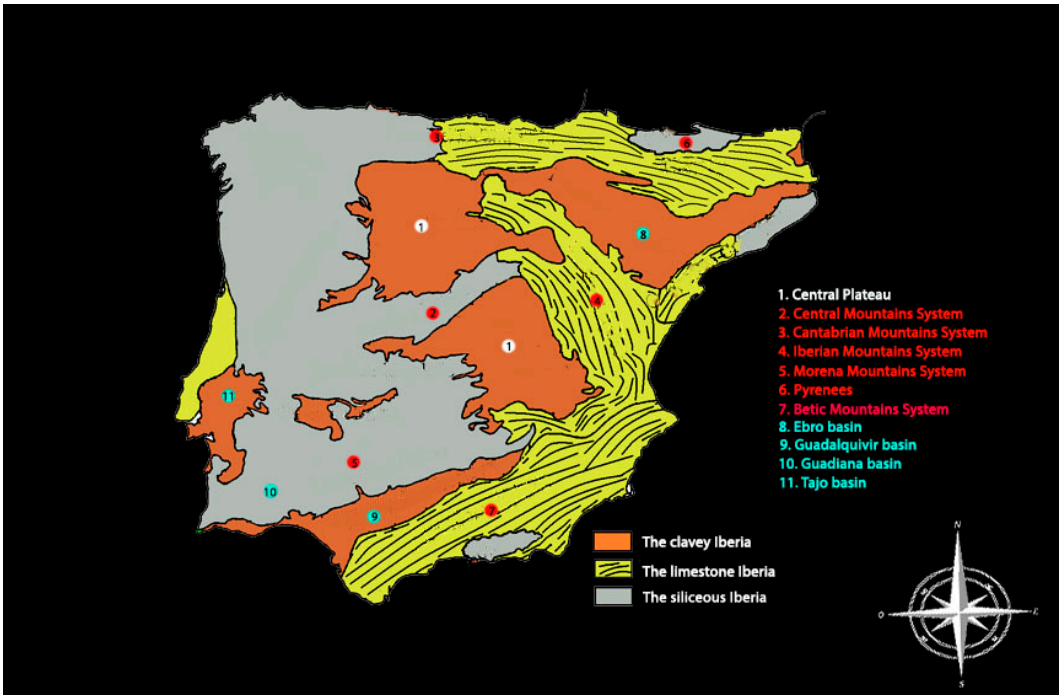


Figure 2.2. Map of lithic division of the Iberian Peninsula

Morphogenetic systems

Both now and in the past, morphogenetic systems modified geological structures in accordance with the characteristics of the prevailing climate. Therefore, during the Quaternary, with its high succession of climatic phases, various morphogenetic systems are also present.

1. **Morphogenetic Glacier System:** A few orographic nuclei within the Iberian Peninsula saw their glacier formations reduced at the highest peaks, for example: the Pyrenees to 1,800m; the Cantabrian Mountains to 1,500m; the Central Mountain System to 2,000 m; and the Betic Mountains to 2,400m. As a result, snow cover and ice tongues were descending towards the base of the mountain to the curve of 800m in the Northern cordilleras; 1,400m in the Central Mountain System; and 1,800m in the Southern Mountain System. These glacial actions have left characteristic forms of erosion, such as cirques and trough valleys, and deposited moraines.

2. **Periglacial System:** Affecting a large region of the Central Plateau and the Ebro Basin, this system resulted in the formation of detrital material –such as angular pebbles and slope deposits; as well as modelling the slopes of mountains.

3. **Arid System:** During interpluvial periods of the Quaternary we see warm and dry phases, evidenced by mantles of runoffs along the periphery of basins and ramps of erosion on mountain slopes. These palaeoshapes are particularly evident in the Ebro Basin and the Central Plateau.

4. **Pluviofluvial system:** In this system we see the areas of large river basins evolve, such as the Ebro, Guadalquivir, Tajo, Duero, and Guadiana. This extensive rainfall also produces exorheic (flow into the sea or ocean) and endorheic (inland flow) movements, creating the fluvial terrace deposits that are subsequently excavated, as well as creating subterranean courses, particularly through limestone, forming caves, upwellings and sinkholes.

5. **Marine System:** The Iberian Peninsula, with a total of 4,100km of shoreline, is almost entirely surrounded by sea, bordered in the west by the Atlantic Ocean, and in the east by the Mediterranean Sea. Both the Atlantic and the Mediterranean are characterized by their own unique combination of water, marine fauna and climate, as well as in their current dynamics, transgressions, tides, salinity, and temperatures. Marine water helps shape the peninsular shoreline, forming natural geographical anomalies such as capes, bays, cliffs, marine caves, marshes, coastal beach ridges, coastal lagoons, and fossil dunes. The system also has a significant in relationship with the biological world, as marine waters provide a rich habitat for a plethora of fauna, present all along the coastline of the Peninsula.



Figure 2.3. The Iberian Peninsula current map and -100 m below present shoreline

The relief (Morphological units)

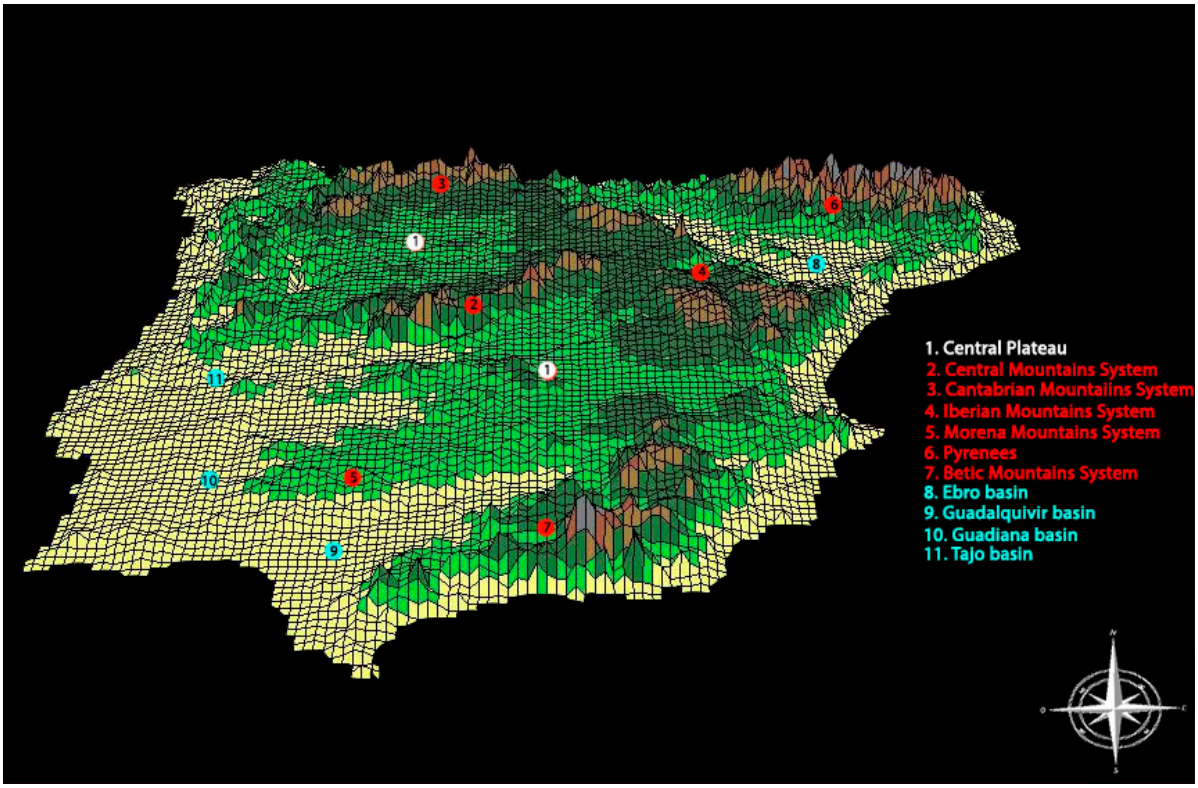


Figure 2. 4. The Iberian Peninsula relief

The Central Plateau

The oldest relief unit within the Iberian Peninsula, it constitutes an extensive high plateau with an area of 210,000 km^2, divided in two distinct regions by the Central Mountain System:

1. Northern Plateau, with an average altitude of 700-800m.
2. Southern Plateau, with an average altitude of 600-700m.

The landform presents a tabular morphology that is highly uniform, with some high moorland, a flat-topped hill, a hill, as well as some depression or fluvial terraces. Granite, gneiss, slates, and quartzites dominate its base, whereas its surface is predominated by clay materials, and its fluvial terraces with pebbles.

Mountain Ranges

-The mountain ranges inside the Central Plateau:

i. **Central Mountain System:** is the morphological unit that divides the Plateau in two parts, and extends from east to west along 700km. Highlights include the Sierras de Gata, Béjar, Gredos (with an altitude of 2,592m), Guadarrama and Ayllon.

ii. **Mountains of Toledo:** located in the centre of the southern Plateau, it spans from east to west with a length of 350km and 100km width. Highlights include the Sierra de Guadalupe (with an altitude of 1,601m).

-The Mountains Ranges surrounding the Plateau:

i. **The Cantabrian Mountain Range:** Forming a narrow corridor between the Cantabrian range to the south, and the Cantabrian Sea to the north, this mountain range extends east-west with a length of 480 km, and width, with a north-south orientation of 100 km. The distance between the present day shoreline and the crest line of the mountain is never more than 50 km wide and the altitude of the

Cordillera is approximately 2,500 m above sea level. Numerous rivers transverse the range, with its general lithology being karstic, and the bedrock limestone. The raw material useful for stone tool manufacturing is generally found as rolled gravels or conglomerates. The area is subdivided into three distinct regions:

1. In the Eastern domain (Basque-Cantabrian area) the highest elevations are found within the southern limb of the anticline of Bilbao, where the highest peak is Castro Valnera with 1,717 m above sea level.
2. In the central domain, the "Asturian Massif" holds the highest elevations, predominantly formed by limestone. The highest peak is Torrecerredo at 2,648 m asl, within the Picos de Europa range. Other notable ranges include Aramo and La Sobia.
3. In the Western (Galician) domain, the mountains progressively vanish. In the northwest of Galicia the tertiary basins are linked to strike-slip faults with a reserve component, which have given rise to some remarkable reliefs. Notable sierras include Ancares and Carel Faro, as well as the mountains that follow the shape of the "Asturian Arch".

ii. **The Iberian Mountains Range:** extends 600 km northwest to southeast, between the Ebro Basin and the Central Plateau. Its geology is complex, with a homogeneous system composed of a series of mountain ranges, massifs, plateaus and depressions. The highest elevations occur in the mountains ranges of the Moncayo (2,313 m), Demanda (San Lorenzo 2,270 m), and Urbion (2,228 m). Given its geographical position, it acts as a watershed between the basin of the Ebro River and the Duero, Tajo, Guadiana, Júcar and Turia Rivers.

iii. **The Morena Mountain Range:** stretching for 450 km from east to west, this range separates the Depression Plateau of the Guadalquivir River. It includes the mountain ranges Aracena, Madrona, and Hornachuelos. Its highest mountain is Bañuela (1,323m), and it consists of materials dating from the primary era (Palaeozoic), particularly slate, quartzite and granite. It geographical position also acts as a watershed between the basins of the Guadalquivir (south) and the Guadiana (north-west) Rivers.

-The Mountain Ranges outside of the Plateau:

i. **The Pyrenees:** separating the Iberian Peninsula from the rest of Europe, this range is located in the extreme northeast of the Peninsula. It extends west-east by 415 km with a width, north-south, of 150 km. Three distinct regions are identified:
   1. *Western or Atlantic*: from the Basque Mountains, with its average elevation gradually increasing west to east.
   2. *Central*: from the Aran Valley to the Somport Pass, the higest peaks being Posets (3,355m), Monte Perdido (3,355m), and Aneto (3,404m).
   3. *Eastern*: the main elevations within this region are the Aragonese Pyrenees and the Albera Massif.

ii. **The Betic Mountain System:** The Betic Cordillera is a group of mountain ranges that extend to the south of the Iberian Peninsula, from the Bay of Cadiz to Alicante. It has a total length of about 600 km. Although this mountain system forms a barrier, it is not continuous, being made up of a series of mountain ranges separated by corridors, which could cause it to lose its sense of continuity. It was these corridors that humans exploited in order to travel from the coastline inland, as well as establishing key communication systems.

The Betic Mountain System is divided into three main zones:

1. *Betic Cordillera*: an interior arch of folding, along the coast, which includes the highlands of Ronda, Almijara, Tejeda, Nevada (3.478 m.a.s.l.), Baza, Gádor, Filabres, and Estancias.

2. *Sub-Betic Cordillera*: an exterior arch of folding, located parallel and to the north of the Betic Cordillera; its highlands include Grazalema, Pandera, Segura, Cazorla (1.830 m.a.s.l.), Sagra, and Espuña (1.579 m.a.s.l.).

3. *Infra-Betic Depression*: a narrow longitudinal depression, located between the Betic and Sub-Betic Cordilleras, and include the Corridor of Boyar, Hoya de Antequera, Granada, Guadix, and Baza.

Depressions

There are three great plains, corresponding to the basins of the Ebro, Guadalquivir and Tajo Rivers. They have a triangular shape and are composed of flat lands and soft materials (Tertiary and Quaternary sediments), related to the clay deposits of the Iberian Peninsula. With regard to the form of relief a tabular landscape predominates, with these became communication routes from the inland to the coast or vice versa by Neanderthal groups.

CHAPTER 3

OBJECTIVES

3.1. HYPOTHESIS TO BE TESTED

This research aims to address the diversity in human behaviour, by assessing differing lithic technical behaviours, subsistence practices, and bioclimatic settlement patterns during the Late Pleistocene, within two climatically and ecologically distinct regions of the Iberian Peninsula – the Cantabrian and Betic regions. The aim is to establish whether the technical, subsistence and settlement patterns of hominid groups of the same species (*Homo neanderthalensis*) changed in respect to varying environmental conditions.

3.2.RESEARCH QUESTIONS

3.2.1 Regarding Neanderthal technical behaviour

1. What can lithic assemblages tell us about the technical behaviour of Neanderthals, within the distinct regions of north and south of the Iberian Peninsula?

2. Are there similarities or differences in the time of development, management, and use of the technical processes?

3. Are technological patterns shared within both regions?

4. Is there technological variability within both regions?

5**.** What is the degree of variability in raw materials used at each site, and in relation to the sites within the two distinct regions? Is it dominated by local or allochthonous raw materials? Are there specific raw materials used for certain types of tools? Could the raw material be the cause of variability within the assemblages themselves, or are the differences or similarities we find in the techniques applied within each region distinct?

3.2.2 Regarding Neanderthal subsistence practices

1. Was the Neanderthal diet diverse? How does the faunal record differ for Neanderthals within both regions, and is this related to differences in their diet?

2. What species of animals were consumed with more quantity and frequency?

3. Did Neanderthals have the ability to hunt small animals? Were they able to hunt and consume birds? Were they able to collect marine resources?

4. Was the subsistence of Neanderthals selective, opportunistic or both, according to the circumstances? Is there any archaeological evidence within both regions of study that would show there was prey selection and could it be interpreted in this way?

5. Is there empirical evidence of consumption of plants by Neanderthals in both regions?

3.2.3. Regarding Neanderthal bioclimatic occupation patterns

1. Is there a difference in Neanderthal settlement patterns between both regions?

2. Is there a preferred pattern of occupation in a specific bioclimatic level?

3. Did Neanderthals occupy an area more intensively because of climatic and ecological factors?

4. What is the degree of intensity of Neanderthal occupation in both regions of study?

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

4. 1. SELECTION OF CHRONOLOGICAL PERIOD, REGIONS, SITES AND ASSEMBLAGES TO STUDY.

My sample for this research is taken from particular archaeological levels found within four sites from each geographically distinct study region, dating to a specific chronological period. From each archaeological site, I aim to re-analyse Mousterian lithic assemblages using a morpho-technical analysis. Published analyses for the rest of the archaeological materials from these sites will be used in the discussion, with all materials presented in a geographical, ecological and climatic context.

4.1.1. Chronological period

The chronological period is Marine Isotope Stage 3, in particular between 60ka to 40ka BP. The reasons why this chronological period has been selected are:

1. Of the 33 sites with Neanderthal remains documented in the Iberian Peninsula, 22 contain Neanderthal remains dated to this period.

2. The majority of sites with stratigraphic sequences and dated Middle Palaeolithic levels documented in the Iberian Peninsula have levels within these chronological dates; there are therefore more sites with levels within this chronology than within other periods inside the Middle Palaeolithic.

3. It is a chronological period in which a significant amount of archaeological materials have been documented through which it is possible study the Neanderthal behaviour.

4. It is the period during which *Homo neanderthalensis* became extinct.

5. The latest dating is listed around 42,000 BP, attributed to some Aurignacian levels in northern Spain and other parts of Europe (Higham *et al* 2014), reopening the debate on whether both species coexisted during this period in certain regions of Europe.

6. The high variability of the climate during this period provides an optimal opportunity to assess whether there is a relationship between climate and Neanderthal adaptation, as well as establishing whether climate could have been an additional cause for the extinction of the Neanderthals.

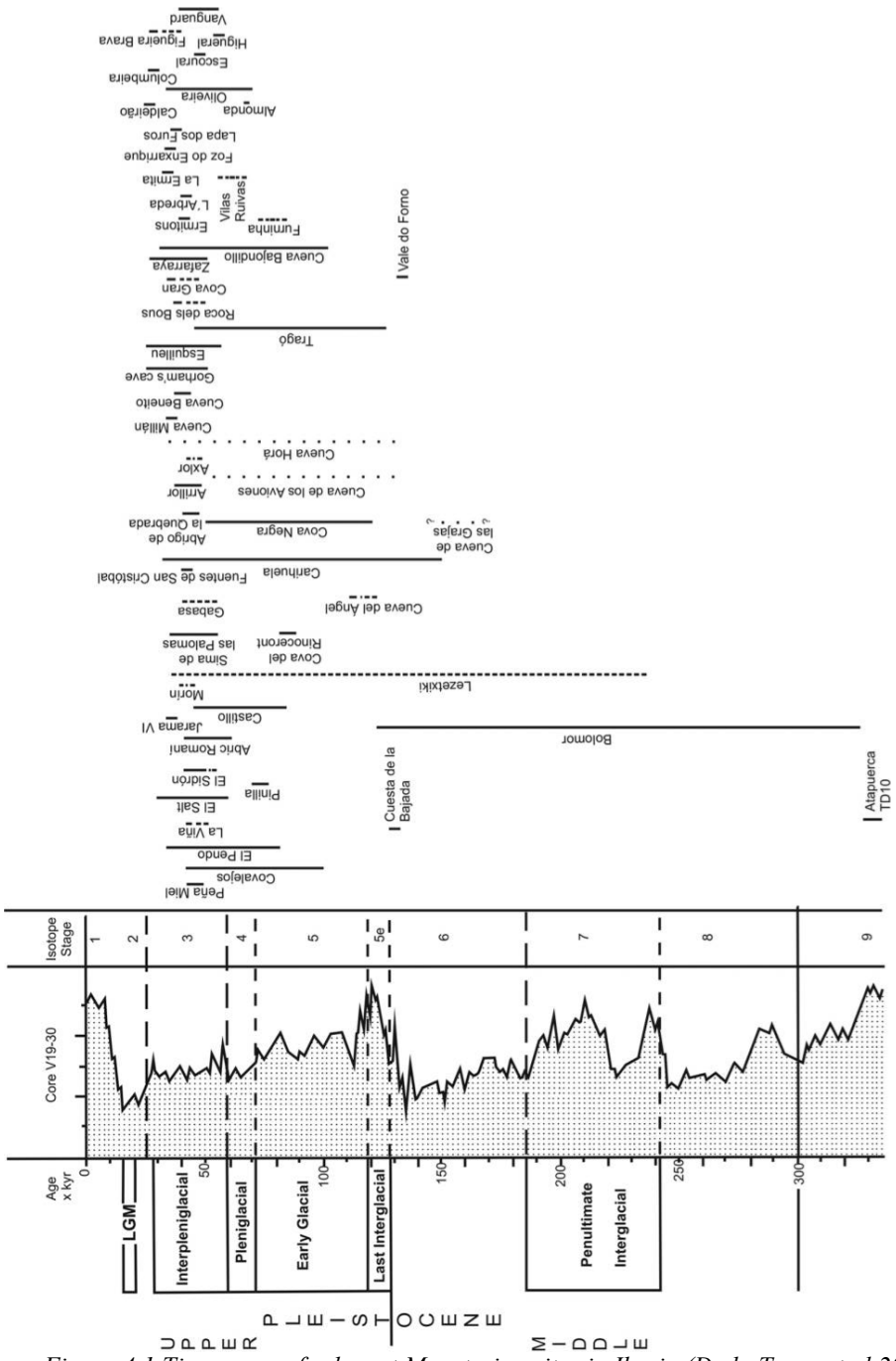


Figure 4.1.Time spam of relevant Mousterian sites in Iberia (De la Torre et al 2013)

4.1.2. Selecting specific regions

The two regions selected inside the Iberian Peninsula for my research are the Betic Mountain System in the southeast, and the Cantabrian Mountain System in the north. The main criteria by which I selected these regions are:

1. Both regions are vast territories with great diversity and ecosystems, which allow for a study of Neanderthal behaviour on a biogeographical scale.

2. There is a good set of Middle Palaeolithic sites in each region, with the potential to address Neanderthal behaviour diachronically in relation to environmental and climate change in both regions.

3. The sites in these regions have provided various lithic assemblages, the study of which allows us to analyse the technological processes used by Neanderthals in both territories.

4. The two regions are suitable for the analysis of territorial occupation by Neanderthals, as both have a similar topography:

- **i.** Narrow coastal plain zone.
- **ii.** Open hill-piedmont zone.
- **iii.** Low mountain zone.
- **iv.** High mountain zone.

5. The two regions are bioclimatically and biogeographically distinct, allowing contrasting ecological influences to be assessed at various spatial scales.



Figure 4.2. Research regions in the Iberian Peninsula: Cantabrian (north) and Betic (south)).

The Betic Mountain System

The Betic Cordillera is a group of mountain ranges that extends to the south of the Iberian Peninsula, from the Bay of Cadiz to Alicante.

In this region there is a large set of Mousterian sites, a selection of which contain a sequence of stratigraphic levels: Devil's Tower, Gorham's Cave, Vanguard Cave, Ibex Cave (Gibraltar); Zafarraya, Humo Complex, Bajondillo, Higueral-Guardia, Ardales, Pileta, Sima de las Palomas de Teba (Málaga); Carigüela, Horá, Las Ventanas (Granada); Higueral of Valleja (Cádiz); Murciélagos (Córdoba); Zájara I (Almería); Sima de las Palomas, Aviones, Antón (Murcia); El Salt, Abric del Pastor, Cova Beneito, Cochino, and Foradá (Alicante).

Neanderthal remains have been located in the south-east of the Iberian Peninsula (see Chapter 2 and Table 2.1.) within the sites of Forbes Quarry and Devil's Tower, in Gibraltar; Zafarraya and Sima de las Palomas de Teba, in Málaga; Carihuela and Horá, in Granada; Sima de las Palomas, in Murcia; and El Salt and Foradá, in Alicante.

Table 4.1. gives the dates for the relevant last Mousterian levels within the Betic region.

BETIC AREA: LAST NEANDERTHALS SITES					
AREA	**SITE**	**LAYER**	**METHOD**	**LAB CODE**	**DATING**
Cádiz	**Higueral de Valleja**	V-VIII	14C		32,840 - 56,800 BP
Gibraltar	**Devil´s Tower**	3	14C	GrN-2888	ca. 30,000 BP
	Ibex	3	ESR		37,000 - 50,000 BP
	Vanguard	Upper Area	14C AMS	OxA-16891;OxA-6892	U53: 54,000 ± 3,300 BP; 46,900 ± 1,500 BP
				OxA-7127	U54: >49,400 BP
				OxA-6998	U55: 41,800 ± 1,400 BP
			U/Th	OxL-1029	46,320 ± 3,300 BP
			OSL	X730	U1-49: 75,100 ± 5,300 BP
				X729	U50: 108,500 ± 7,000 BP
				X724	U51-150: 114,000 ± 5,000 BP
		Northern Alcove	14C AMS	OxA-7078	> 44,100 BP
	Gorham	G (Waechter)	14C AMS	GrN-1556	49,200 ± 3,200 BP
				GrN-1473	47,700 ± 1,500 BP
				GrN-1678	47,000 BP
		Area I (Stringer)	14C AMS	OxA-7791	Ctx.18: 42,200 ± 1,100 BP
				OxA-8542	Ctx.18/19: 42,800 ± 2,100 BP
				OxA-8525	Ctx.19: 43,800 ± 1,300 BP
				OxA-205	Ctx.19: 47,900 ± 2,100 BP
				OxA-8526	Ctx.19: 46,700 ± 1,900 BP
				OxA-6075	Ctx.22b: 45,300 ± 1,700 BP
				OxA-7790	Ctx.22d: 51,700 ± 3,300 BP
		UBSm.4 to SSLm.(Lsm).6	AMS; OSL		35,000 to 67, 000 BP
		IV (Finlayson)	14C AMS		35,000-39,000 BP
Málaga	**Zafarraya**	UA to UG	14C AMS	OxA-23198	46,700 BP
				OxA-21813	49,300 BP
	Bajondillo	13	14C AMS	Ua-28270	37,005±1,790
		14		Ua-16859	> 40,000 BP
	Humo	18	U/Th	OxA-16803	40,730±310 BP; 43,590-44,819 cal BP
		21		OxA-16804	42,140±360 BP; 44,580-45,814 cal BP
Granada	**Carihuela**	VI.9	14C AMS	Beta-74381	45,200 ± 1,270 BP
Murcia	**Las Palomas**	2	14C AMS	OxA10666	34,450 ± 600 BP
				OxA15423	35,030 ± 270 BP
			U/Th	APSLP-1	43,800 ± 1,500 BP
	Antón	I-k	14C AMS	OxA-20881	31,150 ± 170 BP
				OxA-21244	32,890 ± 200 BP
				OxA-20882	31,070 ± 170 BP
		II-h/i		OxA-18672	39,650 ± 550 BP
	Las Aviones	I	14C AMS	OxA-19310	43,290 ± 390 BP
		II		OxA-19311	45,000 ± 450 BP
		III		OxA-19390	45,150 ± 650 BP
		IV		OxA-19312	42,200 ± 360 BP
		V		OxA-20906	38,150 ± 350 BP
Alicante	**El Salt**	V-VI	TL	ES 50	47,200 ± 4,400 BP
		Upper V	OSL	OSL2	44,700 ± 3,200 BP
		V	OSL	OSL1	45,200 ± 3,400 BP
	Beneito	D1	14C	Gif	30,160 ± 680 BP
			AMS	AA1387	38,800 ± 1,900 BP

Table 4.1. Absolute dates from the Betic region, taken from: Cortés et al (2004); Vega Toscano et al (1997); Wood et al (2013), Zilhão et al (2010); Pettit & Balley (2000); Oakley (1964); Volterra et al (2000); Rhodes et al (2000); Ramos Fernández et al (2012); Galván et al (2014); Iturbe et al (1993); Walker et al (2008), Jennings et al (2009).

The Cantabrian Mountain System

Located in the north of the Iberian Peninsula, the region is a geopolitical entity of Spain, extending from Galicia in the west to the Basque Country in the east.

Among the localities attributed to the Middle Palaeolithic levels, I highlight the sequences from El Pendo, El Castillo, Cueva Morin, Covalejos, El Esquilleu, El Sidrón, Cueva del Conde, La Viña, La Flecha, Cueva del Otero, Axlor, Lezetxiki, Labeko Koba and Amalda.

Neanderthal remains have been recovered from the following sites within this region: El Sidrón, El Esquilleu, Covalejos, El Castillo, Axlor, Lezetxiki and Arillor (see Chapter 2 and Table 2.1.).

Table 4.2. gives the dates for the relevant last Mousterian levels within the Cantabrian region.

CANTABRIAN AREA: LAST NEANDERTHALS SITES					
AREA	**SITE**	**LAYER**	**METHOD**	**LAB CODE**	**DATING**
País Vasco	**Lezetxiki**	III	14 C AMS	OxA-21715	> 46,500 BP
				OxA-22627	> 46,700 BP
				OxA-21837	39,560 ± 388 cal BP
	Axlor	D	14 C AMS	Beta-144262	42,000 ± 1280 BP
				Beta-225486	> 43,000 BP
		F		Beta-225487	> 47,500 BP
				Beta-225485	33,310 ± 360 BP
	Abauntz	H	ESR		30,000 ± 5,000 BP
			14 C AMS	Gra-16960	> 45,700 BP
	Kurtzia	Inferior/Basal	14 C AMS	UGRA-293	45,330 ± 2,140 cal BP
	Arrillor	Amk	14 C AMS	OxA-6084	45,700 ± 1,200 BP
				OxA-6251	45,400 ± 1,800 BP
		Smk-1		OxA-6250	43,100 ± 1,700 BP
		Lmc		OxA-6106	37,100 ± 1,000 BP
Cantabria	**El Esquilleu**	VI f	14 C AMS	OxA19246	43,700±1,400 BP
				OxA19966	44,100±1,300 BP
	El Castillo	20 alfa	14 C AMS	OxA-10233	42,100±1,500 BP
				OxA-10328	45,700±1,700 BP
				OxA-10187	42,900±1,400 BP
	Morín	11	14 C AMS	OxA-19083	41,800 ± 450 BP
				OxA-19459	43,600 ± 600 BP
				GifA-96264	39,770 ± 730 BP
	Covalejos	D	14 C AMS	Gra-23814	44,830 ± 760 cal BP
				Gra-23921	44,610 ± 2,300 cal BP
				GrA-33811	46,407 ± 840 cal BP
		I	14 C AMS	Gra-33822	35,530 ± 457 cal BP
		J	TL		38,334 ± 3,560 cal BP
			14 C AMS	GrA-33812	> 45,000 BP
	Mirón	130	14 C AMS	Gx-27112	41,280 ±1,120 BP
Asturias	**La Viña**	XIII basal	14 C AMS	GifA-95537	> 47,600 BP
				GifA-95546	42,200 ± 2,200 BP
			ABOX-SC	OxA-19144	> 59,300 BP
			ABA	OxA-19196	> 62,000 BP
	El Sidrón	III	14 C AMS	GifA-99167	50,289 ± 3,676 cal BP
				GifA-95704	50,820 ± 3,455 cal BP
	La Güelga	Zone D (Mousterian)	14 C	GrN-18256	37,297 ± 1,887 cal BP
		9	14 C AMS	OxA-19244	43,700 ± 800 BP
				OxA-19245	44,300 ± 1,200 BP
	Forno o Conde	N20a	14C	Beta-210572	38,250 ± 390 BP
				Beta-230416	37,710 ± 470 BP
				Beta-224302	29,750 ± 300 BP
	Sopeña	XII	14 C AMS	GrA-39761	35,500 ± 650 BP
Galicia	**A Valiña**	IV [a.k.a. "1"?]	14 C		39, 030 cal. BP

Table 4.2. Absolute dates from Cantabrian region, taken from: Maroto et al (2005, 2012); Vaquero et al (2006); Higham et al (2014); Wood et al (2013, 2016).

4.1.3. Selecting specific sites and assemblages

A total of eight sites have been chosen, four of them located in the south of the Iberian Peninsula: Abrigo 3, Carihuela, Zafarraya, and Gorham´s Cave (encompassing the Betic Mountain System) and another four from the north: Axlor, El Esquilleu, Cueva Morín, and El Castillo (encompassing the Cantabrian Mountain System).

These sites have been selected for the following reasons:

i. Systematic archaeological studies have been carried out within these sites.
ii. They have a contextualised and differentiated stratigraphic sequence.
iii. They have layers with absolute dates.
iv. They have documented and published Mousterian lithic assemblages (they are framed within the chronology encompassing our study).
v. They have documented and published faunal remains.
vi. Anthracological analysis or analysis of pollen (or both) has been performed.

Thus the study of lithic assemblages and the contextualisation of these sites offer us precise and sufficient information to test hypotheses and answer the questions set out above.

From each site I have selected a lithic assemblage corresponding to the last Mousterian layer, dated between 60ka and 35ka. In some sites, with fewer lithic specimens by level, more levels have been selected within the chronology, as in the cases of Gorham´s Cave and Zafarraya. A total sample of 5,870 pieces was analysed for this study.

The eight sites and layers selected for this research are:

MIDDLE PALEOLITHIC SITES TO STUDY						
	SITE	M.A.S.L.	MOUSTERIAN LEVEL	METHOD	SAMPLE	DATING
CANTABRIAN	Axlor	320	III-IV	14C AMS	Beta144262;Beta225486	42,000±1280; >43,000 BP
	El Esquilleu	280	VI f	Ultraflitration	OxA19246;OxA19966	43,700±1,400; 44,100±1,300 BP
	Morín	57	11	ABA; ABOX-SC	OxA19083;OxA19459	41,800±450; 43,600±600 BP
	EL Castillo	195	20 alfa	14C AMS	OxA-10233; OxA-10328	42,100±1500; 45,700±1700BP
BETIC	Abrigo 3	9	17 to 25 (Z4-Z3, sectors C33-C45)	14C AMS	OxA-16803;OxA-16804	40,730±310; 42,140±360 BP
	Carihuela	1020	V (Vega Toscano)	14C AMS	Beta74381	<45,200±1,270 BP
	Zafarraya	1022	UA to UG	Ultraflitration	OxA23198; OxA21813	46,700; 49,300 BP
	Gorham	8	UBSm.4 to SSLm.(Lsm).6	AMS; OSL		35,000 to 67, 000 BP

Table 4.3. Middle Palaeolithic sites and layers to study



Figure 4.3. Middle Palaeolithic sites selected from Betic region



Figure 4.4. Middle Palaeolithic sites selected from Cantabrian region

4.2. DATA COLLECTION METHODS

This section describes the methodology used to collect the data relative to each of the topics of study as stipulated in my objectives.

4.2.1. Lithic assemblages

The first type of data collected was the lithic assemblage from the late Mousterian levels from 8 Middle Palaeolithic sites from within both regions of study. I carried out research sabbaticals at various institutions and museums within Spain, in order to gain access to their collections at: Fundación Instituto de Investigación de Prehistoria y Evolución Humana (Lucena, Córdoba); Yacimientos arqueológicos de la Araña (Málaga); Universidad Autónoma de Madrid; Museo Arqueológico de Granada; Museo Arqueológico de Bilbao; and Museo Arqueológico de Santander.

4.2.2. References database

The second dataset used for a large part of this research was collected from the published scientific literature. A database was constructed of all the published sources used in this study, organised by the following keywords: Neanderthal, Middle Paleolithic, Lithic Technology, Mousterian, Neanderthal Subsistence, Settlement Patterns, Dating, Fauna Remains, Climate, Landscape, Habitat, Environment, etc.. It was then systematically organised using EndNote X7.5.1 software.

4.2.3. Middle Palaeolithic sites fauna database

A database of the faunal remains from 39 Middle Palaeolithic sites from each region (11 from the Betic and 24 from the Cantabrian) was constructed from the literature. I collected the number of identified specimens (NISP) of the following groups of large game: horses, bovids, goats, chamois, deer, reindeer, roe deer, wild boar, woolly rhinoceros, giant deer, and mammoths, and small game: rabbits, tortoise, marine resources, fishes, and birds.

4.2.4. Bioclimatic and archaeological sites database

In order to create bioclimatic maps, I obtained the climate data of current temperatures and rainfall mean values from 2376 weather stations (1204 from the Cantabrian region and 1172 from the Betic region) from the work of López & López (2008) from the University of Navarra:

(http://dadun.unav.edu/bitstream/10171/8156/3/n17Anexo%203-Tabla%20Fuente%20de%20Datos%20nuestros.pdf).

The climatology data series collected by these authors run from 1950 to 1990. For this study only data from weather stations within the two study regions have been selected. Data from the following provinces within the Cantabrian region were selected: La Coruña, Lugo, Orense, Pontevedra, Asturias, León, Palencia, Burgos, Cantabria, Guipuzcoa, Vizcaya, Alava, Logroño, and Navarra. Within the Betic region data were selected from: Valencia, Alicante, Albacete, Murcía, Almería, Granada, Jaén, Málaga, Córdoba, Sevilla, Cádiz, and Huelva. A total of 2376 weather stations were consulted (1204 from the Cantabrian region and 1172 from the Betic region) and their data used to generate very precise and detailed maps spanning both regions.

The maps were created using the ArcGIS 10.3 software on a STRM 90 m Digital Elevation Models map of the Iberian Peninsula taken from CGIAR Consortium for Spatial Information website (http://srtm.csi.cgiar.org/index.asp) produced originally by the Shuttle Radar Topography Mission by NASA and in accordance with the methodologies of Rivas Martínez (1987), Finlayson (2004), Jennings (2007), Jennings *et al* (2011), and López & López (2008).

A database of Mousterian sites was produced from the Spanish archaeological literature, with a total of 699 sites (caves, rockshelters, open air sites) - 387 sites from the Cantabrian region and 312 sites from the Betic region - within a chronology between 100ka and 40ka years BP. Another archaeological site database focusing in the Upper Palaeolithic chronocultural period was also created which included: Châtelperronian: 15 sites (Cantabrian region); Aurignacian: 44 sites (Cantabrian region), 10 sites (Betic region); Gravettian: 38 sites (Cantabrian region), 18 sites (Betic region); Solutrean: 53 sites (Cantabrian region), 82 sites (Betic region).

To obtained the UTM coordinates of the archaeological sites I used the online program IBERPIX (http://contenido.ign.es/iberpix2/visor/) from the Instituto Geográfico Nacional (IGN) of Spain.

The preliminary information has been inputted into a spreadsheet using the following fields:

- ID identifier
- Name of the Meteorological Station
- UTM coordinates (X and Y).
- Altitude (Z)
- Rainfall
- Temperature

Thermotype map

To obtain the thermotype map the following procedure was performed:

1. Calculate the degree of correlation between altitude and temperature: From the altitude and temperate data, a scatter plot with markers was created, which provided the correlation coefficient, which was considered as a gradient (r=-0.005).

2. Likewise, I set all temperatures to the same altitude, calculating the values for each of the stations as if located at the same altitude (Zdet=50 m) by applying the following formula (Fries *et al* 2012):

$$^{T}Det = {}^{T}\,mensual + ({}^{r}\,({}^{z}\,Det - {}^{z}\,station)$$

E.g. 16.11 + ((-0,005) * (50 – 704)) = 19,38

Once this is applied to all stations, the data will be presented as the "determined temperature". It will then be exported into the Arcgis 10 software.

3. The X and Y coordinates and the altitude (Z) (Display XY Data...) are entered into Arcgis 10 software, in this case Datum ED50, Huso 30 were used. The results are then exported in shape format (Export Data), giving it the name "stations.shp".

4. The next step is to interpolate the data following these steps:

In Arc Toolbox click Spatial Analyst Tools → Interpolation → IDW

Now select the following fields:

Imput point features: "stations.shp"

Z value field: “T det”

Output cell size (optional): “30”.

5. Add the Digital Elevation Model (DEM).

6. Solve the following formula (Fries *et al* 2012): ^{T} x,y= ^{T} Det + $(^{r} (z ^{(x y)} - ^{z} Det))$. To do this we open ArcToolbox again and click on Spatial Analyst Tools → Map Algebra → Raster Calculator and proceed to enter the data: E.g determinated temperature + ((-0,005) *(dem – 50)).

Once the temperature map is created, the archaeological sites from both study regions are then plotted in the different chronocultural periods.

Ombrotype map

Using the same data that I had tabulated and exported, step 4 is once again executed, as described above, in this case changing the file “T det” with the “precipitation” file. With the results obtained, as in the previous exercise, after appling a mask with the contour of the desired region (Cantabrian or Betic) to crop the image, we proceed to classify the raster:

Layer properties → classified. In our case, for a greater precision, we have indicated an interval of 30 ranges.

Finally archaeological sites from both the Cantabrian and Betic regions are plotted within the different chronocultural periods.

4.3. METHODS OF DATA ANALYSIS

4. 3.1. Technological analysis of the lithic record

The analysis of the lithic assemblages for this study is set within the perspective of prehistoric lithic technology. Technological analysis of lithic assemblages provides us with data on the technical behaviour, gestures, strategies, methods, everyday life and modes of subsistence, territorial occupation, and even the cognitive abilities of prehistoric human groups.

This study has a dynamic character that attempts to reconstruct the operational sequence: the different modes of acquisition, processing, use and abandonment of different exploited materials. In addition, an analysis of each element of the operational sequence and a morpho-technical study to identify them technically, will be performed. It is my intention to re-animate those anonymous populations whose characteristics I want to interpret, in a constant dialogue between conducting the study, the recovered lithic assemblages, the natural environment and the human societies that produced them. I follow the methodology for lithic analysis described by Inizian *et al* (1999), Boëda (1993, 1994, 1995), Carbonell *et al* (1983, 1992), Laplace (1972), Rodríguez (2004), and Andrefsky (2005, 2012).

The terminological definitions used for each item, in the operational sequence of a Mousterian lithic assemblage, are presented below:

- Hammerstones: a natural implement used for knapping, shaping, or retouching hard stone.

- Core: any type of raw material knapped, as block, plaque or nodule, in order to produce blanks for tools.

Cores are classified into different types depending on the knapping technique employed:

- Discoid: this method is characterized by the alternate exploitation of two opposed convex surfaces that gain alternatively, the scars extending from the edge toward the centre of the piece.

- **Levallois:** this method is conceived by a core with two asymmetrical convex surfaces, which define a plane of intersection. One of the surfaces is debitage around the perimeter, the debitage extending from the perimeter to the centre, and one extreme is prepared by small debitage from where the Levallois products are removed; the other surface becomes the striking platform.

- **Recurrent centripetal:** characterized by uninterrupted production along the whole striking platform.
- **Preferential:** the objective is production of a single flake from each prepared debitage surface.
- **Recurrent unidirectional:** characterized by a single striking platform.
- **Recurrent bidirectional:** characterized by the use of two opposed striking platforms.

- Quina: characterized by a recurrent exploitation of the core by a series of removals that are unidirectional, following fracture planes that are alternatively secant and parallel to the intersection of the two surfaces.

- Globular: characterized by a high exploitation index, evidenced by the presence of various planes, the striking of which gives the piece certain globular aspect.

- Unformed Core: a waste core of knapping that does not present a determined shape.

- Chunks: discarded fragments or pieces from the nodule with or without cortex and with unformed shape.

Products of Knapping

Flake: a lithic flake is a product obtained from a core by any technique of knapping, of which the total length is less than twice its maximum width.

- **Cortical flake:** the first or earliest flakes removed and preserved with more than 50 percent cortex on the dorsal face.
- **Semi-cortical flake:** a flake with less than 50 percent presence of cortex on the dorsal face.
- **Naturally backed flake:** characterized by the presence of a complete or partial cortical backed side.

- **Ordinary flake:** characterized by not implying a particular morphology or a special dimension; has no identifiable technological feature.
- **Levallois flake:** characterized by having a predetermined shape from a Levallois core after preparing of the striking platform, and having a dorsal face covered by centripetal scars and a faceted butt. There are different types: Levallois preferential flake, levallois recurrent unidirectional, Levallois recurrent bidirectional, and Levallois recurrent centripetal.
- **Centripetal flake:** characterized by the presence of centripetal scars on the dorsal face.
- **Kombewa flake or Janus flake:** characterized by the presence of two ventral faces which could show two bulbs.
- **Levallois point:** a flake with a pointed shape from a Levallois core, whose shape resembles an isosceles triangle, having a scar in the shape of an isosceles triangle, which extends from the base to about two-thirds of the total length of the piece.
- **Pseudolevallois point:** characterized by a pointed flake whose technological and morphological axes do not coincide. Technologically a deviated flake from discoidal cores.
- **Blade:** characterized by a flake whose length is equal to or greater than twice to width, having relatively parallel edges.
- **Debris:** characterized by fragments whose mode of fracture cannot be identified, so they cannot be assigned to any other category of object.

- **Knapping accident flake:**

  - **Siret:** accidental break along the debitage axis that divides the flake in two parts.

  - **Plunging:** those flakes where the ventral surface tends to slouch to the interior of the core becoming a convex shape, wherein the distal edge is width.

  - **Hinged:** those flakes that tend to slouch outward. They are usually short and broad, with distal edge rounded off, not sharp, reflected from the scar on the dorsal surface of the distal part of the piece.

  - **Step:** flakes that end abruptly and create a step-like break.

  - **Diverted:** those flakes that have their longitudinal axis tending diagonally either

to the right or the left.

Retouched tools:

- **Mousterian point:** characterised by retouch all down the sides, very thick and showing secondary retouch to create a powerful stabbing point; it has a triangular shape.
- **Denticulate:** characterised by having consecutive notches along one edge that form a series of teeth. There is a variety of denticulates depending on the locality and depth of the retouch on the edges and their morphology.
- **Scraper:** an artefact made on a flake characterized by having consecutive retouch, plain or abrupt, along one or more edges, and a cutting edge and a straight delineation, convex or concave without slit, or denticulate marked. There is a variety of scrapers depending on the locality and depth of the retouch on their edges and their morphology.
- **Burins:** characterised by one negative scar of one or more bladelets at the end of the piece, made by 'Burin hit', thereby forming a plane perpendicular or oblique to the fracture plane.
- **End-scraper:** made on a flake with an edge retouched continuously and evenly with an oblique or steep angle; it has a convex shape.

4.3.1.1. Metrical analysis (Quantitative variables)

4.3.1.1.1. Measurement

For general measures of length, width and thickness of the blanks, I used a high-precision digital caliper Mitutoyo Absolute Digimatic AOS, code no. 500-158-30, and the measurement of the angles (to the scars of the cores, flaking angle, retouching scars) was performed through an angle measuring instrument CCKL Creator; US PAT. 4,766,675.

Cores:

-Length (mm): Maximum dimension of core.

-Width (mm): Maximum width at 90^{o} to the axis along which length was measured.

-Thickness (mm): Maximum thickness.

- Obliquity of scars: indicates the angle of inclination of the removals with respect to the plane of intervention. There are four modes:

i. Plain (P): 0 º to 35 º
ii. Simple (S): 35 º to 55 º
iii. Semi-abrupt (SA): 55 º to 75 º
iv. Abrupt (A): 75 º to 90 º

Flakes: Initially the orientation of the piece was studied considering the platform as the proximal part, and dorsal side oriented facing the viewer, then technical measures (length, width and thickness) were taken. Flakes which are less than 10 mm in length were not morpho-technically analysed.

-Length (mm): on the ventral side, the length was measured to the caliper from the impact point to the distal end.

-Width (mm): was measured perpendicular to the maximal dimension between the two most extreme points.

-Thickness (mm): was measured at a right angle to the maximal dimension between the ventral side and the dorsal side including the bulb.

-Flaking angle: the angle formed by platform and the ventral face, as well as measurements taken of it.

Retouched Tools:

- Obliquity of retouch: indicates the angle of inclination of the retouch with respect to the edge of intervention. I have considered four modes:

i. Plain (P): 0 º to 35 º
ii. Simple (S): 35 º to 55 º
iii. Semi-abrupt (SA): 55 º to 75 º
iv. Abrupt (A): 75 º to 90 º

4.3.1.1.2. Area

This was calculated by multiplying the length by the width of the blank. Several categories have been established from modules with a range of 250 mm^2. Once

established, modules were classified into three groups: pieces of small size (A1, A2, A3 and A4), pieces of medium size (A5 and A6) and pieces of large size (A7, A8, A9 and A10).

A1: < 250 mm2

A2: between 251-500 mm^2

A3: between 501-750 mm^2

A4: between 751-1000 mm^2

A5: between 1001-1250 mm^2

A6: between 1251-1500 mm^2

A7: between 1501-1750 mm^2

A8: between 1751-2000 mm^2

A9: between 2001-2250 mm^2

A10: > 2250 mm^2

4.3.1.1.3. Indices

The indices are based on the Analytic of Laplace (1972).

-Elongation index: calculated by dividing the length by the width of the flake.

EI1: < 0,5

EI2: between 0,51 and 1

EI3: between 1,01 and 1,5

EI4: between 1,51 and 2

EI5: > 2 (blade blank)

-Flattening index: calculated by dividing the thickness by the lesser of the other two dimensions of the flake (length or width).

FI1: < 1

EI2: between 1,01 and 2

EI3: between 2,01 and 3

EI4: between 3,01 and 4

EI5: > 4

4.3.1.2. Descriptive analysis (Qualitative variables)

4.3.1.2.1. Cores

The attributes considered for the morpho-technical study of the cores were:

- Cortex: amount of cortex that remains on the surface of intervention. According to its surface area five categories were established.

- 0C (without cortex)
- 1C (≤ 25% on the surface)
- 2C (to 50%)
- 3C (to 75%)
- 4C (> 75%)

- Stage of the production sequence:

i. **Initialization:** corresponds to the early stages of the reduction process of debarking the nodule, and the technical criteria are reflected to carry out the systematic reduction.

ii. **Exploitation:** moment of full exploitation for systematically obtaining knapping products, in which the core has a well-defined model of configuration.

iii. **Terminal:** final stage of the reduction sequence, where the core has exhausted its productive capacity and presents reduced dimensions where the scars are overlapped, which makes it difficult to recognise the knapping methods applied.

- Planes of the Intervention: to describe the core volumetrically I distinguished three planes: horizontal (H), transverse (T) and sagital (S). The edge with more knapping is situated in the distal part and the surface with more scars will be the top horizontal face. With the planes of intervention of the core we can recognise the type of reduction sequence performed: unipolar, bipolar or multipolar.

- Centripetal character: the percentage of removals in the periphery of the core is analysed. In the methodology I apply four types depending on the perimeter intervened on each plane.

- Centripetal tendency (1C the removals were performed on less than 25 percent of the perimeter.
- Shortly centripetal (2C): the removals extend over 25 to 50 percent of the perimeter.
- Centripetal (3C): over 50 to 75 percent of the perimeter.
- Totally centripetal (4C): the removals were performed on the whole perimeter.

- Character of depth: defined by the length of removals in relation to the area of intervention.

- Very marginal (vm)
- Marginal (m)
- Deep (d)
- Very deep (vd)
- Total (t)

- **Character of the front edge:** the delineation of the edge of intersection between the plane of intervention and the plane of configuration is described by the following generic form:

- Rectilinear (RT)
- Convex (CX)
- Concave (CC)
- Sinuous (SIN)

- **Character of symmetry:** characterised by the shape of the different planes of reduction divided by the sagittal edge.

- Sym= Symmetric.
- Nsym= No symmetric.

- Method of Knapping: the method of reduction of a core in order to produce flakes. There are a number of strategies and technical criteria that have been defined as different methods: Discoid, Levallois, Quina.

4.3.1.2.2. Flakes

For morpho-technical analysis the following descriptive criteria are taken into consideration:

- Ventral face: characterised by forming the fracture plane from where the piece chipped off from the core; generally presents a bulb more or less marked and in some cases almost non-existent (diffuse).

In the ventral face I analysed the following features:

- Type of bulb:

  - Marked (M)
  - Diffuse (D)

- Delineation: describing the outline of surface of ventral face.

  - Rectilinear (RT)
  - Convex (CX)
  - Concave (CC)
  - Sinuous (SIN)

- Corticality of butt:

  - Cortical (CO): the butt has presence of cortex.
  - Non cortical (NCO): the butt has no cortex.

- Type of butt:

  - Platform (PLA)
  - Linear (LIN)
  - Punctiform (PUN)

- Facets of butt:

  - Non faceted (NF):
  - Faceted:
    - Unifaceted (UF)
    - Bifaceted (BF)
    - Multifaceted (MF)

- Delineation of butt:

  - Rectilinear (RT)
  - Convex (CX)
  - Concave (CC)
  - Sinuous (SIN)
  - Uniangular (1a)

- Biangular (2a)

-Dorsal face: the upper side of a flake, which carries the scars and ridges of previous removals. If it is a primary flake chipped off a nodule the dorsal surface will carry the cortex.

In the ventral face I analysed the following features:

- Corticality:

  - Non cortical (NCO): 0 % of cortex.
  - Non cortical/cortical (NCO(CO)): < 50% of cortex.
  - Cortical /non cortical (CO(NCO)): > 50% of cortex.
  - Totally cortical (CO): 100% of cortex.

- Number of scars: 1,2,3,4,5,6,….

- Direction of scars:

  - Unipolar (UNI)
  - Bipolar (BIP)
  - Centripetal (CEN)
  - Multipolar (MUL)

- General morphology of flake: is analysed from the following orientations of the flake: frontal morphology; sagittal morphology; transversal morphology. The different morphologies that we can find are:

  - Quadrangular (CDG)
  - Trapezoidal (TRP)
  - Pentagonal (PTG)
  - Poligonal (PLG)
  - Circular (CIR)
  - Oval (OV)

4.3.1.2.3. Retouched Tools

These are characterised by the modification of a blank in order to configure a particular morphology by retouching of their edges, conferring on them a specific functional utility.

In my study, firstly the blank was determined (flake, fragmented flake, fragment of flake) and then studied using the analytical criteria of each type of blank. For retouched tools, retouched areas starting with the left side and following a clockwise direction (left edge,

distal edge, right edge, proximal edge) were analysed.

For the retouched tools I analysed the following features:

- General localisation of the retouched edges:
  - Left edge.
  - Distal edge.
  - Right edge.
  - Proximal edge.

- Type of tool:
  - Simple tool: one edge with retouch.
  - Double tool: two edges with retouch.
  - Composite tools (3 or 4 edges with retouch).

- Analysis of edges 1, 2, 3, 4
  - Facial atribute:
    - Unifacial (U)
    - Bifacial (B)
    - Trifacial (T)
    - Multifacial (M)

  - Centripetal character:
    - 1C retouched area < 25%.
    - 2C retouched area between 25 to 50%.
    - 3C retouched area between 50 to 75%.
    - 4C retouched area between 75 to 100%.

  - Extent of retouch: It is defined by the length of retouched in relation to the edge of intervention.
    - Marginal (m)
    - Minimally invasive (mi)
    - Semi-invasive (si)
    - Invasive (i)
    - Total (t)

  - Position of retouch:
    - Direct (d): retouched on dorsal face.
    - Inverse (i): retouched on ventral face.
    - Alternate (Al): retouched on opposite edges on both faces.
    - Bifacial (b): working into both faces from same edge.

  - Distribution of retouch:
    - Continuous (ct)
    - Discontinuous (dc)
    - Partial (p)

- Denticulate (dent)
- Notch (n)

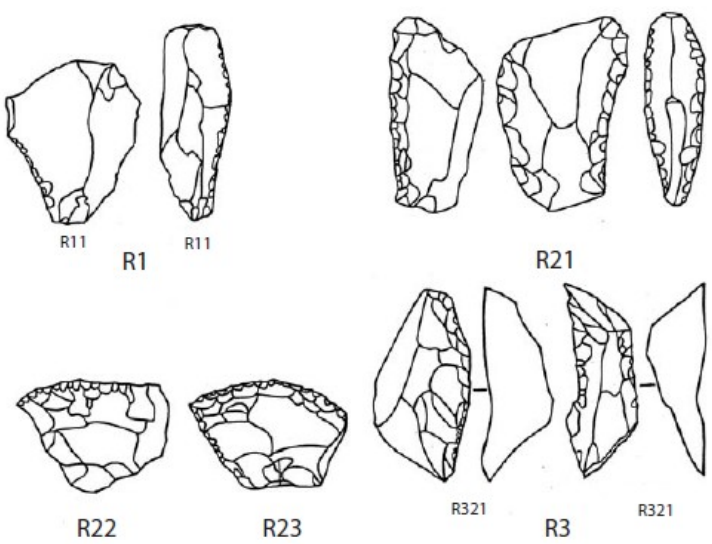
- Form of retouched edge:
  - Rectilinear (rt)
  - Concave
  - Convex
  - Sinuous (sin)
  - Denticulate (dent)
  - Notch (n)

- Morphology of retouched:
  - Scaly (sc)
  - Stepped (st)
  - Sub-parallel
  - Parallel

Finally, all retouched tools through the analytical and structural form of Laplace (1972) were analysed. According to its retouch each object was classified in a typological group (denticulate, scraper, point, etc.) and at the same time, depending on the location, angle and depth of retouch, classified into sub-groups.

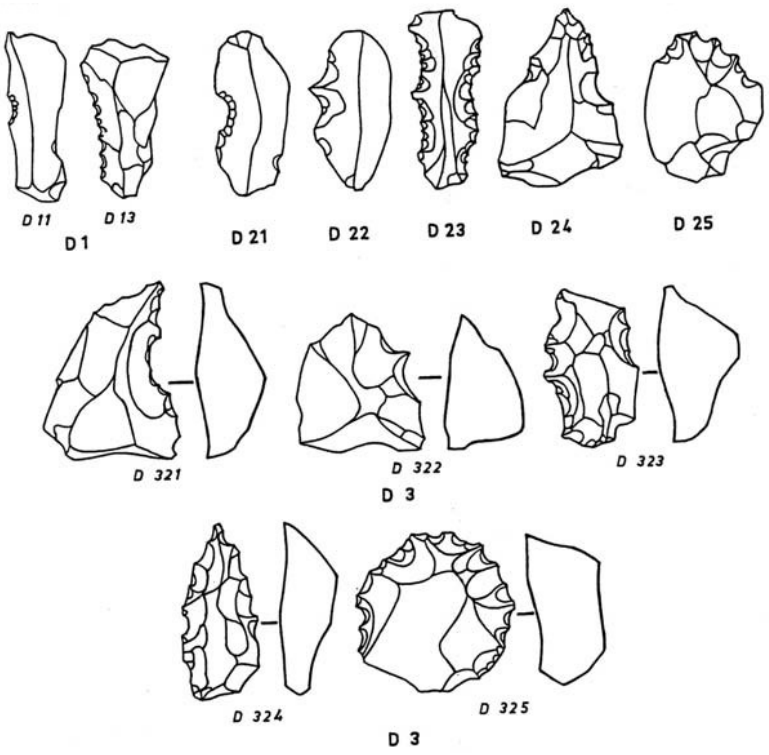
-Typological description:

- Scrapers:



R11: marginal scraper
R21: side scraper
R22: transverse scraper
R23: side transverse scraper
R321: carinated scraper

- Denticulates:



D1: marginal denticulate
D21: *encoche*
D22: spine
D23: denticulate scraper
D24: denticulate point
D25: denticulate end-scraper
D3: carinated denticulate

LITHIC ANALYSIS METHODOLOGY								
General Information								
Site		**Excavation**		**Chronology**		**Category**		**Orientation**
Museum		**Directed by**		**Square**		**x**		**Slope**
Collection		**Year**		**Number**		**y**		**Photo**
Box Number		**Layer**		**Raw material**		**Zsup/inf.**		**Drawing**
HAMMERSTONE								
	Length		Cobbles, pebbles or blocks selected in order to flake them or use them as hammers without anthropic marks (WM)					
	Width		Cobbles, pebbles or blocks with percussion marks (M)					
	Thickness		Cobbles, pebbles or blocks with anthropic fracture (s) (F)					
CORES								
Length	**Corticality**	**Reduction sequence**	**Intervention planes**	**Retouch extent**	**Oblicuity**	**Removals Extent**	**Frontal edge morphology**	**Direction of scars**
Width	<25% (1)	Initialization stage	Horizontal	<25% (1C)	Plain (P) 0° to 35°	Marginal (M)	Straight (RT)	Unipolar (UNI)
Thickness	25 to 50% (2)	Exploitation stage	Transversal	25 to 50% (2C)	Simple (S) 35° to 55°	Very marginal (VM)	Convex (CX)	Bipolar (BIP)
Area (lenght x widht)	50 to 75% (3)	Terminal Stage	Sagital	50 to 75% (3C)	Semi-abrupt (SA) 55° to 75	Extensive (E)	Concave (CC)	Centripal (CEN)
Concretion	>75% (4)			75% to 100% (4C)	Abrupt (A) 75° to 90°	Very extensive (VE)	Concave (CC)	multipolar (MUL)
Patina						Total (T)	Sinuous (SIN)	multipolar centripetal (MC)
Burned								
		Symmetry		**Number of Scars**		**Strategies of Knapping**		**Methods of Knapping**
		Symmetrical (SY)		In the surface 1 (1,2,3…)		Unipolar (UNI)		Discoidal
		Non symmetrical (NSY)		In the surface 2 (1,2,3…)		Bipolar (BIP)		Levallois
				In the surface 3 (1,2,3…)		Bipolar Orthogonal(BIP)		Kombewa
						Centripal (CEN)		Quina
						multipolar (MUL)		
FLAKES								
Lenght		Elongation index (width/length)		Cortex general	**Description**		**Accident of knapping**	
Widht		Flattening index (thickness /R)		Retouch	Plain flakes		Overshot flake	
Thickness		Concretion		Photo	Centripetal flake		Reflected flake	
R (smaller measure)		Patina		Drawing	Pseudo-Levallois point		Siret	
Area (lenght x widht)		Burned		Broken	Levallois flake		Deflected flake	
Ventral face								
Type of bulb	**Delineation**		**Corticality of butt**	**Type of butt**	**Facets of butt**	**Flaking Angle**	**Delineation of butt**	**Morphology of butt**
Marked (M)	Straight (RT)		Cortical (CO)	Platform (PLA)	Non faceted (NF)		Straight (RT)	Triangular (TRG)
Difuse (D)	Convex (CX)		Non cortical (NCO)	Linear (LIN)	Unifaceted (UF)		Convex (CX)	Quadrangular (CDG)
	Concave (CC)			Punctiform (PUN)	Bifaceted (BF)		Concave (CC)	Trapezoidal (TRP)
	Sinuous (SIN)				Multifaceted (MF)		Sinuous (SIN)	Pentagonal (PTG)
							Uniangular (1a)	Poligonal (PLG)
							Biangular (2a)	Circular (CIR)
								Oval (OV)
Dorsal face								
	Amount of cortex			**Scars**			**Direction of scars**	
	Non cortical (NCO)			1 scar (1)			Unipolar (UNI)	
	Totally cortical (CO)			2 scar (2)			Bipolar (BIP)	
	<50% cortical (NCO (CO))			3 scar (3)			Centripal (CEN)	
	>50% cortical (CO (NCO)			4 scar (4)			multipolar (MUL)	
				5 scar (5)			multipolar centripetal (MC)	
				6 scar (6)				
				…				
RETOUCH FLAKES								
		General Localitation				**Type of tool**		
		Right edge				Simple tool (1 edge with retocuh)		
		Left edge				Double tool (2 edge with retouch)		
		Distal edge				Composite tools (3 or 4 edge with retouch)		
		Proximal edge						
Analysis of edges 1, 2, 3, 4								
Localitation 1	**Facial atribute 1**	**Extent 1**	**Angle 1**	**Extent in the face 1**	**Depth at the edge 1**	**Direction 1**	**Delineation 1**	**Morphology 1**
Right edge	Unifacial (U)	<25% (1C)	Plain (P)	Marginal (M)	Marginal (M)	Direct (D)	Non continuous (NCT)	Straight (RT)
Left edge	Bifacial (B)	25 to 50% (2C)	Simple (S)	Very marginal (VM)	Very marginal (VM)	Alternate (A)	Denticulate (DENT)	Convex (CX)
Distal edge	Trifacial (T)	50 to 75% (3C)	Semi-abrupt (SA)	Extensive (E)	Deep (D)	Inverse (I)	Continuous (CT)	Concave (CC)
Proximal edge	Multifacial (M)	75% to 100% (4C)	Abrupt (A)	Very extensive (VE)	Very deep (VD)	Alternating (AL)	Notch (NT)	Sinuous (SIN)
				Total (T)	Total (T)	Bifacial (B)		Uniangular (1a)
								Biangular (2a)
LAPLACE TYPOLOGY								
		Scraper			**Denticulates**			
		R 11	Marginal scraper		D1	Marginal denticulate		
		R21	Side scraper		D21	Encoche		
		R22	Transverse scraper		D22	Spine		
		R23	Side-transverse scraper		D23	Scraper denticulate		
		R321	Carène scraper		D24	Point denticulate		
					D25	End-scraper denticulate		
					D3	Carène denticulate		
REFERENCES: Laplace, 1972; Carbonell et al, 1983; Inizian *et al*., 1999; Boëda 1993								

Table 4. 4. Lithic analysis methodology

CHAPTER 5

NEANDERTHAL TECHNOLOGICAL BEHAVIOUR

5.1 INTRODUCTION

In this chapter I discuss the analysis of the Late Middle Palaeolithic assemblages recovered from eight archaeological sites corresponding to two distinct regions of the Iberian Peninsula – the Cantabrian region to the north, and the Betic region to the south. The sites were chosen for their chronological integrity, as well as their geographical and geological contexts. The aim is to investigate the technological behaviour of Neanderthals, and establish whether any distinctive patterns emerge in both areas of study. The sites chosen for this analysis are:

Cantabrian Region	**Betic Region**
Axlor Cave (Levels 3 and 4)	*Abrigo 3 (*Z4-Z3, sectors C33-C45*)*
Esquilleu Cave (Level 6 f)	*Carihuela Cave (Levels III-IV)*
Morin Cave (Level 11)	*Zafarraya Cave (Levels UA-UG)*
El Castillo Cave (Level 20)	*Gorham´s Cave (Levels UBSm.4 to SS1.m(lsm).6)*

The Mousterian lithic assemblages have been studied using morpho-technical attributes, as detailed in Chapter 4. Using this methodology, it is possible to accurately pinpoint the location of each piece within its unique position in the sequence linking raw material to tool. This provides a valuable insight into the criteria applied by Neanderthals in the production and configuration of tools, i.e. gestures, strategies, methods, management, selection, adaptation, etc.

A summary of each archaeological site is included, with its geographical and geological setting, historical background, stratigraphic sequence and dating, as well as a brief description of the archaeological material recovered, according to the published data. The lithic assemblages were divided into three main categories- cores, flakes, and retouched tools.

The morpho-technical analysis is supplemented with further comparative statistical analyses in order to compare the lithic assemblages from both regions of study within the Iberian Peninsula. The observations obtained as a result of this study are then placed in the wider context of the Mousterian lithic assemblages of the Middle Palaeolithic of both areas of study in order to obtain a broader view of Neanderthal technological behaviour.

5.2 ANALYSES OF MOUSTERIAN LITHIC ASSEMBLAGES FROM CANTABRIAN REGION.

5.2.1 AXLOR CAVE

5.2.1.1 Location

Axlor Cave is located in the village of Dima (Bizkaia), about 320m above sea level in the Urrestei Mountain. It is an old upwelling, silted up, belonging to the Balzola Karst System. The visible extent of the site is 60m^2, and it is situated within an interior valley where the Cantabrian valleys (Atlantic basin) and the Alavese Plateau (Mediterranean basin) meet. Its distance from the present coastline is just over 30km (Barandarián 1980; Ríos-Garaizar 2012).



Figure 5.1. View of Axlor Cave

5.2.1.2 Geological setting

The geological make-up of Axlor is mostly karstic, from the Urgonian complex (Lower Cretaceous), alternating with sandstones and siltstones bands related to the Purbeck-Weald and Supraurgoniano complexes respectively, both being Lower Cretaceous. Quaternary deposits within river basins have also been reported in this area (Baldeón 1999).

5.2.1.3 Historical Background

The site was discovered by J.M. Barandiarán in 1932 and excavated by his team between 1967 and 1971. In 2000, a new excavation, led by J. González-Urquijo and J.J. Ibañez, was carried out. The results from the first excavations were only ever partially published (Barandarián 1980, Baldeón 1999, Altuna 1989, Basade 1970), while the materials recovered from its second excavation are still undergoing analysis (González-Urquijo *et al* 2005, 2006; Ríos-Garaizar 2005, 2012; Castaños 2005; Mozota 2009).

5.2.1.4 Stratigraphic sequence

Barandarián described nine stratigraphic levels. The first two levels were reportedly sterile, with levels III to VIII showing to evidence of human occupation (Barandarián 1980). When Urquijo and Ibañez carried out new excavations at Axlor, levels that were contemporary with those identified by Barandarián were discovered. However, despite efforts to correlate both stratigraphies, with Urquijo and Ibañez´s levels B to N corresponding to Barandarián´s Levels III to VIII, this has often not been an easy task. The historic stratigraphic sequences often intersect the newly documented units, with Levels III and IV corresponding with Levels B and D; Level VI corresponding with Levels E and F; Level VII to Level M; and Level VIII to Level N (Tables 5.1. and 5.2.)(Ríos-Garaizar *et al* 2015)

<table>
<tr><th colspan="2">Stratigraphic sequence</th></tr>
<tr><th>Barandarian</th><th>González & Ibáñez</th></tr>
<tr><td>0</td><td></td></tr>
<tr><td>I</td><td></td></tr>
<tr><td>II</td><td>A</td></tr>
<tr><td rowspan="2">III</td><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td>IV</td><td>D</td></tr>
<tr><td rowspan="2">V</td><td>E</td></tr>
<tr><td>F</td></tr>
<tr><td>VI</td><td>M</td></tr>
<tr><td>VII</td><td rowspan="2">N</td></tr>
<tr><td>VIII</td></tr>
<tr><td>IX</td><td>P</td></tr>
</table>

Table 5.1. Correlation of the stratigraphic sequence of Axlor Cave from Barandarián and González & Ibáñez excavations.

Barandarian sequence			
Level	**Composition**	**Thickness (cm)**	**Cultural attribution**
0	Cemented limestone pebbles	100	Sterile
I	Limestone blocks and sediment	250	Sterile
II	Sand and some stones	60	Sterile
III	Sandy-clay with gravels	25	Mousterian
IV	Clayey-silt	50	Mousterian
V	Sandy with limestones pebbles and lenses of clay	40	Mousterian
VI	Sandy, stony with hearths	40	Mousterian
VII	Sandy, stony with hearths	10	Mousterian
VIII	Sandy with hearths and limestone stones	50	Mousterian
IX			Sterile
González & Ibañez sequence			
Level	**Composition**	**Thickness (cm)**	**Cultural attribution**
A	Clay	5-40	Sterile
B	abundance of bones and lithics	5-7	Mousterian
C	Sandy with lenses of clay	15-25	Sterile
D	abundance of bones and lithics	25	Mousterian
E	Clay with limestone clasts	5-10	Sterile
F	Clay with limestone clasts	50	Mousterian
M	brown and red matrix	40	Mousterian
N	yellowish clay	10	Sterile
P	yellowish clay with big limestone blocks		Sterile

Table 5.2. Stratigraphic sequence from Barandarián and González & Ibáñez excavations.

5.2.1.5 Dating

González & Ibáñez (2001) have attributed this sequence to the late Middle Palaeolithic (Table 5. 3).

Level	Cultural attribution	Material	Method	Lab. Ref.	Date	References
D	Mousterian	bone	14 C AMS	Beta-144262	42,000 ± 1280 BP	González & Ibáñez 2001
D	Mousterian	bone	14 C AMS	Beta-225486	> 43,000 BP	Ríos Garaizar 2012
F	Mousterian	bone	14 C AMS	Beta-225487	> 47,500 BP	Ríos Garaizar 2012
F	Mousterian	bone	14 C AMS	Beta-225485	33,310 ± 360 BP	Ríos Garaizar 2012

Table 5.3. Dating of Axlor Cave.

5.2.1.6 Archaeological record

J.M. Basade (1973) reports that five separate human dental remains were recovered from Level III and subsequently attributed as Neanderthal remains. These were three molars, a pre-molar, and a canine, all attributed to an adult Neanderthal.

5.2.1.7 Lithic Assemblage

The number of lithics analysed from this site totalled 1,219 pieces, attributed to levels III (n=754) and IV (n=465), recovered during the original excavations carried out by Barandarián. The collection is currently housed at the Archaeological Museum of Bilbao.

Raw Material

The composition of the raw material is characterised by a high proportion of flint (85%) (Figures 5.2. and 5.3.), which is not naturally present within the site. The nearest sources of flint in the area are located either within coastal outcrops of flysch at Treviño at a distance of 30km north from site, or in outcrops at Urbasa between 40km to 50km south of the site (Tarriño 2001). According to Ríos Garaizar (2005), flint was introduced into the site in the form of retouched flakes (Quina side scrapers), which were then further exploited as second generation cores or for ramified blank production. Other raw materials (15%) were sourced from local sources, such as mudstone and quartz, which were introduced into the site in the form of unmodified pebbles and were rarely used for the production of large cutting tools.

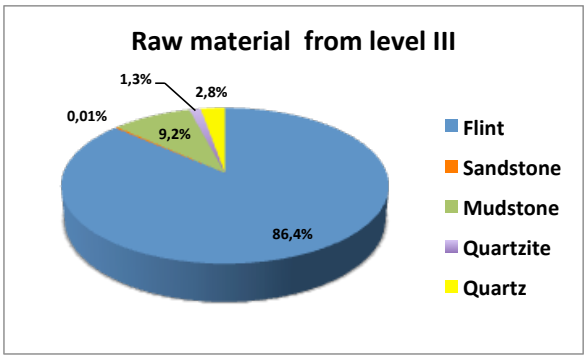


Figure 5.2. Raw material from level III

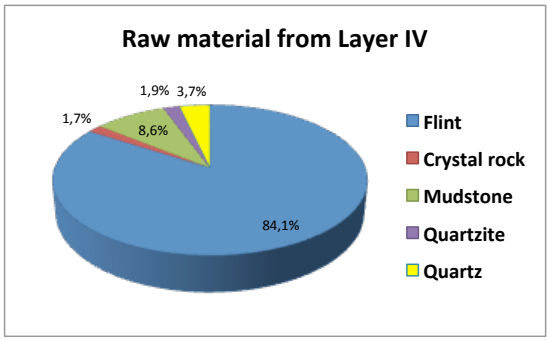
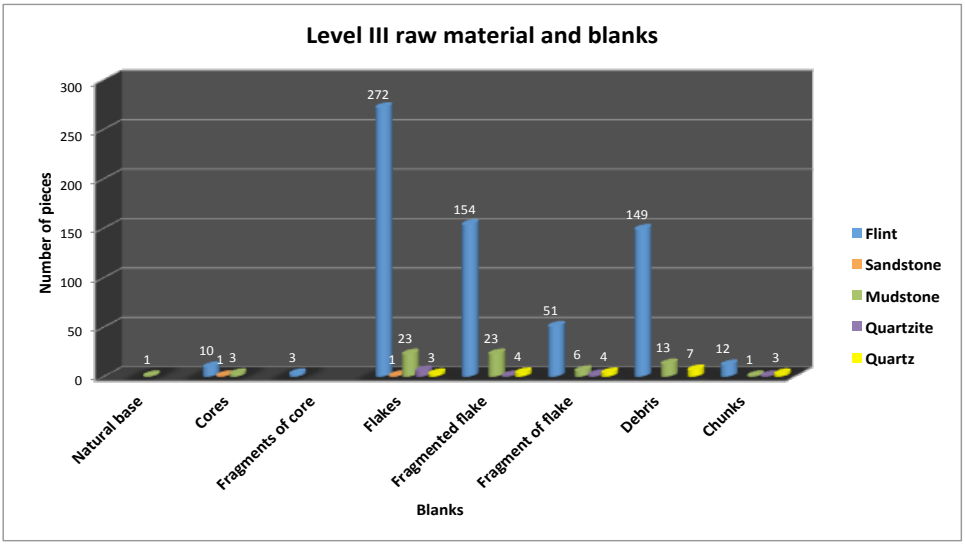


Figure 5.3. Raw material from level IV

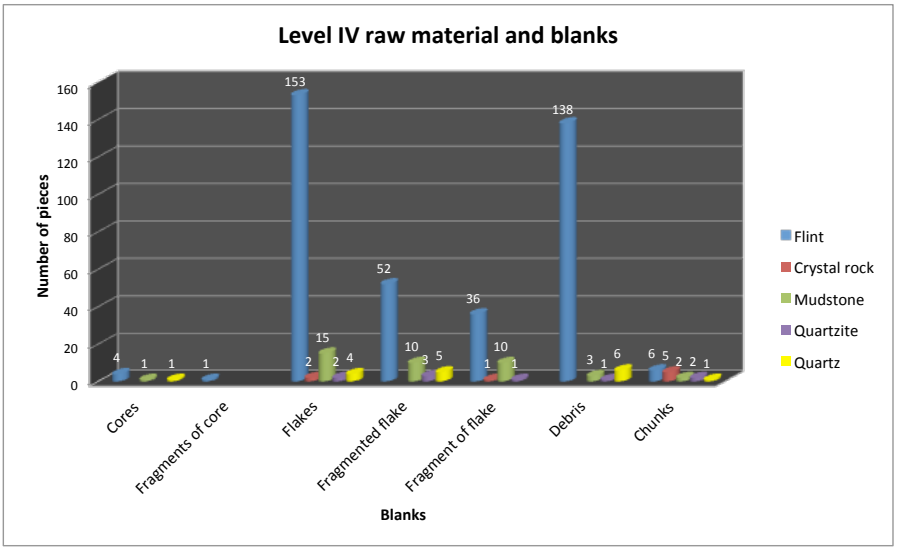
Technical Categories

The bulk of both assemblages is composed mainly of flakes (n=481; 40%), flake fragments (n=363; 29%) and debris (n=317; 25%), with cores amounting to a very insignificant percentage. A predominance of knapping products is observed, suggesting that the knapping strategy employed at the site was oriented towards the systematic production of flakes (Tables 5.4,5.5; Figures 5.4,5.5).



Level III	Natural base	Cores	Fragments of core	Flakes	Fragmented flake	Fragment of flake	Debris	Chunks	TOTAL	%
Flint		10	3	272	154	51	149	12	651	86
Sandstone		1		1					2	0,3
Mudstone	1	3		23	23	6	13	1	70	9
Quartzite				6	1	2		1	10	1
Quartz				3	4	4	7	3	21	3
TOTAL	1	14	3	305	182	63	169	17	754	
%	0,1	1,9	0,4	40,5	24,1	8,4	22,4	2,3		

Figure 5.4 and Table 5.4. Raw material and blanks from level III.



Level IV	Cores	Fragments of core	Flakes	Fragmented flake	Fragment of flake	Debris	Chunks	Total	%
Flint	4	1	153	52	36	138	6	390	84
Crystal rock			2		1		5	8	2
Mudstone	1		15	10	10	3	2	41	9
Quartzite			2	3	1	1	2	9	2
Quartz	1		4	5		6	1	17	4
total	6	1	176	70	48	148	16	465	
%	**1**	**0,2**	**38**	**15**	**10**	**32**	**3**		

Figure 5.5 and Table 5.5. Raw material and blanks from level IV.

Analysis of cores

From levels III and IV, it was possible to identify 15 cores, 5 cores on flakes, and 4 core fragments (Table 5.6). The four core fragments and one core on flake are not included in the analysis, as data on them is incomplete. The attributes of a total of 19 cores were analysed according to the criteria previously described in Chapter 4.

The proportions of raw materials of the Axlor cores correspond with those observed for the whole lithic assemblage studied. Flint cores were the most abundant (n=18; 75%), followed by mudstone (n=4; 17%), sandstone (n=1; 4%) and quartz (n=1; 4%).

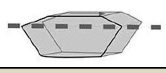
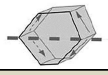
Although the majority of the cores do not have remnants of cortex (n=10; 55%), 9 cores (45%) still retained some of their cortex at the point they were abandoned. The cores produced from local raw materials corresponded with the pieces retaining the most amount of cortex (mudstone: n=1; 5% with 50% of cortex, n=1; 5% with 75 % of cortex, sandstone: n=1; 5% with 75 % of cortex) (Table 5.6).

When looking at the stages of the knapping sequence, we observe that most of the cores (n=17; 89%) are in the terminal stage, with no cores belonging to the first stages of reduction present in the assemblage (Table 5.6). From these results, we can infer evident cultural and economical behaviours which we can attribute to these archaeological levels – flint cores were exploited until they were completely exhausted, whereas more readily available and inferior raw materials were seemingly frivolously abandoned.

When quantifying how the cores were reduced, we observe that bifacial reduction is predominant (n=14; 79%), with only 5 (26%) pieces showing signs of unifacial reduction. The knapping strategies employed were also varied – the most common being centripetal (n=9; 47%) and multidirectional (n=6; 32%), with unidirectional (n=2; 11%) and bidirectional (n=2; 11%) being less common (Table 5.6). This predominance in centripetal and multidirectional strategies is in accordance with what is expected of the terminal stage of the knapping sequence, as previously observed. These cores are mainly characterised by

non-hierarchical strategies.

The method of knapping is very difficult to identify in this assemblage due to the intense degree of exploitation of the cores, and so cannot be classified with any further precision. In addition, the sample size is very small, with many of the flakes a by-product of the reduction of retouched tools, mainly from the Quina side-scrapers. Despite these limitations, I was able to identify that some cores were reduced by Quina (n=12; 63%) methods (Table 5.6).

ANALYSIS OF CORES



Level	Raw material	Cores	Cores on flake	Fragment of cores	TOTAL	%
III	Flint	5	5	3	13	54
	Mudstone	3			3	13
	Sandstone	1			1	4
IV	Flint	4		1	5	21
	Mudstone	1			1	4
	Quartz	1			1	4
TOTAL		15	5	4	24	
%		63	21	17		

AMOUNT OF CORTEX

Level	Raw material	0%	≤ 25%	≤ 50%	≤ 75%	TOTAL	%
III	Flint	6	3			9	45
	Mudstone	1		1	1	3	15
	Sandstone				1	1	5
IV	Flint	1	3			4	20
	Mudstone	1				1	5
	Quartz	1				1	5
TOTAL		10	6	1	2	19	
%		55	30	5	10		

STAGE OF KNAPPING SEQUENCE

Level	Raw material	Exploitation	Terminal	TOTAL	%
III	Flint		9	9	45
	Mudstone	1	2	3	15
	Sandstone		1	1	5
IV	Flint	1	3	4	20
	Mudstone		1	1	5
	Quartz		1	1	5
TOTAL		2	17	19	
%		11	89		

FACIAL ATTRIBUTE

Level	Raw material	Bifacial	Unifacial	TOTAL	%
III	Flint	8	1	9	47
	Mudstone	2	1	3	16
	Sandstone		1	1	5
IV	Flint	4		4	21
	Mudstone		1	1	5
	Quartz		1	1	5
TOTAL		14	5	19	
%		74	26		

STRATEGIES OF KNAPPING

Level	Raw material	Centripetal	Unidirectional	Bidirectional	Multidirectional	TOTAL	%
III	Flint	4	1	1	3	9	47
	Mudstone	2	1			3	16
	Sandstone				1	1	5
IV	Flint	1		1	2	4	21
	Mudstone	1				1	5
	Quartz	1				1	5
TOTAL		9	2	2	6	19	
%		47	11	11	32		

METHOD OF KNAPPING

Level	Raw material	Quina	Indeterminate	TOTAL	%
III	Flint	6	3	9	47
	Mudstone	2	1	3	16
	Sandstone		1	1	5
IV	Flint	4		4	21
	Mudstone		1	1	5
	Quartz		1	1	5
TOTAL		12	7	19	
%		63	37		

Table 5.6. Analysis of cores.

The result of the metric measurements of the cores show a mean of 44mm length, 37mm width and 23mm thickness, with a mean area of 2110mm^2, suggesting on average that the cores from this site are of small size (Table 5.7).

		Length	Width	Thickness	Area
Number of cores		19	19	19	19
Mean		44	37	23	2110
Mode		43	25	21	504
Median		36	27	20	935
Maximum value		109	115	53	12495
Minimum value		24	21	12	506
Kurtosis		3	5	2	8
Standard deviation		23	25	12	3004
Percentile	25	30	25	18	812
	50	36	27	20	935
	75	44	33	23	1340

Table 5.7. Measures of cores from levels III and IV.

A scatter plot of the measurements (length and width) of the cores shows a concentration of points between 24mm x 48 mm (length) and 20mm x 48 mm (width) (Figure 5.6); this again shows that the majority of the cores are of an average small size.

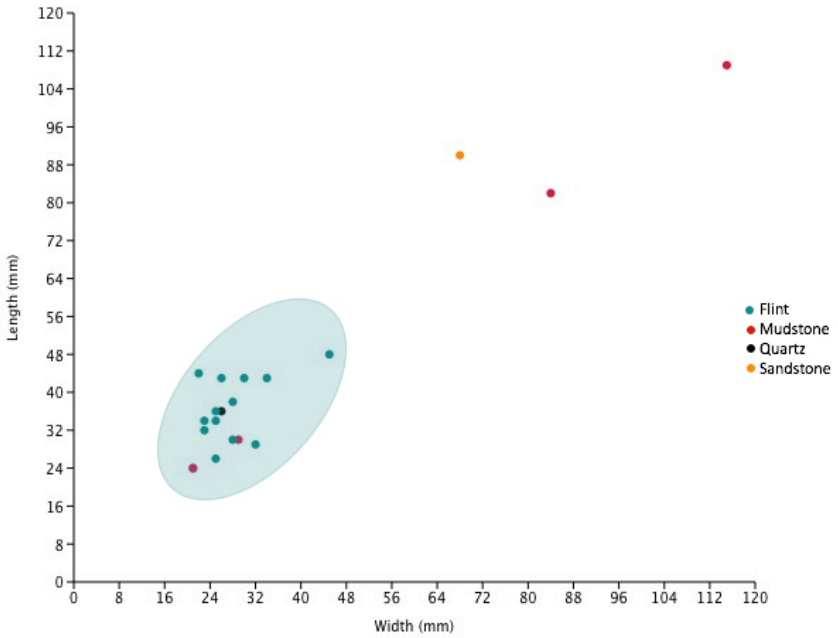


Figure 5.6. Scatter plot of the measurements of cores from level III and IV.

The Flake Analyses

The flake sample studied (n=481) is made up of 305 flakes from Level III and 176 flakes from Level IV. An additional 363 flake fragments, from both levels, were also studied.

Ventral Face

Type of Bulb

The assemblage is dominated by flakes showing a diffuse bulb (n=278; 58%) with fewer showing a pronounced bulb (n=195; 41%). The flint flakes show a high proportion of both types of bulb, which would suggest a different use of hammers, strike intensity or method of knapping (Table 5.8).

The delineation of the ventral face is diverse, with sinuous delineation pieces (n=257; 53%) outnumbering convex (n=89; 19%), straight (n=79; 16%) and concave delineation (n=50; 10%) (Table 5.8).

Butt

When describing the butt surface, the majority of the assemblage is non-cortical (n=457; 95%) only 18 (4%) showing any remnants of cortex (Table 5.8). This indicates that there are no flakes originating from the initial phase of reduction of the cores, suggesting that the primary preparation of the pebbles took place outside of the cave.

The platform is the most common type of butt present in the assemblage (n=332; 69%), followed by a smaller proportion of linear (n=96; 20%), puntiform (n=29; 6%), and cortical (n=18; 4%) types (Table 5.8). The linear type of butt, which is highly represented in this assemblage, is most likely derived from the exploitation of Quina retouched side-scrapers. The preparation of the butt is characterised by a high presence of plain butts (n=351; 73%), followed by multifaceted (n=46; 10%), puntiform (n=31; 6%), bifaceted (n=29; 6%), and cortical (n=18; 4%) (Table 5.8).

Among the different types of delineation of butt, the most represented type is the straight delineation, present in 304 pieces (63%), followed by sinuous (n=99; 21%), uniangular (n=44; 9%), convex (n=5; 1%), and concave (n=5; 1%) (Table 5.8).



VENTRAL FACE AND BUTT



TYPE OF BULB

Level	Raw material	Marked	Difuse	Deleted	Kombewa	TOTAL	%
III	Flint	122	145	1	4	272	57
	Sandstone		1			1	0,2
	Mudstone	10	13			23	5
	Quartzite	3	3			6	1
	Quartz		3			3	1
IV	Flint	54	96	1	2	153	32
	Crystal rock		2			2	0,4
	Mudstone	6	9			15	3
	Quarzite		2			2	0,4
	Quartz		4			4	1
TOTAL		195	278	2	6	481	
%		41	58	0,4	1		

DELINEATION OF VENTRAL FACE

Level	Raw material	Sinuous	Convex	Concave	Straight	Kombewa	TOTAL	%
III	Flint	149	50	26	43	4	272	57
	Sandstone		1				1	0,2
	Mudstone	11	4	2	6		23	5
	Quartzite	2	2	1	1		6	1
	Quartz	1			2		3	1
IV	Flint	81	27	20	23	2	153	32
	Crystal rock	1	1				2	0,4
	Mudstone	9	2	1	3		15	3
	Quartzite	1	1				2	0,4
	Quartz	2	1		1		4	1
TOTAL		257	89	50	79	6	481	
%		53	19	10	16	1		

CORTICALITY OF BUTT

Level	Raw material	Cortical	No cortical	Kombewa	TOTAL	%
III	Flint	11	257	4	272	57
	Sandstone		1		1	0,2
	Mudstone	3	20		23	5
	Quartzite		6		6	1
	Quartz	1	2		3	1
IV	Flint	2	149	2	153	32
	Crystal rock		2		2	0,4
	Mudstone		15		15	3
	Quartzite	1	1		2	0,4
	Quartz		4		4	1
TOTAL		18	457	6	481	
%		4	95	1		

TYPE OF BUTT

Level	Raw material	Platform	Linear	Puntiform	Cortical	Kombewa	TOTAL	%
III	Flint	188	55	14	11	4	272	57
	Sandstone	1					1	0,2
	Mudstone	14	4	2	3		23	5
	Quartzite	5	1				6	1
	Quartz	2			1		3	1
IV	Flint	104	33	12	2	2	153	32
	Crystal rock	1		1			2	0,4
	Mudstone	12	3				15	3
	Quartzite	1			1		2	0,4
	Quartz	4					4	1
TOTAL		332	96	29	18	6	481	
%		69	20	6	4	1		

FACETS OF BUTT

Level	Raw material	Plain	Bifaceted	Multifaceted	Puntiform	No faceted	Kombewa	TOTAL	%
III	Flint	208	14	21	14	11	4	272	57
	Sandstone	1						1	0,2
	Mudstone	12	2	3	3	3		23	5
	Quartzite	3		3				6	1
	Quartz	1			1	1		3	1
IV	Flint	110	11	16	12	2	2	153	32
	Crystal rock			1	1			2	0,4
	Mudstone	14		1				15	3
	Quartzite		1			1		2	0,4
	Quartz	2	1	1				4	1
TOTAL		351	29	46	31	18	6	481	
%		73	6	10	6	4	1		

DELINEATION OF BUTT

Level	Raw material	Sinuous	Convex	Concave	Straight	Uniangular	Coritcal	Kombewa	TOTAL	%
III	Flint	34	2	4	195	22	11	4	272	57
	Sandstone				1				1	0,2
	Mudstone	4			13	3	3		23	5
	Quartzite	3			3				6	1
	Quartz	1			1		1		3	1
IV	Flint	50	3	1	78	17	2	2	153	32
	Crystal rock	1				1			2	0,4
	Mudstone	3			12				15	3
	Quartzite					1	1		2	0,4
	Quartz	3			1				4	1
TOTAL		99	5	5	304	44	18	6	481	
%		21	1	1	63	9	4	1		

Table 5. 8. Ventral face and butt analysis.

The analysis of the internal knapping angles of 474 flakes indicates a mean of 107°, a mode of 120° and a median of 107°. These data suggest a preference for obtuse angles (Table 5.9).

Angle of knapping		
Number of flakes		474
Mean		107
Mode		120
Median		107
Maximum value		145
Minimum value		66
Kurtosis		-0,4
Standard deviation		14
Percentile	25	96
	50	107
	75	118

Table 5.9. Angle of knapping of the total of the flakes

Dorsal Face

The study of the dorsal surface shows the degree of transformation within the knapping sequence. In the case of the frequency of corticality on the dorsal surface, the majority of flakes (n=400; 83%) do not retain any cortex, with 58 pieces (12%) retaining less than 50% of cortex, 11 pieces (2%) retaining more than 50% of cortex, and only 6 pieces (1%) being fully cortical flakes. The under-representation of cortical pieces would once again reinforce the interpretation that the primary reduction of pebbles took place outside of the cave. The kombewa flakes (n=6; 1%) have not been considered in this analysis (Table 5.10).

The direction of scars shows a high diversity, with three categories being highly represented: multidirectional (n=172; 36%), unidirectional (n=153; 32%), and centripetal (n=110; 23%). Bidirectional scars are under-represented (n=32; 7%) (Table 5.10).



DORSAL FACE

AMOUNT OF CORTEX							
Level	**Raw material**	**0%**	**≤50%**	**>50%**	**100%**	**TOTAL**	**%**
III	**Flint**	241	23	3	1	268	56
	Sandstone	1				1	0,2
	Mudstone	14	5	2	2	23	5
	Quartzite	5	1			6	1
	Quartz	3				3	1
IV	**Flint**	119	27	3	2	151	31
	Crystal rock	2				2	0,4
	Mudstone	10	1	3	1	15	3
	Quartzite	2				2	0,4
	Quartz	3	1			4	1
TOTAL		400	58	11	6	475	
%		83	12	2	1		

DIRECTIONS OF SCARS									
Level	**Raw material**	**Centripetal**	**Unidirectional**	**Bidirectional**	**Multidirectiona**	**indeterminate**	**Kombewa**	**TOTAL**	**%**
III	**Flint**	73	97	18	79	1	4	272	57
	Sandstone		1					1	0,2
	Mudstone	8	9	1	2	3		23	5
	Quartzite	3	1		2			6	1
	Quartz			1	2			3	1
IV	**Flint**	24	39	11	74	3	2	153	32
	Crystal rock				2			2	0,4
	Mudstone	1	5	1	7	1		15	3
	Quartzite	1			1			2	0,4
	Quartz		1		3			4	1
TOTAL		110	153	32	172	8	6	481	
%		23	32	7	36	2	1		

Table 5.10. Dorsal face analysis.

The analysis of the scars of 467 flakes indicates a mean of 9 scars, a mode of 8 and a median of 3. As scars are indicative of previous removals, a mean of 9 scars on the dorsal face suggests a high degree of reduction (Table 5.11).

Number of scars		
Number of flakes		467
Mean		9
Mode		8
Median		8
Maximum value		40
Minimum value		1
Kurtosis		2,6
Standard deviation		6
Percentile	25	5
	50	8
	75	12

Table 5.11. Number of scars of the dorsal face from levels III and IV.

The measurement data of flakes shows a mean length of 24mm, a mean width of 24mm and a mean thickness of 7mm. The mode and median show similar measures. The mean area is 626mm^2. These measurements suggest that on average, the pieces are of a small size. The elongation index shows a mean of 1.08, suggesting that there is no laminar tendency in the assemblage. The flattening index shows a mean of 0.35, suggesting the flakes are extremely thin (Table 5.12).

		Length	Width	Thickness	Area	Elongation Index	Flattening index
Number of flakes		481	481	481	481	481	481
Mean		24	24	7	626	1,08	0,35
Mode		20	25	7	820	0,57	0,31
Median		22	23	6	546	1,00	0,31
Maximum value		74	75	34	4664	2,94	1,46
Minimum value		7	8	2	105	0,41	0,12
Kurtosis		3	3	5	23	2,12	7,16
Standard deviation		9	9	4	476	0,41	0,15
Percentile	25	18	18	4	326	0,79	0,24
	50	22	23	6	546	1,00	0,31
	75	29	29	9	767	1,28	0,42

Table 5.12. Measures of the flakes from levels III and IV.

Two scatterplots of the measurements (length and width) of flakes show a concentration of points between 10mm x 35mm (length) and 10mm x 40mm (width) within both levels (III and IV) (Figure 5.7 and 5.8). Once again, the majority of the flint flakes are predominantly small in size, while the mudstone and quartzite flakes are of medium size. This could be related to the kind of raw material used to obtain these products. In the case of flint, the majority of the blanks were flakes, whereas in the case of the local raw materials (mudstone, quartzite, sandstone), the blanks were mainly pebbles.

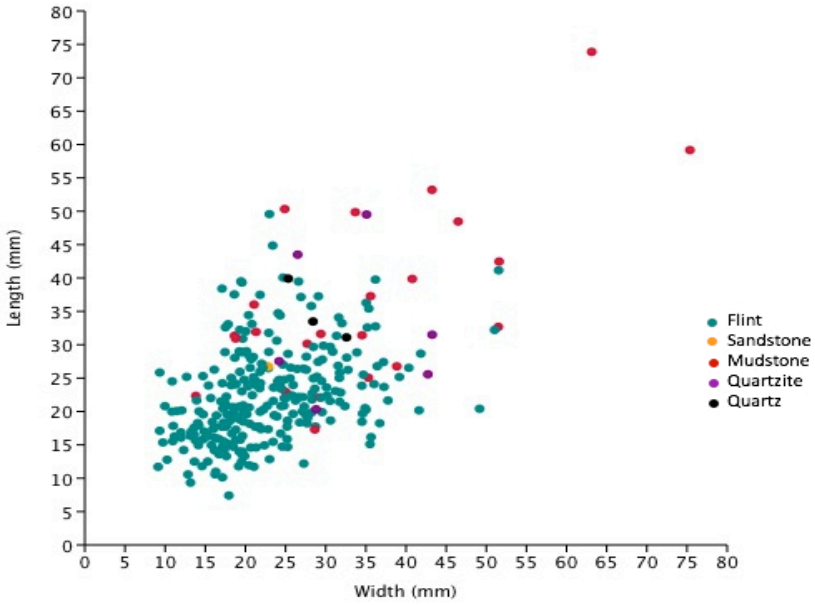


Figure 5.7. Scatter plot of the measurements of the flakes from level III.

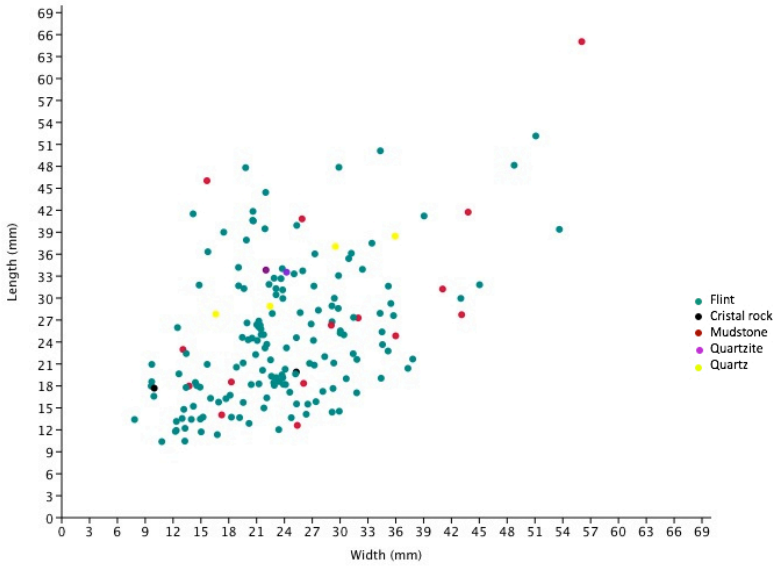


Figure 5.8. Scatter plot of the measurements of the flakes from level IV.

Retouched pieces

A total of 271 retouched pieces were studied from Levels III-IV (Table 5.13). The kind of blanks that were selected for retouching are flakes (n=147; 54%), followed by fragmented flakes (n=69; 25%), flake fragments (n=42; 15%), chunks (n=7; 3%) and fragments of core (n=1; 0.5%) in smaller proportions respectively. The majority of the pieces have unifacial retouch (n=255; 94%) with only 6% (n=16) of pieces showing a bifacial retouch.

Regarding the extent of retouch found along the edge of the flakes, retouched pieces with a >25 to ≤50% extent of retouch predominate in the assemblage (n=132; 50%), followed by pieces with >50% ≤ 75% extent (n=39; 14%), ≤25% (n=28; 10%) and >75 ≤100% extent (n=8; 3%) respectively. With these data we can conclude that the retouched tools assemblage have an high degree of retouch.

Although the sum of the individual number of retouched pieces analysed equals 271, the total number of shaped edges analysed is 319, as represented in Table 5.13. The majority of the retouch is located on the sides (n=253; 79%). The right side is the predominant side with extensive retouch (n=129; 40%), followed by the left side (n=124; 39%), and the distal (n=49; 15%) and proximal (n=16, 5%) areas in smaller proportions respectively.

Semi-abrupt retouch angles (n=200; 58%) are the dominant angles present in this assemblage, followed by abrupt angles (n=80; 23%), and simple angles (n=66; 19%).

With regard to the extent of retouch on the dorsal/ventral surfaces, extensive retouch is the most well represented (n=183; 53%), followed by marginal retouch (n=135; 39%), very marginal retouch (n=21; 6%) and very extensive (n=7; 2%). In relation to the depth of retouch on the dorsal/ventral surfaces, marginal retouch prevails (n=167, 48%), followed by deep retouch (n=151, 44%), very marginal (n=24, 7%), and very deep (n=4, 1%).

The predominant direction of retouch is direct (n=314; 91%), followed by inverse (n=15; 4%), alternate (n=10; 3%), and alternating (n=7; 2%).

The delineation of the retouched edge is predominantly continuous (n=300; 87%), followed by denticulate retouch (n=42; 12%) and encoche retouch (n=4; 1%) less represented. The data obtained by these two attributes are in direct correlation with the type of tools within the assemblage, i.e. scrapers and denticulates.

Regarding the morphology of the retouched edge, the sinuous type is most common (n=133; 38%), followed by convex (n=99; 29%), straight (n=66; 19%), denticulate (n=42; 12%), encoche (n=4; 1%), and finally concave (n=2; 1%).



RETOUCHED TOOL



TYPES OF BLANK

Level	Raw material	Flakes	Fragmented flake	Fragment of flake	Fragment of core	Chunk	Debris	TOTAL	%
III	Flint	70	37	15	1	5	4	132	49
	Mudstone	5	6	2				13	5
	Quartzite	2						2	1
	Quartz	1	1	1				3	1
IV	Flint	58	17	20		1	1	97	36
	Crystal rock	1	1					2	1
	Mudstone	4	2	3		1		10	4
	Quarzite	2	3	1				6	2
	Quartz	4	2					6	2
TOTAL		147	69	42	1	7	5	271	
%		54	25	15	0	3	2		

FACIAL ATRIBUTE

Level	Raw material	Unifacial	Bifacial	TOTAL	%
III	Flint	127	5	132	49
	Mudstone	13		13	5
	Quartzite	2		2	1
	Quartz	3		3	1
IV	Flint	91	6	97	36
	Crystal rock		2	2	1
	Mudstone	8	2	10	4
	Quarzite	5	1	6	2
	Quartz	6		6	2
TOTAL		255	16	271	
%		94	6		

EXTENSION

Level	Raw material	≤ 25%	>25 ≤50%	>50 ≤75%	>75 ≤100%	Unknown	TOTAL	%
III	Flint	17	61	16	5	33	132	49
	Mudstone	2	6	1		4	13	5
	Quartzite		2				2	1
	Quartz		2			1	3	1
IV	Flint	5	48	18	3	23	97	36
	Crystal rock		2				2	1
	Mudstone	2	3	3		2	10	4
	Quarzite	2	3	1			6	2
	Quartz		5			1	6	2
TOTAL		28	132	39	8	64	271	
%		10	49	14	3	24		

LOCALITATION

Level	Raw material	Left	Distal	Right	Proximal	Unknown	TOTAL	%
III	Flint	60	26	61	9		156	49
	Mudstone	6		3			9	3
	Quartzite			2			2	1
	Quartz	1		2			3	1
IV	Flint	47	20	47	5		119	37
	Crystal rock		1			1	2	1
	Mudstone	5	1	7			13	4
	Quarzite	2	1	4	1		8	3
	Quartz	3		3	1		7	2
TOTAL		124	49	129	16	1	319	
%		39	15	40	5	0,3		

ANGLE

Level	Raw material	Abrupt	Semi abrupt	Simple	TOTAL	%
III	Flint	46	84	36	166	48
	Mudstone	4	9	3	16	5
	Quartzite		2		2	1
	Quartz	1	2		3	1
IV	Flint	22	84	22	128	37
	Crystal rock		2		2	1
	Mudstone	3	6	5	14	4
	Quarzite	3	5		8	2
	Quartz	1	6		7	2
TOTAL		80	200	66	346	
%		23	58	19		

DEEP OF RETOUCHED ON SURFACE

Level	Raw material	Very marginal	Marginal	Extensive	Very extensive	TOTAL	%
III	Flint	10	73	81	2	166	48
	Mudstone	1	9	6		16	5
	Quartzite			2		2	1
	Quartz			3		3	1
IV	Flint	8	38	77	5	128	37
	Crystal rock			2		2	1
	Mudstone	1	8	5		14	4
	Quarzite		3	5		8	2
	Quartz	1	4	2		7	2
TOTAL		21	135	183	7	346	
%		6	39	53	2		

DEEP OF RETOUCHED ON EDGE

Level	Raw material	Very marginal	Marginal	Deep	Very deep	TOTAL	%
III	Flint	9	78	77	2	166	48
	Mudstone		8	8		16	5
	Quartzite			2		2	1
	Quartz		2	1		3	1
IV	Flint	12	63	52	1	128	37
	Crystal rock		2			2	1
	Mudstone	2	7	5		14	4
	Quarzite		2	5	1	8	2
	Quartz	1	5	1		7	2
TOTAL		24	167	151	4	346	
%		7	48	44	1		

DIRECTION

Level	Raw material	Direct	Inverse	Alternate	Alternating	TOTAL	%
III	Flint	151	8	5	2	166	48
	Mudstone	15			1	16	5
	Quartzite	2				2	1
	Quartz	3				3	1
IV	Flint	117	6	2	3	128	37
	Crystal rock	1		1		2	1
	Mudstone	12		1	1	14	4
	Quarzite	7		1		8	2
	Quartz	6	1			7	2
TOTAL		314	15	10	7	346	
%		91	4	3	2		

DELINEATION

Level	Raw material	Continuous	Denticulate	Encoche	TOTAL	%
III	Flint	140	26		166	48
	Mudstone	9	7		16	5
	Quartzite	1	1		2	1
	Quartz	3			3	1
IV	Flint	126	2		128	37
	Crystal rock	2			2	1
	Mudstone	7	5	2	14	4
	Quarzite	5	1	2	8	2
	Quartz	7			7	2
TOTAL		300	42	4	346	
%		87	12	1		

MORPHOLOGY

Level	Raw material	Straight	Convex	Concave	Sinuous	Denticulate	Encoche	TOTAL	%
III	Flint	25	33	1	81	26		166	48
	Mudstone	5	1		3	7		16	5
	Quartzite				1	1		2	1
	Quartz		1		2			3	1
IV	Flint	33	54	1	38	2		128	37
	Crystal rock		1		1			2	1
	Mudstone	2	2		3	5	2	14	4
	Quarzite	1	3		1	1	2	8	2
	Quartz		4		3			7	2
TOTAL		66	99	2	133	42	4	346	
%		19	29	1	38	12	1		

Table 5.13. Retouched tools analysis.

Following the Laplace typology (Table 5.14), the retouched tools are grouped into four main groups: scrapers (n=224), denticulates (n=38), Mousterian points (n=4), and end-scrapers (n=5).

Amongst the scrapers, there is a similar proportion of side scrapers with abrupt retouch (R21) (n=91; 34%) and side scrapers with marginal retouch (R1) (n=86; 32%). Less represented are the transverse scrapers R22 (n=20; 7%), and side-transverse scrapers R23 (n=16; 6%) and R3 (n=11; 4%) respectively.

Amongst the denticulates, several types were identified - marginal denticulate retouch D1 (n= 27; 10%), carinated denticulate D3 (n=4; 1%), encoche D21 (n=3, 1%), denticulate scrapers D23 (n=2; 1%), denticulate end-scrapers D25 (n=2; 1%) -.

Within the tool assemblage analysed (n=4, 1%) Mousterian points were documented.

LAPLACE TYPOLOGY																	
Level	Raw material	R1	R21	R22	R23	R3	Mousterian Point	D1	D3	D21	D23	D25	G11	G12	G3	TOTAL	%
III	Flint	44	40	12	6	6	2	16	2		1	2			1	132	49
	Mudstone	3	2		1			5	1		1					13	5
	Quartzite		1						1							2	1
	Quartz	2				1										3	1
IV	Flint	28	41	7	9	3	2	2		1			3	1		97	36
	Crystal rock		1	1												2	1
	Mudstone	4	2					3		1						10	4
	Quarzite	1	2			1		1		1						6	2
	Quartz	4	2													6	2
TOTAL		86	91	20	16	11	4	27	4	3	2	2	3	1	1	271	
%		32	34	7	6	4	1	10	1	1	1	1	1	0,4	0,4		

Table 5.14. Laplace Typology.

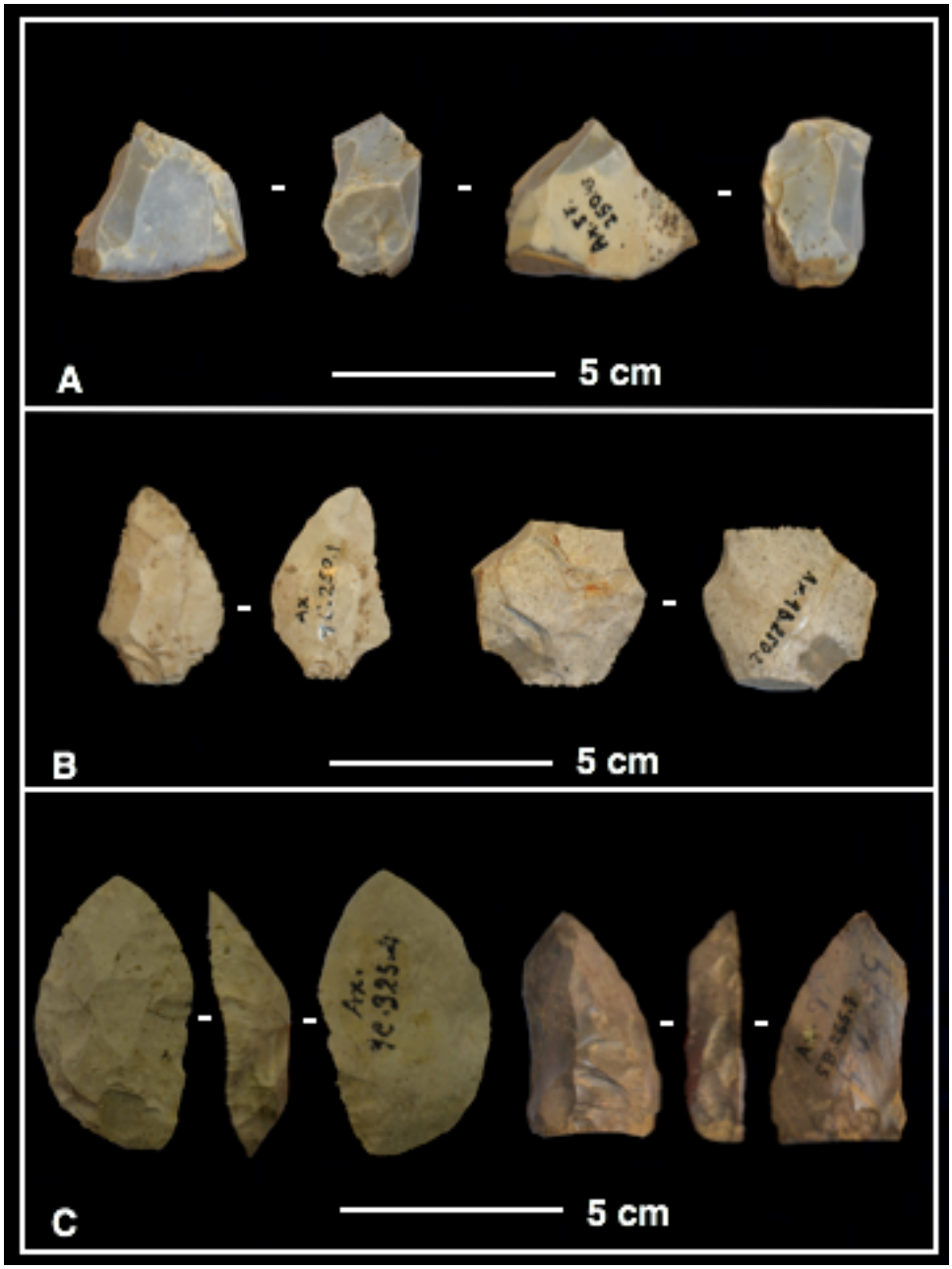


Figure 5. 9. Detail of some lithic artefacts: A. Core, B. Flakes, and C. Retouched tools.

5.2.2 *ESQUILLEU CAVE*

5.2.2.1 Location

Esquilleu Cave is located near the village of Castro-Cillorigo (Cantabria), about 350m above sea level in the *Picos de Europa*. The site is actually a large rock shelter (10m x 15m) that is partially filled with a deposit of unknown depth (more than 8m deep). The geological setting of the site is within a small, rugged, basin set between mountains and valleys. Located on a steep mountain slope, bellow it, at 68 m, is the Deva river, whose valley cuts a natural narrow gorge flowing out towards the Cantabrian coast (26km from the cave) (Baena *et al* 2005).



Figure 5.10. View of Esquilleu Cave

5.2.2.2 Geological setting

The cave is formed of Upper Carboniferous (Westphalian) limestone, with deposits of dark and grey Namurian limestone to the south. The site is located between two geologic domains, the *Picos de Europa* domain (to the north), comprised of quartzite, limestone, and black flint; and the *Pisuerga-Carrión* domain (to the south) comprised of sandstone and mudstones (Manzano *et al* 2005).

5.2.2.3 Historical Background

The cave was discovered by members of the CAEAP group in the early 1980s (Muñoz *et al* 1985). A series of field seasons from 1997 to 2006, led by J. Baena Preysler, were carried out as a result of collaboration between the Autonomous University of Madrid and the Department of Culture of the Government of Cantabria. The results from these excavations were only partially published in several synthetic papers (Baena *et al* 1999, 2001, 2002, 2004, 2005, 2014; Yravedra *et al* 2014;) while research is still on going today.

5.2.2.4 Stratigraphic sequence

A total of 41 stratigraphic levels were defined, 34 of them showing evidence of Mousterian occupations. The occupational sequence is also divided by four main sedimentary units termed A, B, C and D (Jordá *et al* 2008, Mallol *et al* 2010). The area excavated varied according to each level: 14 m^2 were excavated in levels III-VI, 6 m^2 in levels VII-XX and 4 m^2 for levels XXI-XXX (Table 5.15). In total, a depth of 4.2 m was reached. From the top to bottom, levels III to V contained evidence of ephemeral occupation, levels VI to XIV evidence of denser occupation, while levels XV to XXX appear to have been comprised of more specialised occupation (Baena *et al* 2005). Levels XXX to XXXVI are currently under study and levels XXXVII to XLI are sterile deposits formed by low-energy processes (Jordá *et al* 2008).

Level	Composition	Thickness (cm)
III	Breccia with limestones pebbles	15
IV	Clayey-silt	8
V	Fine gravels	10
VIF	Gravels	2-4
VI	Fine gravels	14
VII	Fine gravels	7
VIII	Fine gravels	26
IX	Gravels	2
X	Fine gravels	6
XI	Clayey-sand with gravels	
XIF	Clay with pebbles	
XII	Clay	3-5
XIII	Clay	5-11
XIV	Clay	1-4
XV	Clayey-sand	2-10
XVI	Clay	4-12
XVII	Clay	4-7
XVIII	Clay	2-7
XIX	Clay	2-6
XX	Clayey-silt	
XXI		
XXII		
XXIII		
XXIV		
XXV		
XXVI		
XXVII		
XXVIII		
XIX		
XXX		

Table 5.15. Stratigraphic sequence from Esquilleu Cave (Baena et al 2005).

5.2.2.5 Dating

Dating was conducted in different laboratories and in some cases using different procedures. The first dating sequence revealed a very recent Middle Palaeolithic to levels IV, and IIIb. The dates from level III are inconsistent because it is a level that has been altered by sedimentary processes and carnivore action. It is also possible that the samples in question may have been contaminated by post-depositional processes or percolation. Also the dates were taken from very small fragments of bone without human modification (Baena *et al* 2014; Higham *et al* 2014) (Table 5.16).

Level	Sample	Method	Lab. Ref.	Date
III	charcoal	AMS	GrA-33829	3,640 ± 90 BP
III	bone	AMS	AA-29664	12,050 ± 130 BP
III	bone	Ultrafiltration	OxA-19967	19,300 ± 100 BP
III	bone	Ultrafiltration	OxA-19968	19,310 ± 80 BP
IIIb	bone	Ultrafiltration	OxA-19246	20,810 ± 110 BP
IV	charcoal	AMS	GrA-35064	22,840 ± 280-250 BP
IV	charcoal	AMS	GrA-35064	23,560 ± 120 BP
V	charcoal	AMS	GrA-35066	30,250 ± 500-430 BP
VIF	charcoal	AMS	AA-37883	34,380 ± 670 BP
VI	charcoal	AMS	GrA-33816	40,110 ± 500-420 BP
VI-1	bone	Ultrafiltration	OxA-19965	43,700 ± 1,400 BP
VI-2	bone	Ultrafiltration	OxA-19966	44,100 ± 1,300 BP
XIF	charcoal	AMS	AA-37882	36,500 ± 830 BP
XIII	charcoal	AMS	Beta-149320	39,000 ± 300 BP
XVII-1	charcoal	AMS	OxA-X-2297-31	49,400 ± 1,300 BP
XVII-2	charcoal	ABOX-SC	OxA-20320	52,600 ± 1,200 BP
XVII	charcoal	ABOX-SC	OxA-20318	53,400 ± 1,300 BP
XVII	charcoal	AMS	OxA-19993	> 54,000 BP
XVII	charcoal	ABOX-SC	OxA-20319	> 58,500 BP
XVIII	charcoal	AMS	OxA-19993	49,700 ± 1,600 BP
XIX-1	charcoal	ABA	OxA-19085	39,280 ± 340 BP
XIX-2	charcoal	ABOX-SC	OxA-19086	> 54,600 BP
XIX-3	charcoal	AMS	OxA-V-2284-29	39,600 ± 400 BP
XIX-4	charcoal	AMS	OxA-V-2284-30	39,650 ± 450 BP
XXI-I	charcoal	ABOX-SC	OxA-20321	> 59,600 BP
XXI	burnt clay	TL	Mad 3299	51,034 ± 5,114 BP
XXIb	burnt clay	TL	Mad 3300	53,491 ± 5,114 BP

Table 5.16. Dating from Esquilleu Cave (Baena et al 2014).

5.2.2.6 Archaeological record

Only one human remain was documented in the area excavated, in level XI, a juvenile canine, which has been classified as Neanderthal. From the palaeontological point of view, a total of 71,814 bone remains in total were documented in all levels excavated. Ibex dominates the fauna assemblage, followed by chamois and deer. The presence of carnivores in the site is low, almost non-existent. Only a few hyena teeth were documented in level III, as well as some canid and small felid bones in levels V-XIII (Yravedra *et al* 2014).

Micro-stratigraphic study revealed a succession of hearths, with thick accumulations of ash, burnt bones and artefacts. These hearths have been identified in levels XXI, XXII, XXV, XXVIII and XXIX.

Over 100,000 lithics were documented. Technologically, the lithic assemblage from Esquilleu Cave reveals a variety of knapping methods. In the terminal Middle Palaeolithic levels (VII to IV), Discoidal knapping methods predominate, based on reduction of cores and resultant product size. Raw material selection is entirely local. From a morpho-technical point of view quadrangular/triangular pieces of medium thickness are documented. Typologically, there is a greater presence of denticulates in these layers.

Level	Method of Knapping	Raw Materials	Fauna (NISP)
III	Discoid	Quarzite, limonite, lutite	390
IV	Discoid	Quarzite, limonite, lutite	149
V	Discoid	Quarzite, lutite, others	554
VIF	Discoid	Lutite/ferruginous, black flint, fine quarzite	1228
VI	Discoid	Lutite/ferruginous, black flint, fine quarzite	1994
VII	Discoid	Lutite/ferruginous, black flint, fine quarzite	1469
VIII	Levallois	Lutite, fine quarzite	1210
IX	Levallois	Lutite, fine quarzite	1210
X			67
XI	Quina	Quarzite	1871
XIF	Quina	Quarzite	23450
XII	Quina	Quarzite	779
XIII	Quina	Quarzite	7470
XIV	Quina	Quarzite	1623
XV	Quina	Quarzite, flint, black flint, griotte	1758
XVI	Quina	Quarzite, quartz	401
XVII	Levallois	Quarzite, black flint, griotte	387
XVIII	Levallois	Quarzite, black flint, griotte	369
XIX	Discoid	Quarzite	638
XX	Discoid	Quarzite, foreign flint	3782
XXI	Discoid	Quarzite, griotte	17018
XXII	Discoid	Quarzite	2004
XXIII	Discoid	Quarzite, quartz	2405
XXIV	Discoid	Quarzite	126
XXV	Discoid	Quarzite	12
XXVI	Discoid	Quarzite	280
XXVII	Discoid	Quarzite, quartz	316
XXVIII	Discoid	Quarzite, quartz	72
XIX	Discoid		79
XXX	Discoid	Quarzite, quartz	582

Table 5.17. Knapping methods from Esquilleu Cave (Baena et al 2014)

5.2.2.7. Lithic Assemblage

The number of lithics analysed from this site totalled 1,461 pieces, from level VIf, recovered during the excavations carried out by J. Baena. The collection is currently housed at the Museum of Prehistory and Archaeology of Cantabria.

Raw Material

Raw material availability in the area was not limited in terms of quantity, but rather in terms of quality. Quartzite is the dominant raw material in all levels, followed by quartz as well as ferruginous and siliceous rocks. 99.2% of the raw materials are local, found in nearby alluvial deposits about 200m from the cave, with a maximum distance radius of 5km. The 0.8% of materials that were not derived from this local setting raise the possibility of a remote catchment some distance from the site. Materials from levels III to V come from the river zone, while those found in levels VII to XX show a greater diversity and a wider geographical range stretching as far as the coastline (Baena *et al* 2012). For example, in the case of flint, the macroscopic appearance and alteration (Mangado 2004) of the lithics found link them to coastal formations near of the *San Vicente de la Barquera* zone (Sarabia 1999).

A preference for secondary deposits as a specific catchment area for the raw materials according to the index of cortex from the quartzite is documented. Only the black flint (which is rare) is not found in alluvial deposits but is, rather, located in veins.

From level VIf, quartzite (75%) is the dominant raw material, followed by ferruginous mudstone (21%), while other raw materials (flint, limestone, sandstone) are present in smaller proportion (3%)(Figure 5.11).

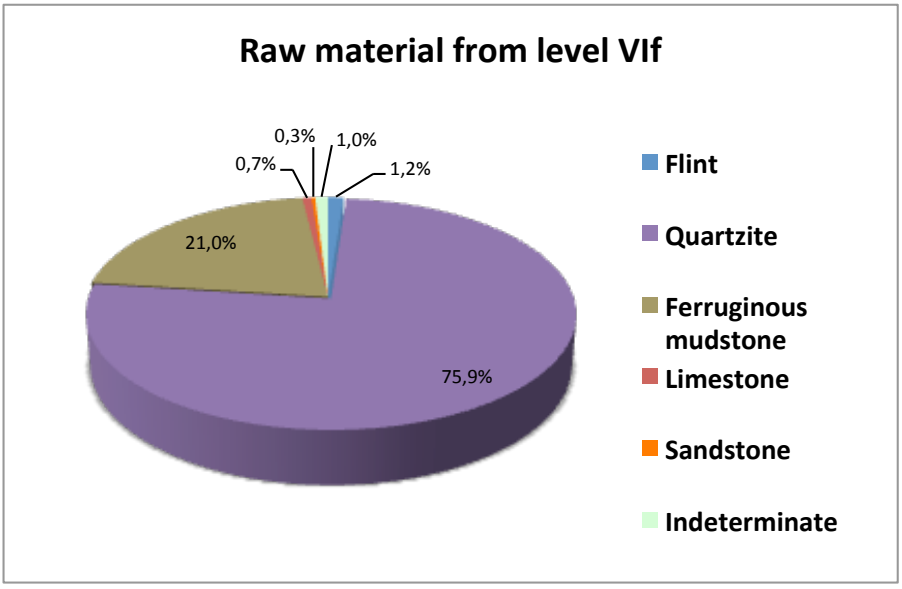


Figure 5.11. Raw material from level VIf.

Technical Categories

The bulk of the assemblage is composed of flakes (n=527; 36%), followed by flake fragments (n=503; 35%) and debris (n=356; 24%) whereas cores are limited (n=28; 2%) (Figure 5.12 and Table 5.18). Knapping products predominate, suggesting that the knapping strategy employed at the site was orientated towards the systematic production of flakes.

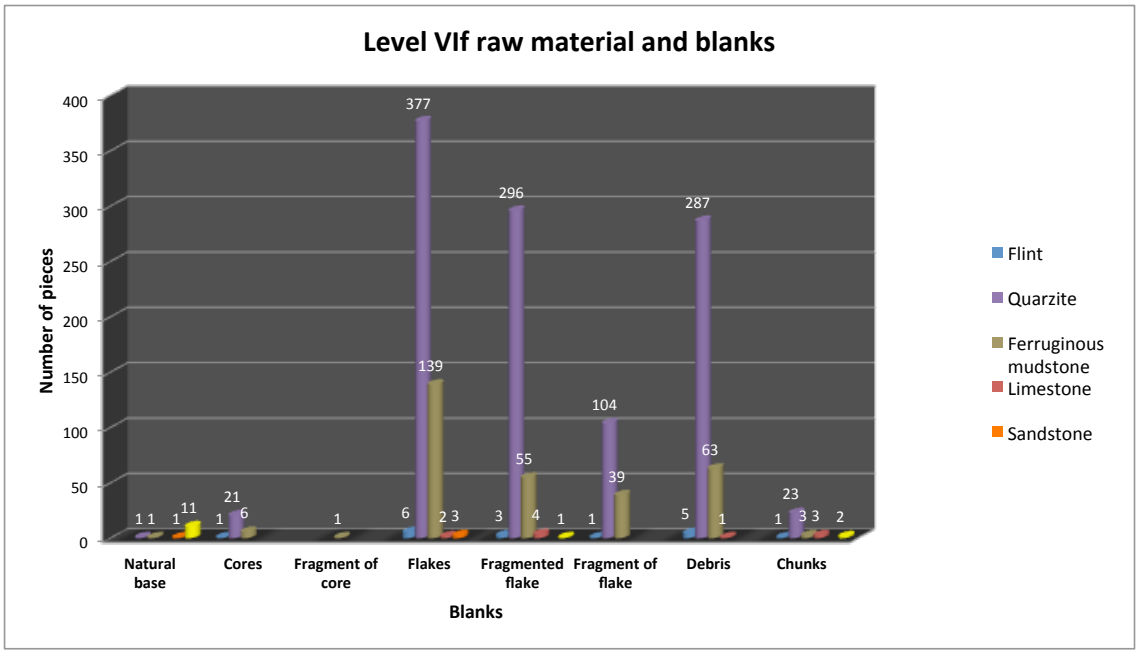


Figure 5.12. Raw material and blanks from level VIf.

Level VIf	Natural base	Cores	Fragment of core	Flakes	Fragmented flake	Fragment of flake	Debris	Chunks	TOTAL	%
Flint		1		6	3	1	5	1	17	1,2
Quarzite	1	21		377	296	104	287	23	1109	76
Ferruginous mudstone	1	6	1	139	55	39	63	3	307	21
Limestone				2	4		1	3	10	1
Sandstone	1			3					4	0,3
Indeterminate	11				1			2	14	1
TOTAL	14	28	1	527	359	144	356	32	**1461**	
%	1	2	0,1	36	25	10	24	2		100

Table 5.18. Raw material and blanks from level VIf.

Analysis of cores

From level VIf, I was able to identify 25 cores and 3 cores on flakes (Table 5.19). Attribute analysis was carried out on 28 cores. The raw material proportion of the core assemblage is the same as for the total assemblage. Quartzite cores are most abundant (n=21; 75%), followed by ferruginous mudstone (n=6; 21%) and flint (n=1; 4%) (Table 5.19).

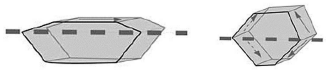
Half of the cores do not present cortex (n=14; 50%), while another 14 do (50%). However, 8 pieces (29%) with cortex feature a low percentage (Table 5.19).

Regarding the stage of knapping sequence, the highest percentages of the cores (n=25; 89%) are in the terminal stage. No cores in the early stages of the reduction were identified (Table 5.19). It is important to note that the predominance of cores in the terminal stage of knapping could be related to the economic behaviour evident in the technological system of this level.

The exploitation of surfaces shows that a bifacial reduction strategy is predominant, present in 26 pieces (93%), while only two pieces correspond to trifacial (n=1; 4%) and globular (n=1;4%) reduction (Table 5.19). The knapping strategies are varied, however a centripetal strategy (n=24; 86%) dominates, while the other strategies of unidirectional (n=1; 4%), bidirectional (n=2; 7%) and multidirectional (n=1; 4%) reduction are represented by occasional cores (Table 5.19). The centripetal strategy identified on the cores is also in concordance with the interpretation that these cores relate predominately to the terminal stage of the knapping sequence.

The predominant method of knapping observed is the discoidal (n=19; 68%). There are 3 cores (11%) displaying evidence of the Levallois method of knapping, one core (4%) evidencing the Globular method and 5 (18%) evidencing indeterminate methods. These five were very difficult to identify due to the intensity of exploitation of the cores and their small size (Table 5.19). The Discoidal cores were organized by dividing them into two

opposed secant surfaces, separated by an intersection plane, in order to obtain flakes by centripetal and usually bifacial removals. This cores assemblage is characterized by non-hierarchical surfaces, except in the three Levallois cores.



ANALYSIS OF CORES



TYPES OF CORES

Level	Raw material	Cores	Cores on flake	TOTAL	%
VIf	Flint	1		1	4
	Ferruginous mudstone	5	1	6	21
	Quartzite	19	2	21	75
TOTAL		25	3	28	
%		89	11		

AMOUNT OF CORTEX

Level	Raw material	0%	≤ 25%	>25 ≤50%	TOTAL	%
VIf	Flint	1			1	4
	Ferruginous mudstone	1	1	4	6	21
	Quartzite	12	7	2	21	75
TOTAL		14	8	6	28	
%		50	29	21		

STAGE OF KNAPPING SEQUENCES

Level	Raw material	Exploitation	Terminal	TOTAL	%
VIf	Flint		1	1	4
	Ferruginous mudstone	1	5	6	21
	Quartzite	2	19	21	75
TOTAL		3	25	28	
%		11	89		

FACIAL ATTRIBUTE

Level	Raw material	Bifacial	Trifacial	Globular	TOTAL	%
VIf	Flint	1			1	4
	Ferruginous mudstone	5		1	6	21
	Quartzite	20	1		21	75
TOTAL		26	1	1	28	
%		93	4	4		

STRATEGIES OF KNAPPING

Level	Raw material	Centripetal	Unidirectional	Bidirectional	Multidirectional	TOTAL	%
VIf	Flint	1				1	4
	Ferruginous mudstone	5	1			6	21
	Quartzite	18		2	1	21	75
TOTAL		24	1	2	1	28	
%		86	4	7	4		

METHOD OF KNAPPING

Level	Raw material	Discoidal	Levallois	Globular	Indeterminate	TOTAL	%
VIf	Flint	1				1	4
	Ferruginous mudstone	4		1	1	6	21
	Quartzite	14	3		4	21	75
TOTAL		19	3	1	5	28	
%		68	11	4	18		

Table 5.19. Analysis of cores.

Metric analysis of the cores shows that they mean 43mm in length, 35mm in width and 20mm in thickness. The Area of the cores mean 1570 mm^2. These measurements indicate

that on mean cores are of small size (Table 5.20).

		Length	Width	Thickness	Area
Number of flakes		28	28	28	28
Mean		43	35	20	1570
Mode		37	30	15	1148
Median		42	34	19	1381
Maximum value		65	55	40	3584
Minimum value		25	23	12	572
Kurtosis		-0,46	0,49	1,54	1,03
Standard deviation		10	8	7	729
Percentile	25	37	29	15	1136
	50	42	34	19	1381
	75	49	38	22	1994

Table 5.20. Metric analysis of the cores from level VIf.

A scatter plot of the measurements (length and width) of the cores shows a concentration of points between 30mm x 55mm (length) and 25mm x 45mm (width) (Figure 5.13). This again shows that the majority of the cores are of small size.

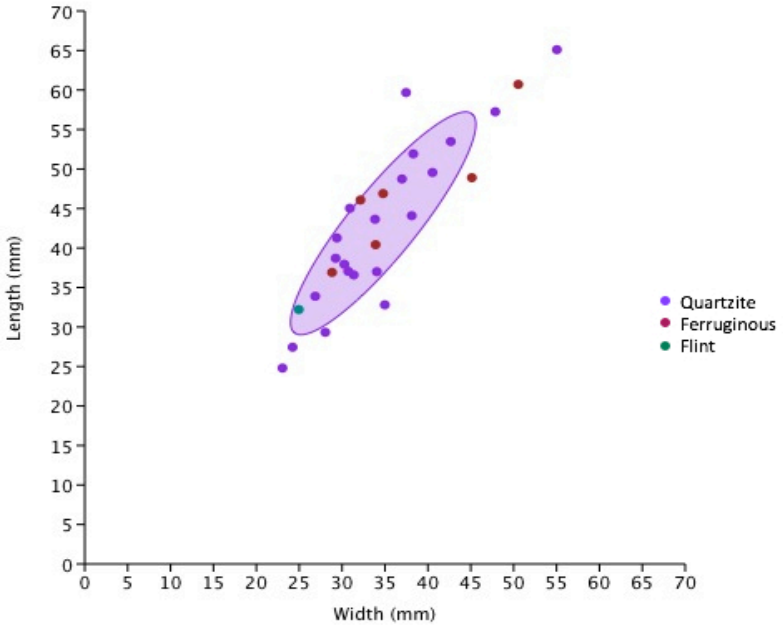


Figure 5.13. Scatter plot of the measurements of the cores from level VIf.

The Flake Analyses

The flake assemblage of level VIf is composed of 527 flakes and 363 flake fragments. For this reason we can consider that obtaining flakes was the main objective of the production sequence.

Ventral Face

Type of Bulb

Regarding the types of bulb of percussion, the flake assemblage is dominated by those of diffuse type (n=352; 67%) while fewer are of the pronounced type (n=172, 33%). In the case of the quartzite and ferruginous mudstone flakes, we can see a high proportion of both types of bulb. This might be due to the differential use of hammers or differences in strike intensity or in the method of knapping applied (Table 5.21).

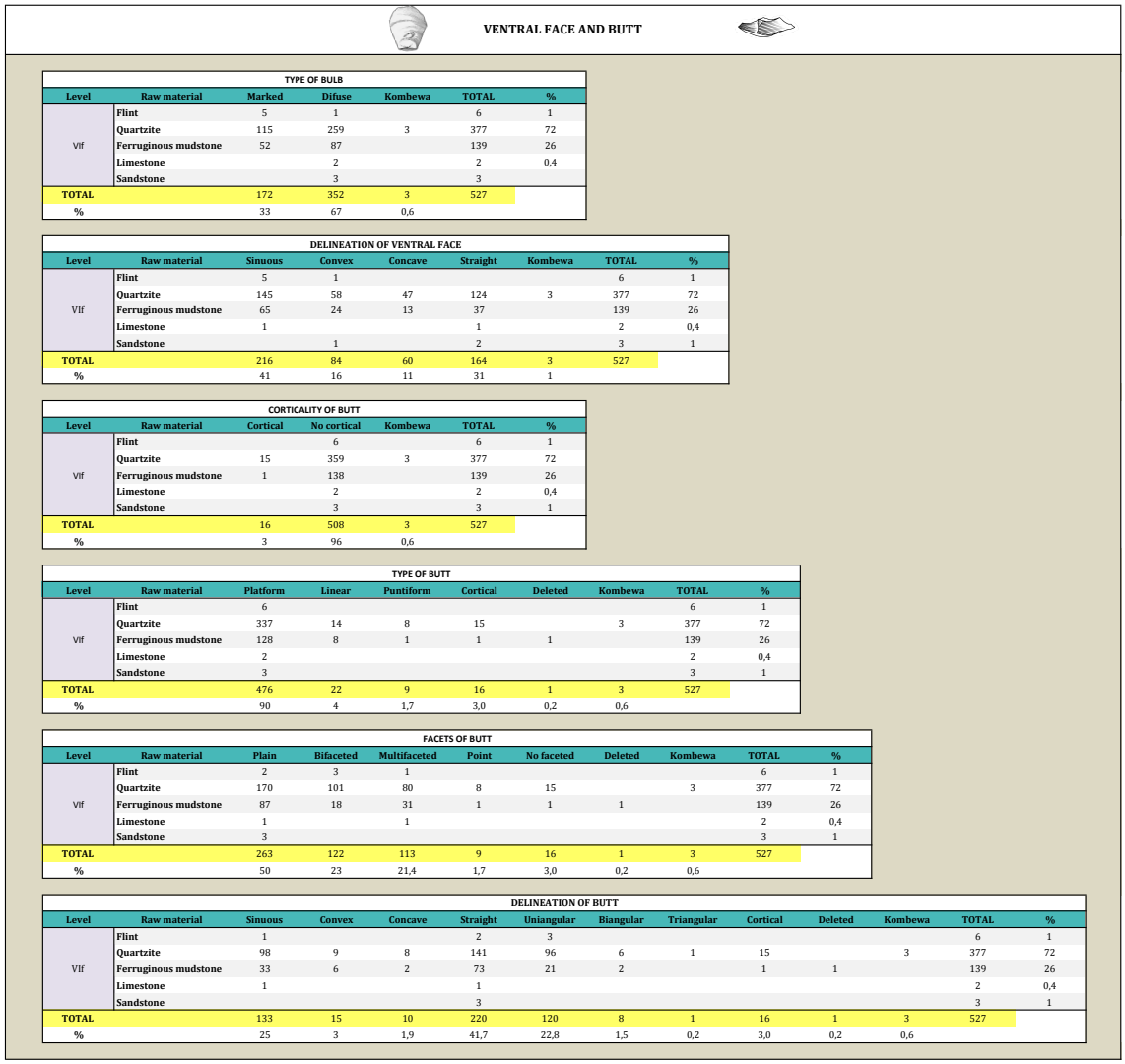
In relation to the delineation of the ventral face we can see diversity, although sinuous delineation (n=216; 41%) dominates, followed by straight (n=164; 31%), while fewer pieces follow a convex (n=84; 16%) or concave (n=60; 11%) delineation (Table 5.21).

Butt

With regard to the butt surface of the lithics analysed, the assemblage (n=508; 96%) is almost entirely non-cortical, with only 16 artefacts (3%) showing cortex (Table 20). Platform is the type of butt most frequently represented (n=476; 90%), while the other categories of linear (n=22; 4%) and puntiform (n=9; 1.7%) butts are present in small numbers (Table 5.21).

Butt preparation is characterized by a dominance of plain butts (n=263; 50%), followed by dihedral (n=122; 23%) and multifaceted (n=113; 21.4%) variants. Other categories occur in lower frequency: cortical (n=16; 3%) and puntiform (n=9; 1.7%) (Table 5.21).

There are many different types of butt delineation present. The most frequently represented type is a straight delineation (n=220; 41.7%), followed by the other types in smaller proportion: sinuous (n=133; 25%), uniangular (n=120; 22.8%), convex (n=15; 3%), concave (n=10; 1.9%), biangular (n=8; 1.5%) (Table 5.21).



VENTRAL FACE AND BUTT

TYPE OF BULB

Level	Raw material	Marked	Difuse	Kombewa	TOTAL	%
VIf	Flint	5	1		6	1
	Quartzite	115	259	3	377	72
	Ferruginous mudstone	52	87		139	26
	Limestone		2		2	0,4
	Sandstone		3		3	
TOTAL		172	352	3	527	
%		33	67	0,6		

DELINEATION OF VENTRAL FACE

Level	Raw material	Sinuous	Convex	Concave	Straight	Kombewa	TOTAL	%
VIf	Flint	5	1				6	1
	Quartzite	145	58	47	124	3	377	72
	Ferruginous mudstone	65	24	13	37		139	26
	Limestone	1			1		2	0,4
	Sandstone		1		2		3	1
TOTAL		216	84	60	164	3	527	
%		41	16	11	31	1		

CORTICALITY OF BUTT

Level	Raw material	Cortical	No cortical	Kombewa	TOTAL	%
VIf	Flint		6		6	1
	Quartzite	15	359	3	377	72
	Ferruginous mudstone	1	138		139	26
	Limestone		2		2	0,4
	Sandstone		3		3	1
TOTAL		16	508	3	527	
%		3	96	0,6		

TYPE OF BUTT

Level	Raw material	Platform	Linear	Puntiform	Cortical	Deleted	Kombewa	TOTAL	%
VIf	Flint	6						6	1
	Quartzite	337	14	8	15		3	377	72
	Ferruginous mudstone	128	8	1	1	1		139	26
	Limestone	2						2	0,4
	Sandstone	3						3	1
TOTAL		476	22	9	16	1	3	527	
%		90	4	1,7	3,0	0,2	0,6		

FACETS OF BUTT

Level	Raw material	Plain	Bifaceted	Multifaceted	Point	No faceted	Deleted	Kombewa	TOTAL	%
VIf	Flint	2	3	1					6	1
	Quartzite	170	101	80	8	15		3	377	72
	Ferruginous mudstone	87	18	31	1	1	1		139	26
	Limestone	1		1					2	0,4
	Sandstone	3							3	1
TOTAL		263	122	113	9	16	1	3	527	
%		50	23	21,4	1,7	3,0	0,2	0,6		

DELINEATION OF BUTT

Level	Raw material	Sinuous	Convex	Concave	Straight	Uniangular	Biangular	Triangular	Cortical	Deleted	Kombewa	TOTAL	%
VIf	Flint	1			2	3						6	1
	Quartzite	98	9	8	141	96	6	1	15		3	377	72
	Ferruginous mudstone	33	6	2	73	21	2		1	1		139	26
	Limestone	1			1							2	0,4
	Sandstone				3							3	1
TOTAL		133	15	10	220	120	8	1	16	1	3	527	
%		25	3	1,9	41,7	22,8	1,5	0,2	3,0	0,2	0,6		

Table 5.21. Ventral face and butt analysis.

Below we can see the morphometric analysis of knapping angles of 524 flakes, which give a mean of 109°, a mode of 110° and a median of 110°. These data indicate the preference for an obtuse knapping angle (Table 5.22).

Angle of knapping		
Number of flakes		524
Mean		109
Mode		110
Median		110
Maximum value		183
Minimum value		66
Kurtosis		2,5
Standard deviation		12
Percentile	25	100
	50	110
	75	118

Table 5.22. Angle of knapping of the flakes from level VIf.

Dorsal Face

Examining the dorsal surface reveals the degree of transformation within the knapping sequences. Regarding the degree of cortex on the dorsal surface, the majority of flakes (n=380; 72%) do not show cortex, 99 of them (19%) present less than 50% cortex on their surfaces, 45 pieces (8.5%) have more than 50% cortex and only 13 (2.5%) are fully cortical flakes (Table 5.23). The presence of cortical pieces suggests that the primary reduction of the pebbles also took place inside the cave.

The direction of scars is highly diverse, with three categories having a high degree of representation: multidirectional (n=254; 48%), unidirectional (n=136; 26%) and centripetal (n=93; 18%), while the bidirectional category (n=29; 6%) is far less frequently represented (Table 5.23).



DORSAL FACE

AMOUNT OF CORTEX							
Level	**Raw material**	**0%**	**≤50%**	**>50%**	**100%**	**TOTAL**	**%**
VIf	**Flint**	5			1	6	1
	Quartzite	275	76	26	10	377	72
	Ferruginous mudstone	99	21	18	1	139	26
	Limestone	1	1			2	0,4
	Sandstone		1	1	1	3	1
TOTAL		380	99	45	13	527	
%		72	19	8,5	2,5		

DIRECTIONS OF SCARS								
Level	**Raw material**	**Centripetal**	**Unidirectional**	**Bidirectional**	**Multidirectional**	**indeterminate**	**TOTAL**	**%**
VIf	**Flint**				5	1	6	1
	Quartzite	71	100	24	173	9	377	72
	Ferruginous mudstone	22	35	5	74	3	139	26
	Limestone				1	1	2	0,4
	Sandstone		1		1	1	3	1
TOTAL		93	136	29	254	15	527	
%		18	26	6	48	3		

Table 5.23. Dorsal face analysis

With regard to the number of scars, the flakes have a mean of 5 scars, a mode of 3 and median of 4. This is indicative of high reduction intensity because the scars show the previous removals and a mean of 5 scars on the dorsal face is consistent with a high degree of reduction (Table 5.24)

Number of scars		
Number of flakes		525
Mean		5
Mode		3
Median		4
Maximum value		19
Minimum value		1
Kurtosis		3,9
Standard deviation		3
Percentile	25	3
	50	4
	75	6

Table 5.24. Number of scars of the flakes from level VIf.

Morphometrically, flakes measure on mean of 29mm in length, 28mm in width and 10mm thick. Both the mode and the median are similar. Regarding surface area this mean 858

mm^2. These measurements indicate that on mean, pieces are of small size. The elongation index shows a mean of 1.10, which means that there is no laminar tendency in the assemblage. The flattening index shows a mean of 0.41, this meaning that the flakes are very thin (Table 5.25).

		Length	Width	Thickness	Area	Enlogation Index	Flattening index
Number of flakes		527	527	527	527	527	527
Mean		29	28	10	858	1,10	0,41
Mode		27	25	9	528	1,44	0,47
Median		27	26	10	716	1,03	0,39
Maximum value		67	73	29	3049	6,81	1,13
Minimum value		10	9	2	25	0,40	0,17
Kurtosis		0,45	0,61	0,61	2	49	3
Standard deviation		10	10	4	556	0,45	0,13
Percentile	25	21	21	7	483	0,82	0,32
	50	27	26	10	716	1,03	0,39
	75	35	33	13	1082	1,29	0,48

Table 5.25. Measures of the flakes from level VIf

A scatter plot of the measurements (length and width) of flakes shows a concentration of points between 10mm x 35mm (length) and 10mm x 40 mm (width) for this assemblage (Figure 5.14). We can see again that the majority of the flakes are small and predetermined.

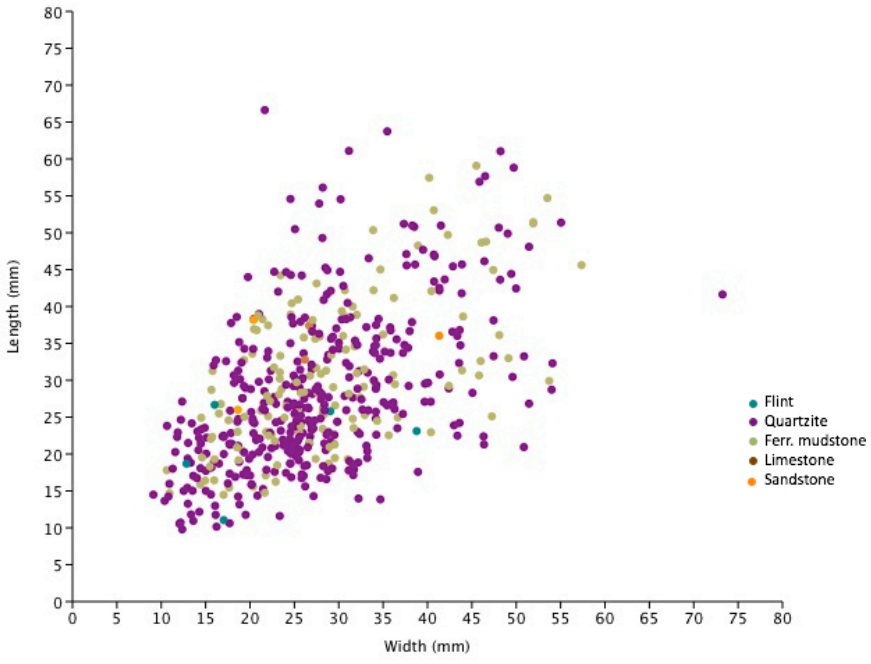


Figure 5.14. Scatter plot of the measurements of the flakes from level VIf.

Retouched pieces

A total of 82 retouched pieces were studied from (Table 5.26). The kind of blanks that were selected for retouching are flakes (n=61; 74%), followed by fragmented flakes (n=13; 16%), flake fragments (n=8; 10%) in a smaller proportions respectively. The majority of the pieces have unifacial retouch (n=54; 66%) with only a third (n=28; 34%) pieces showing a bifacial retouch.

Regarding the extent of retouch found along the edge of the flakes, retouched pieces with a >25 to ≤50% extent of retouch predominate in the tool assemblage (n=37; 45%), followed by pieces with >50% ≤ 75% extent (n=33; 40%), ≤25% (n=9; 11%) and >75 ≤100% extent (n=3; 4%) respectively. With these data I can conclude that the retouched tools assemblage does not have an extensive degree of retouch.

Although the sum of the individual number of retouched pieces analysed equals 82, the total number of shaped edges analysed is 122, as represented in Table 5.26. The majority of the retouch is located on the side (n=104; 86%). The left side is the predominant side with extensive retouch (n=53; 44%), followed by the right side (n=51; 42%) and the distal (n=14; 12%) and proximal (n=3, 2%) areas in smaller proportions respectively.

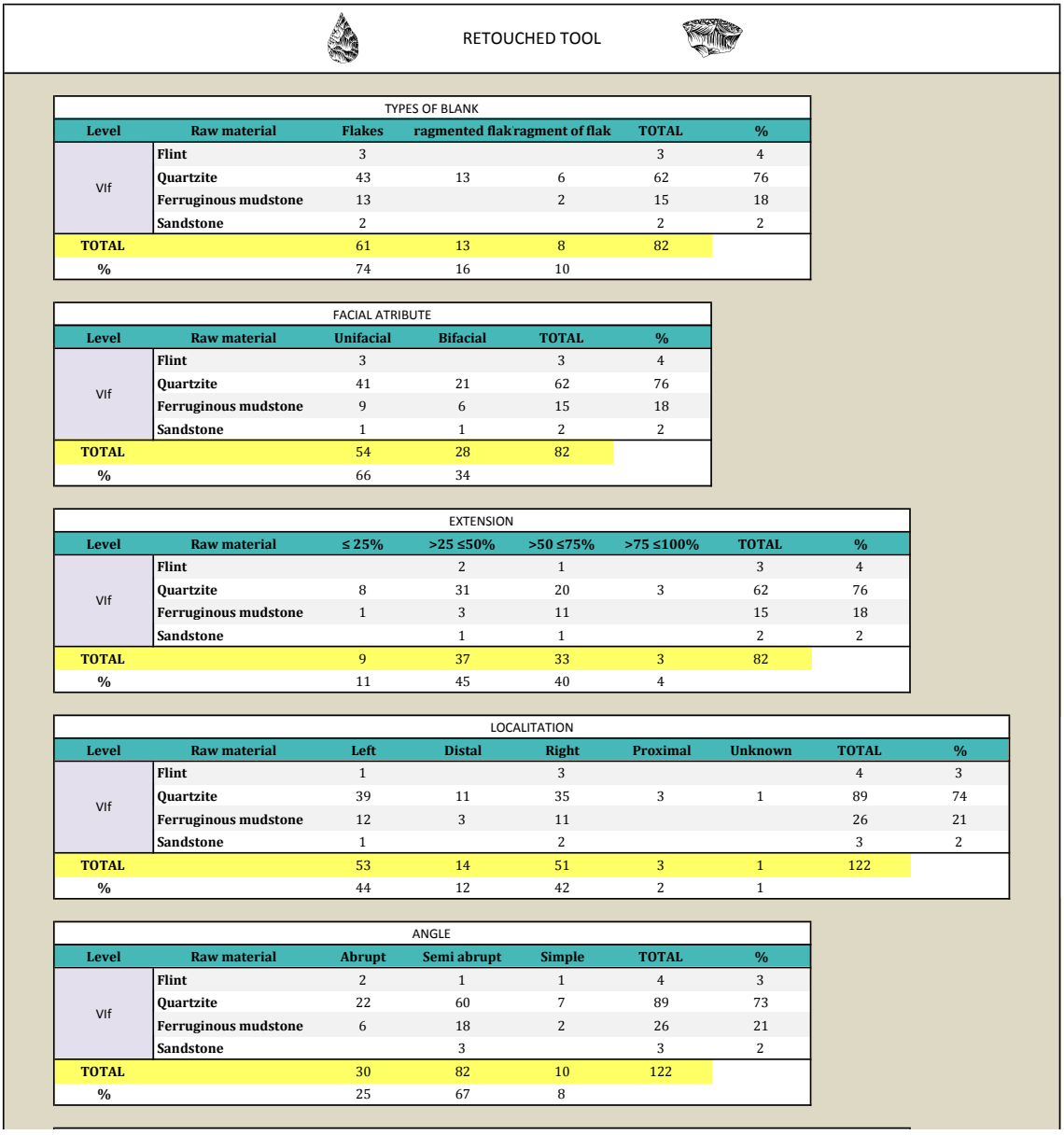
Semi-abrupt retouch angles (n=82; 67%) are the dominant angles present in this assemblage, followed by abrupt angles (n=30; 25%) and simple angles (n=10; 8%).

With regard to the extent of retouch on the dorsal/ventral surfaces, marginal retouch is the most represented (n=57; 47%), followed by extensive retouch (n=35; 29%), very marginal retouch (n=18; 15%) and very extensive retouch (n=12; 10%). And in relation to the depth of retouch on the dorsal/ventral surfaces, marginal retouch prevails (n=70, 57%), followed by deep retouch (n=37; 30%), very marginal (n=10, 8%) and very deep (n=37, 30%).

The predominant direction of retouch is direct (n=76; 62%), followed by alternate (n=16; 13%), alternating (n=16; 13%) and inverse (n=14; 11%).

The delineation of the retouched edge is predominantly denticulate retouch (n=92; 75%), followed by continuous (n=28; 23%) and encoche retouch (n=1; 2%). The data obtained by these two attributes are in direct correlation with the type of tools within assemblage: denticulates and scrapers.

Regarding the morphology of the retouched edge, the convex denticulate type is the most common (n=93; 76%), followed by sinuous (n=12; 10%), straight (n=10; 8%), convex (n=5; 4%) and finally encoche (n=2, 2%).



TYPES OF BLANK

Level	Raw material	Flakes	ragmented flak	ragment of flak	TOTAL	%
VIf	Flint	3			3	4
	Quartzite	43	13	6	62	76
	Ferruginous mudstone	13		2	15	18
	Sandstone	2			2	2
TOTAL		61	13	8	82	
%		74	16	10		

FACIAL ATRIBUTE

Level	Raw material	Unifacial	Bifacial	TOTAL	%
VIf	Flint	3		3	4
	Quartzite	41	21	62	76
	Ferruginous mudstone	9	6	15	18
	Sandstone	1	1	2	2
TOTAL		54	28	82	
%		66	34		

EXTENSION

Level	Raw material	≤ 25%	>25 ≤50%	>50 ≤75%	>75 ≤100%	TOTAL	%
VIf	Flint		2	1		3	4
	Quartzite	8	31	20	3	62	76
	Ferruginous mudstone	1	3	11		15	18
	Sandstone		1	1		2	2
TOTAL		9	37	33	3	82	
%		11	45	40	4		

LOCALITATION

Level	Raw material	Left	Distal	Right	Proximal	Unknown	TOTAL	%
VIf	Flint	1		3			4	3
	Quartzite	39	11	35	3	1	89	74
	Ferruginous mudstone	12	3	11			26	21
	Sandstone	1		2			3	2
TOTAL		53	14	51	3	1	122	
%		44	12	42	2	1		

ANGLE

Level	Raw material	Abrupt	Semi abrupt	Simple	TOTAL	%
VIf	Flint	2	1	1	4	3
	Quartzite	22	60	7	89	73
	Ferruginous mudstone	6	18	2	26	21
	Sandstone		3		3	2
TOTAL		30	82	10	122	
%		25	67	8		

DEEP OF RETOUCHED ON SURFACE

Level	Raw material	Very marginal	Marginal	Extensive	Very extensive	TOTAL	%
VIf	Flint	2	2			4	3
	Quartzite	12	38	30	9	89	73
	Ferruginous mudstone	4	14	5	3	26	21
	Sandstone		3			3	2
TOTAL		18	57	35	12	122	
%		15	47	29	10		

DEEP OF RETOUCHED ON EDGE

Level	Raw material	Very marginal	Marginal	Deep	Very deep	TOTAL	%
VIf	Flint	2	2			4	3
	Quartzite	5	48	32	4	89	73
	Ferruginous mudstone	3	17	5	1	26	21
	Sandstone		3			3	2
TOTAL		10	70	37	5	122	
%		8	57	30	4		

DIRECTION

Level	Raw material	Direct	Inverse	Alternate	Alternating	TOTAL	%
VIf	Flint	4				4	3
	Quartzite	55	13	9	12	89	73
	Ferruginous mudstone	15	1	6	4	26	21
	Sandstone	2		1		3	2
TOTAL		76	14	16	16	122	
%		62	11	13	13		

DELINEATION

Level	Raw material	Continuous	Denticulate	Encoche	TOTAL	%
VIf	Flint		4		4	3
	Quartzite	22	66	1	89	73
	Ferruginous mudstone	5	20	1	26	21
	Sandstone	1	2		3	2
TOTAL		28	92	2	122	
%		23	75	2		

MORPHOLOGY

Level	Raw material	Straight	Convex	Sinuous	Denticulate	Encoche	TOTAL	%
VIf	Flint				4		4	3
	Quartzite	7	5	9	67	1	89	73
	Ferruginous mudstone	3		2	20	1	26	21
	Sandstone			1	2		3	2
TOTAL		10	5	12	93	2	122	
%		8	4	10	76	2		

Table 5.26. Retouched tools analysis.

Following the Laplace typology (Table 5.27), the retouched tools are grouped into three main groups: scrapers (n=17), denticulates (n=65), and end-scrapers (n=2).

Amongst the scrapers, there is a similar proportion of side scrapers with abrupt retouch (R21) (n=8; 10%) and side scrapers with marginal retouch (R1) (n=8; 10%). Less represented are carinated scrapers R3 (n=1; 1%).

Amongst the denticulates, several types were identified marginal denticulate retouch D1 (n=14; 17%) and D13 (n=14; 17%), denticulate scrapers D23 (n=17; 21%), encoche D21 (n=9; 11%), denticulate point D24 (n=4; 5%), denticulate scrapers D25 (n=2; 2%), spine D22 (n=2; 2%), and carinated denticulate D3 (n=1; 1%).

Within the tool assemblage analysed (n=2; 2%) end-scrapers G11 were documented.

LAPLACE TYPOLOGY															
Level	Raw material	R1	R21	R3	D1	D3	D13	D22	D21	D23	D24	D25	G11	TOTAL	%
VIf	Flint						3							3	4
	Quartzite	6	7	1	8	1	10	1	7	14	3	2	2	62	76
	Ferruginous mudstone	2	1		4		1	1	2	3	1			15	18
	Sandstone				2									2	2
TOTAL		8	8	1	14	1	14	2	9	17	4	2	2	82	
%		10	10	1	17	1	17	2	11	21	5	2	2		

Table 5.27. Laplace Typology

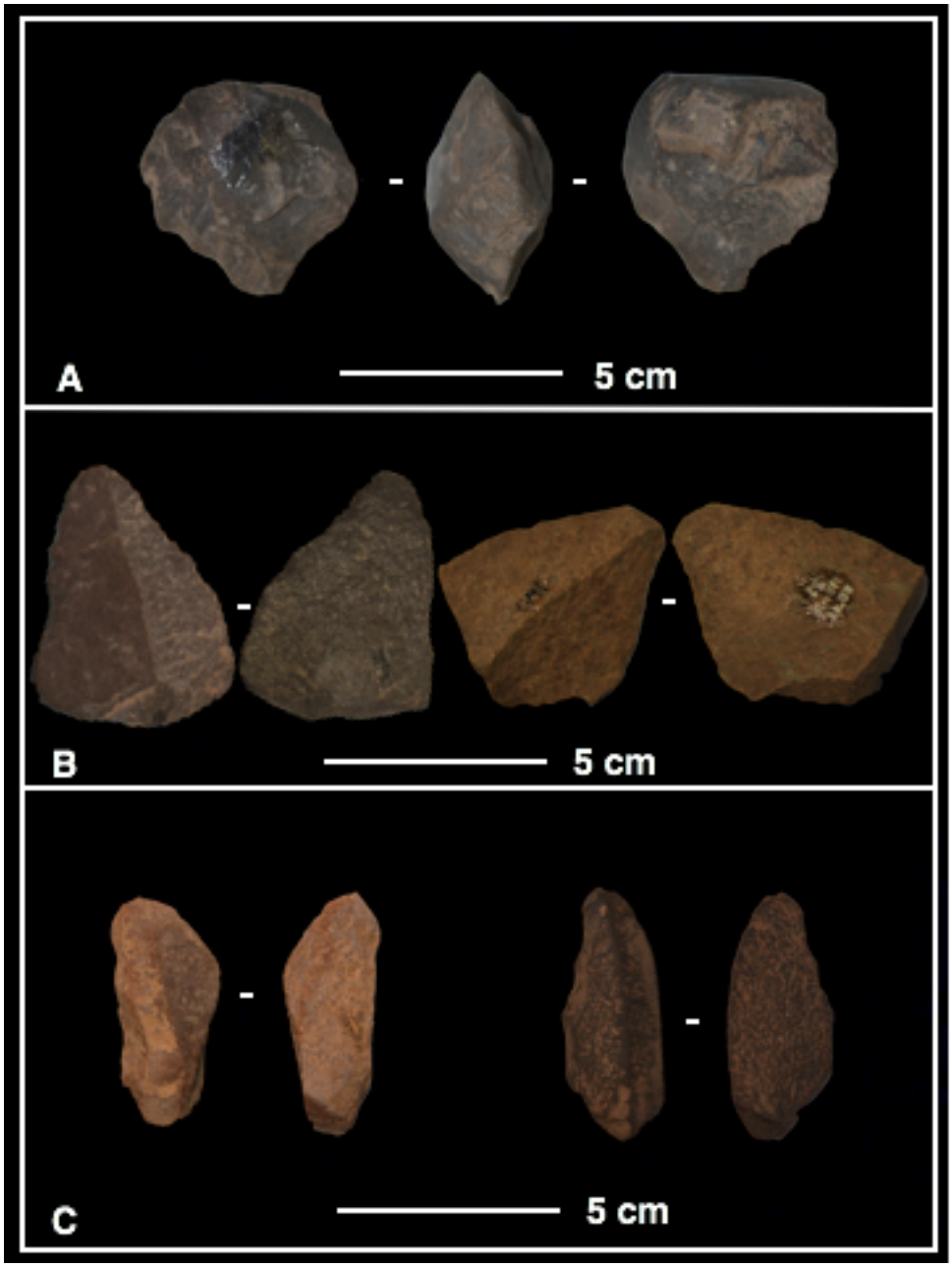


Figure 5.15. Detail of some lithic artefacts: A. Core, B. Flakes, and C. Retouched tools.

5.2.3. *MORIN CAVE*

5.2.3.1 Location

Morin Cave is situated in the village of Villanueva de Villaescusa (Cantabria Province), on the hill of Mazo-Moril in the Solia drainage basin, at 60m a.s.l., and 6 km from the present coastline. The cave is about 10m long, its entrance is 2m high and it faces northwest. The cave mouth is oriented to the south-east, while further inside the cave, to the south-west (González Echegaray *et al* 1971). Its coordinates are 0º 10`10``W and 43º 21`43``N.



Figure 5.16. View of Morin Cave

5.2.3.2 Geological Setting

The cave is situated on a small hill of Urgonian (Aptian) limestone. It is related to an uvala and developed when the water level was at least 20m higher than the current levels, prior to the development of the modern valley (Gómez 1981)

5.2.3.3 Historical Background

This site was discovered in 1910 by H. Obermaier and P. Wernert (Obermaier 1925) and was extensively excavated in the early part of the twentieth century. In 1912, J. Carballo carried out a trial dig. Between 1917 to 1919, J. Carballo conducted the first full excavation. In 1918 J. Carballo invited the Count of Vega del Sella to excavate. These excavations lasted until 1920 (Vega del Sella 1921; Carballo 1923). From 1966 to 1969 a

Spanish-American team led by Gonzalez Echegaray and Freeman carried out another excavation (González Echegaray *et al* 1971, 1973; González Echegaray & Freeman 1978). The last excavation was carried out by Maíllo-Fernández in 2005 in order to review the sequence and understand the formation of the sedimentary deposit in the cave (Maíllo-Fernández *et al* 2014).

5.2.3.4. Stratigraphic Sequence

The stratigraphic sequence at this site consists of 22 archaeological levels: Level 1: Azilian; Level 2: Magdalenian; Level 3: late Solutrean; Levels 4 and 5b: Gravettian; Level 5a: envolved Aurignacian; Levels 6 and 7: typical Aurignacian; Levels 8 and 9: Archaic Aurigacian; Level 10: Châtelperronian; Levels 11 to 17: Mousterian; Levels 18 to 21 sterile; Level 22: Mousterian (Maíllo-Fernández *et al* 2014) (Table 5.28).

Level	Composition	Thickness (cm)	Cultural attribution
1	Sandy-silty	2-20	Azilian
2	Silty-sand with gravel	5-10	Magdalenian
3	Silt	2-8	Upper Solutrean
4	Sandy-silt	5-20	Gravettian
5	Sandy silt with gravel	15-30	Gravettian and final Aurignacian
6	Silty	20-30	Early Aurignacian
7	Sandy silt clay lenses	10-18	Early Aurignacian
8	Silty-sand	10-20	Early Aurignacian
9	Silty-sand with fine gravel	5-8	Proto-Aurignacian
10	Clay	2-5	Proto-Aurignacian
11	Sandy-silty	8-18	Châtelperronian
12	Silt with gravel	12-20	Mousterian
13	Clayey-silt	5-8	Mousterian
14	Silty-clay	7-10	Mousterian
15	Clayey-silt	15-20	Mousterian
16	Silty-sand	12-15	Mousterian
17	Sandy-silt with gravel	12-22	Mousterian
18	Sandy-silt	45-70	Sterile
19	Sandy-silty	12-22	Sterile
20	n/a	2-5	Sterile
21	n/a	7-10	Sterile
22	n/a	2-5	Indeterminate Palaeolithic

Table 5.28. Stratigraphic sequence of the Morin Cave (Maíllo-Fernández et al 2014).

5.2.3.5. Dating

Level	Cultural attribution	Material	Lab. Ref.	Date	cal BP, 95.4% probability Range	
5s	Gravettian	Charcoal	SI 953	20120 ± 340 BP	25194	23452
7	Early Aurignacian	Charcoal	SI 954	31500 ± 880 BP	37985	33975
7	Early Aurignacian	Charcoal	SI 955	28680 ± 840 BP	34381	31171
7	Early Aurignacian	Charcoal	SI 955a	27260 ± 1500 BP	35220	28610
8	Proto-Aurignacian	Charcoal	SI 956	27710 ± 1300 BP	34925	29420
8	Proto-Aurignacian	Charcoal	GifA96263	36590 ± 770 BP	42432	39734
8	Proto-Aurignacian	Charcoal	OxA19084	40060 ± 350 BP	44399	43052
8	Proto-Aurignacian	Charcoal	SI 952	27630 ± 540 BP	33022	30820
8	Proto-Aurignacian	Charcoal	SI 952a	27360 ± 740 BP	33445	30214
9	Proto-Aurignacian	Charcoal	GrA33891	33430 ± 250-230 BP	38470	36879
10	Châtelperronian	Charcoal	GrA33823	29380 ± 260-240 BP	34033	32984
10	Châtelperronian	Charcoal	SI 951	27800 ± 560 BP	33235	30935
10	Châtelperronian	Charcoal	SI 951a	>30340 BP	N/A	
11	Mousterian	Charcoal	OxA19083	41800 ± 450 BP	46022	44406
11	Mousterian	Charcoal	OxA19459	43600 ± 600 BP	48343	45648
11	Mousterian	Charcoal	GifA96264	42000 ± 730 BP	46922	44120

Table 5.29. Dating of Morin Cave (Maíllo-Fernández et al 2014).

5.2.3.6. Archaeological Record

The terminal Mousterian levels l1 and 12, are characterised by Discoidal and partly Levallois methods of knapping. Typologically, in these levels there is a greater presence of denticulates. Levels 13-17 were initially attributed to the Mousterian of Acheulean (MTA) tradition (Freeman, 1971b) due to the predominance of cleavers (Vasconian facies).

5.2.3.7. Lithic Assemblage

The number of lithics analysed from this site totals 596 pieces, recovered from level 11 during the excavations carried out by Echegaray and Freeman. The collection is currently housed at the Museum of Prehistory and Archaeology of Cantabria.

Raw material

The raw material of this assemblage comes from the local and semi-local surroundings. Around the Morin Cave there is a high diversity and abundance of raw materials in nearby alluvial deposits of the River Solía. A preference for secondary deposits as the specific catchment area for the raw materials according to the index of cortex is documented. In Level 11, flint (53%) dominates as raw material, followed by quartzite (16%), mudstone (15%) and other raw materials, which are present in smaller proportions (Figure 5.17). Quartzite and flint are present as small pebbles, while sandstone and ophite appear as

cobbles.

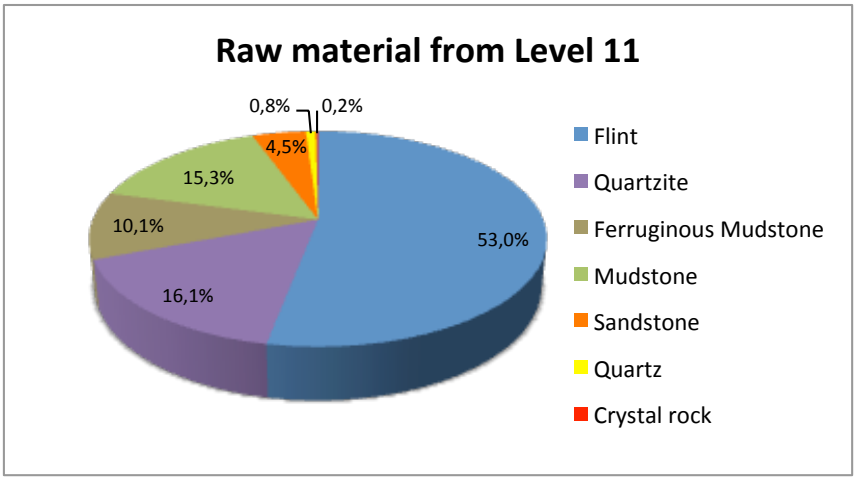


Figure 5.17. Raw material from level 11

Technical Categories

The assemblage is composed mainly of debris (n=380; 63%), followed by flakes (n=84; 14%) and fragmented flakes (n=81; 14%), while other blanks are less represented: flake fragments (n=25; 4%), cores (n=16; 3%), chunks (n=10; 2%) and natural base (n=2; 0.3%) (Figure 5.18, Table 5.30). Knapping products predominate, suggesting that the knapping strategy employed at the site was orientated towards the systematic production of flakes.

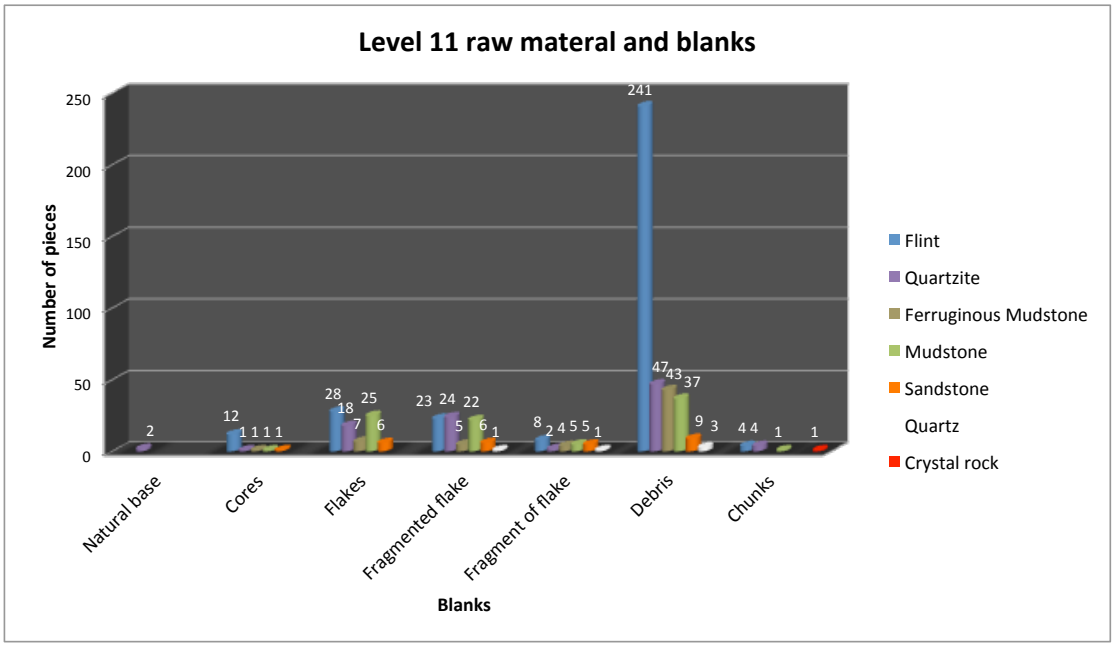


Figure 5.18. Raw material and blanks from level 11.

	Natural base	Cores	Flakes	Fragmented flake	Fragment of flake	Debris	Chunks	TOTAL	%
Flint		12	28	23	8	241	4	316	53
Quartzite	2	1	18	24	2	47	4	96	16
Ferruginous Mudstone		1	7	5	4	43		60	10
Mudstone		1	25	22	5	37	1	91	15
Sandstone		1	6	6	5	9		27	5
Quartz				1	1	3		5	0,8
Crystal rock							1	1	0,2
TOTAL	2	16	84	81	25	380	10	596	
%	0,3	3	14	14	4	63	2		

Table 5.30. Raw material and blanks from level 11.

Analysis of cores

From level 11, 11 cores, 3 cores on flakes and 2 fragments of core were identified. The raw material of the cores mirrors the proportions of the total assemblage. Flint cores are most abundant with 12 items (75%), followed by other raw materials with one item each: ferruginous mudstone (n=1; 6%), mudstone (n=1; 6%), sandstone (n=1; 6%), quartzite (n=1; 6%) (Table 5.31).

A total of 9 cores (56%) present cortex, however 6 pieces (37%) with cortex feature only a low percentage (≤ 25%). 3 pieces (19%) feature cortex on >25 and ≤50% of their surfaces, and 7 cores (44%) do not present cortex at all (Table 5.31).

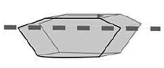
Regarding the stage of knapping sequence represented, all cores (n=16; 100%) are in the terminal stage. This shows that there was an intense degree of exploitation of the cores and this could be related to the economic behaviour evident from the technological system employed in this level (Table 5.31).

The exploitation of surfaces shows that a bifacial reduction strategy predominates with 14 pieces (88%), while only 2 pieces (12%) evidence a unifacial reduction strategy (Table 5.31).

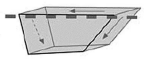
The majority of knapping strategies are centripetal (n=13; 81%) followed by multidirectional (n=3; 19%) (Table 5.31). The centripetal and multidirectional strategies identified on the cores are also in accordance with the interpretation that these cores represent the terminal stage of the knapping sequence.

The predominant method of knapping represented is Discoidal (n=14; 88%). The Discoidal cores were organized by dividing them in to two opposed secant surfaces, separated by an intersection plane in order to obtain flakes by centripetal and generally bifacial

organization removals. There are 2 cores (12%) for which the preparation was not determined because of the intense degree of explotation of the cores and their small size. The core assemblage is characterised by non-hierarchical surfaces (Table 5.31).




ANALYSIS OF CORES



TYPE OF CORES

Level	Raw material	Cores	Core on flakes	Fragment of cores	TOTAL	%
11	Flint	9	1	2	12	75
	Ferruginous mudstone		1		1	6
	Mudstone		1		1	6
	Sandstone	1			1	6
	Quartzite	1			1	6
TOTAL		11	3	2	16	
%		69	19	12		

AMOUNT OF CORTEX

Level	Raw material	0%	≤ 25%	>25 ≤50%	TOTAL	%
11	Flint	5	5	2	12	75
	Ferruginous mudstone			1	1	6
	Mudstone	1			1	6
	Sandstone	1			1	6
	Quartzite		1		1	6
TOTAL		7	6	3	16	
%		44	37	19		

STAGE OF KNAPPING SEQUENCE

Level	Raw material	Terminal	TOTAL	%
11	Flint	12	12	75
	Ferruginous m	1	1	6
	Mudstone	1	1	6
	Sandstone	1	1	6
	Quartzite	1	1	6
TOTAL		16	16	
%		100		

FACIAL ATTRIBUTE

Level	Raw material	Bifacial	Unifacial	TOTAL	%
11	Flint	10	2	12	75
	Ferruginous m	1		1	6
	Mudstone	1		1	6
	Sandstone	1		1	6
	Quartzite	1		1	6
TOTAL		14	2	16	
%		88	12		

STRATEGIES OF KNAPPING

Level	Raw material	Centripetal	Multidirectional	TOTAL	%
11	Flint	9	3	12	75
	Ferruginous m	1		1	6
	Mudstone	1		1	6
	Sandstone	1		1	6
	Quartzite	1		1	6
TOTAL		13	3	16	
%		81	19		

METHOD OF KNAPPING

Level	Raw material	Discoidal	Indeterminate	TOTAL	%
11	Flint	10	2	12	75
	Ferruginous m	1		1	6
	Mudstone	1		1	6
	Sandstone	1		1	6
	Quartzite	1		1	6
TOTAL		14	2	16	
%		88	12		

Table 5.31. Analysis of cores.

Morphometrically, the cores mean 40mm in length, 30mm in width and 21mm in thickness. The mean surface area is 1526mm^2. These measurements indicate that on mean cores are of small size (Table 5.32).

		Length	Width	Thickness	Area
Number of cores		16	16	16	16
Mean		40	30	21	1526
Mode		22	21	17	840
Median		34	25	19	831
Maximum value		120	82	50	9777
Minimum value		22	21	12	471
Kurtosis		10	10	8	14
Standard deviation		23	15	9	2253
Percentile	25	28	22	17	699
	50	34	25	19	831
	75	44	32	23	1459

Table 5.32. Metric measures of the cores from level 11.

A scatter plot of the measurements (length and width) of the cores shows a concentration of points between 22mm x 52mm (length) and 20mm x 40mm (width) (Figure 5.19), showing again that the majority of the cores are of small size.

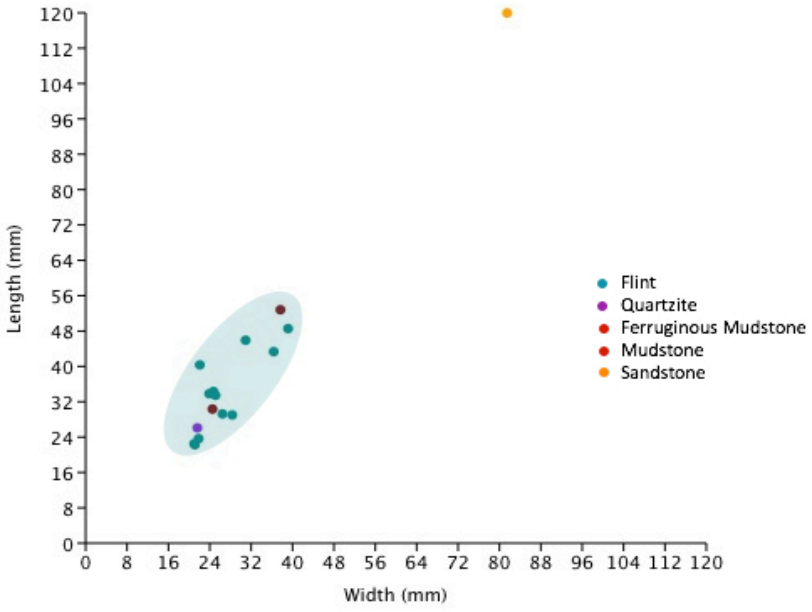


Figure 5.19. Scatter plot of the measurements of the cores from level 11.

The Flake Analyses

The flake assemblage of level 11 is composed of 84 flakes and 106 flake fragments. For this reason we can consider that obtaining flakes was the main objective of the production sequence.

Ventral Face

Type of Bulb

Regarding the types of bulb present, the flake assemblage is dominated by those of diffuse type (n=66; 79%) while fewer are of pronounced type (n=18; 21%) (Table 5.33). In relation to the delineation of the ventral face we can see diversity although sinuous delineation (n=30; 36%) is dominant, followed by straight (n=28; 33%) and convex (n=22; 26%), while fewer pieces show concave (n=4; 5%) delineation (Table 5.33).

Butt

Regarding butt surfaces, the assemblage is almost entirely (n=78; 93%) non-cortical, with only 6 (7%) showing cortex (Table 5.33). Platforms are the most frequently represented type of butt (n=73; 87%), while the other categories of cortical (n=6; 7%), puntiform (n=3; 4%) and linear (n=2; 2%) butt are present in small numbers (Table 5.33).

The preparation of butts is characterised by a frequent presence of plain (n=63; 75%), followed by dihedral (n=10; 12%), butts. The other categories occur in lesser frequency: cortical (n=6; 7%), multifaceted (n=3; 4%) and puntiform (n=2; 2%) (Table 5.33).

There are many different types of butt delineation. Most frequently represented is straight delineation (n=53; 63%), followed by the other types in lesser proportion: sinuous (n=15; 18%), uniangular (n=7; 8%), convex (n=2; 2%) and concave (n=1; 1%) (Table 5.33).



VENTRAL FACE AND BUTT



TYPE OF BULB					
Level	Raw material	Marked	Difuse	TOTAL	%
11	Flint	5	23	28	33
	Ferruginous mudstone	2	5	7	8
	Mudstone	7	18	25	30
	Sandstone		6	6	7
	Quartzite	4	14	18	21
TOTAL		18	66	84	
%		21	79		

DELINEATION OF VENTRAL FACE							
Level	Raw material	Sinuous	Convex	Concave	Straight	TOTAL	%
11	Flint	10	5	2	11	28	33
	Ferruginous mudstone	2	2		3	7	8
	Mudstone	9	10	1	5	25	30
	Sandstone	1		1	4	6	7
	Quartzite	8	5		5	18	21
TOTAL		30	22	4	28	84	
%		36	26	5	33		

CORTICALITY OF BUTTS					
Level	Raw material	Cortical	No cortical	TOTAL	%
11	Flint		28	28	33
	Ferruginous mudstone	1	6	7	8
	Mudstone	1	24	25	30
	Sandstone		6	6	7
	Quartzite	4	14	18	21
TOTAL		6	78	84	
%		7	93		

TYPE OF BUTT							
Level	Raw material	Platform	Linear	Puntiform	Cortical	TOTAL	%
11	Flint	26	1	1		28	33
	Ferruginous mudstone	6			1	7	8
	Mudstone	23		1	1	25	30
	Sandstone	6				6	7
	Quartzite	12	1	1	4	18	21
TOTAL		73	2	3	6	84	
%		87	2	4	7		

FACET OF BUTT								
Level	Raw material	Plain	Bifaceted	Multifaceted	Puntiform	No faceted	TOTAL	%
11	Flint	22	3	2	1		28	33
	Ferruginous mudstone	5		1		1	7	8
	Mudstone	19	5			1	25	30
	Sandstone	5	1				6	7
	Quartzite	12	1		1	4	18	21
TOTAL		63	10	3	2	6	84	
%		75	12	4	2	7		

DELINEATION OF BUTT									
Level	Raw material	Sinuous	Convex	Concave	Straight	Uniangular	Cortical	TOTAL	%
11	Flint	8			18	2		28	33
	Ferruginous mudstone	2			4		1	7	8
	Mudstone	4	2	1	15	2	1	25	30
	Sandstone	1			4	1		6	7
	Quartzite				12	2	4	18	21
TOTAL		15	2	1	53	7	6	84	
%		18	2	1	63	8	7		

Table 5.33. Ventral face and butt analysis.

Below, the morphometric analysis of knapping angle from 84 flakes is presented, which shows a mean of 108°, a mode of 105° and a median 108°, suggestive of a preference for a type of obtuse angle (Table 5.34).

Angle of knapping		
Number of flakes		84
Mean		108
Mode		105
Median		108
Maximum value		134
Minimum value		68
Kurtosis		1,1
Standard deviation		11
Percentile	25	102
	50	108
	75	115

Table 5.34. Angle of knapping of the flakes from level 11.

Dorsal Face

The study of the dorsal surface shows the degree of transformation within the knapping sequence. As regards the presence of cortex, the majority of flakes (n=70; 83%) do not present cortex, 8 (10%) present less than 50% cortex on their surfaces, 4 (5%) present more than 50% while only 2 (2%) are fully cortical flakes (Table 5.35).

The direction of scars is highly diverse, with three categories frequently represented: multidirectional is the most frequent (n=44; 52%), followed by unidirectional (n=22; 26%) and centripetal (n=15; 18%), while the bidirectional category is represented by only one example (Table 5.35).



DORSAL FACE

Amount of cortex

Level	Raw material	0%	≤50%	>50%	100%	TOTAL	%
11	Flint	27		1		28	33
	Ferruginous mudstone	6	1			7	8
	Mudstone	23	2			25	30
	Sandstone	4	2			6	7
	Quartzite	10	3	3	2	18	21
TOTAL		70	8	4	2	84	
%		83	10	5	2		

Direction of scars

Level	Raw material	Centripetal	Unidirectional	Bidirectional	Multidirectional	Cortical	TOTAL	%
11	Flint	7	6		15		28	33
	Ferruginous mudstone	1	5		1		7	8
	Mudstone	6	4		15		25	30
	Sandstone		3	1	2		6	7
	Quartzite	1	4		11	2	18	21
TOTAL		15	22	1	44	2	84	
%		18	26	1	52	2		

Table 5.35. Dorsal face analysis.

Regarding the number of scars on the 84 flakes, there is a mean of 6 scars, a mode of 5, and a median of 5. This is indicative of a high intensity of reduction because the scars show the previous removals, while a mean of 6 scars on the dorsal face indicates a high degree of reduction (Table 5.36).

Number of scars		
Number of flakes		84
Mean		6
Mode		5
Median		5
Maximum value		16
Minimum value		1
Kurtosis		1,1
Standard deviation		3
Percentile	25	3
	50	5
	75	8

Table 5.36. Number of scars of the flakes from level 11.

Morphometric analysis shows a mean of 27mm length, 26mm width and 10mm thickness for the flakes. As regards surface area, the mean is 802mm^2. These measurements indicate that, on mean, pieces are small. The elongation index shows a mean of 1.08, meaning that there is no laminar tendency in the assemblage. The flattening index shows a mean of 0.42, meaning that the flakes are very thin (Table 5.37).

		Length	Width	Tchickness	Area	Elongation index	Flattening index
Number of flakes		84	84	84	84	84	84
Mean		27	26	10	802	1,08	0,42
Mode		17	20	10	218	1,00	0,30
Median		24	24	9	590	1,04	0,40
Maximum value		71	68	21	4865	2,28	0,86
Minimum value		11	11	3	155	0,48	0,20
Kurtosis		1,4	2,0	0,2	11,9	1,31	0,67
Standard deviation		12	11	4	725	0,34	0,13
Percentile	25	18	18	6	326	0,85	0,33
	50	24	24	9	590	1,04	0,40
	75	33	32	12	1051	1,23	0,50

Table 5.37. Measures of the flakes from level 11.

A scatter plot of flake measurements (length and width) shows a concentration of points between 10mm x 30mm (length) and 10mm x 30mm (width) for this assemblage (Figure 5.20). We can see again that the majority of the flint flakes are small and predetermined, while the ferruginous mudstone and quartzite flakes are larger, possibly because their blanks were bigger or flint was simply more intensely reduced.

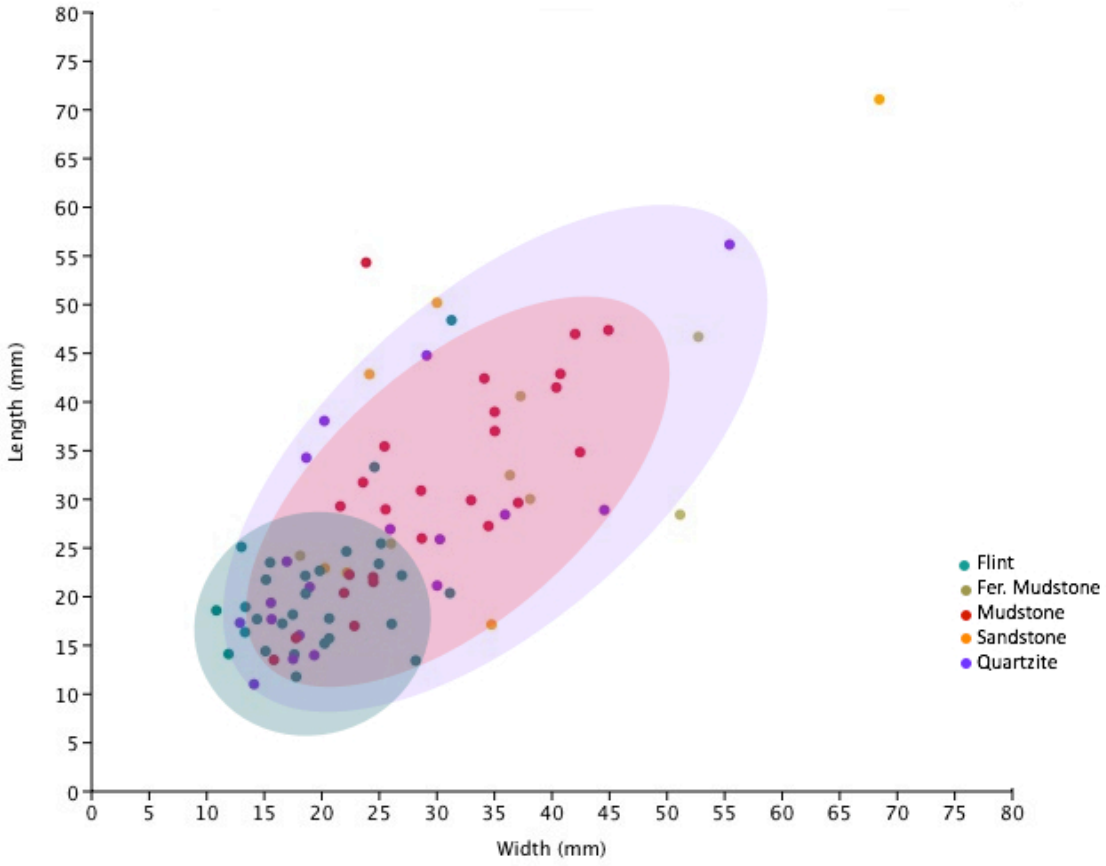


Figure 5.20. Scatter plot of the measurements of the flakes from level 11

Retouched pieces

A total of 79 retouched pieces were studied from (Table 5.38). The kind of blanks that were selected for retouch are flakes (n=37; 47%), followed by fragmented flakes (n=32; 41%), flake fragments (n=8; 10%) and debris (n=2; 3%) in a smaller proportions respectively. The majority of the pieces have unifacial retouch (n=58; 73%) with only (n=21; 27%) pieces showing bifacial retouch.

Regarding the extent of retouch found along the edge of the flakes, retouched pieces with a >25 to ≤50% extent of retouch predominate in the tool assemblage (n=27; 34%), followed by pieces with >50% to ≤ 75% extent (n=17; 22%) and ≤25% (n=13; 16%) respectively. With these data we can conclude that the retouched tools assemblage has an extensive degree of retouch.

Although the sum of the individual number of retouched pieces analysed equals 79, the total number of shaped edges analysed is 106, as represented in Table 5.38. The majority of the retouch is located on the side (n=82; 78%). The left side is the most common with extensive retouch (n=43; 41%), followed by the right (n=39; 37%), and the distal (n=13; 12%) and proximal (n=4, 4%) areas in smaller proportions respectively.

Semi-abrupt retouch angles (n=60; 57%) are the dominant angles present in this assemblage, followed by abrupt angles (n=28; 26%) and simple angles (n=18; 17%).

With regard to the extent of retouch on the dorsal/ventral surfaces, marginal retouch is the most represented (n=60; 57%), followed by extensive retouch (n=26; 25%), very marginal retouch (n=18; 17%) and very extensive retouch (n=2; 2%). In relation to the depth of retouch on the dorsal/ventral surfaces, marginal retouch prevails with 60% (n=64), followed by deep retouch (n=28; 26%), very marginal (n=13, 12%) and very deep (n=1, 1%).

The predominant direction of retouch is direct (n=71; 67%), with inverse (n=13; 12%) and alternate (n=11; 10%) and alternating (n=11; 10%) less represented.

The delineation of the retouched edge is predominantly denticulate retouch (n=81; 76%), followed by continuous (n=25; 24%). The data obtained by these two attributes are in direct correlation with the type of tools within assemblage: denticulates and scrapers.

Regarding the morphology of the retouched edge, the denticulate type is the most common (n=81; 76%), followed by sinuous (n=10; 9%), convex (n=7; 7%), straight (n=6; 6%) and finally concave (n=2; 2%).



RETOUCHED TOOL



TYPES OF BLANK

Level	Raw material	Flakes	Fragmented flake	Fragment of flake	Debris	TOTAL	%
11	Flint	13	8	4	2	27	34
	Ferruginous mudstone	6	2	1		9	11
	Mudstone	6	8	1		15	19
	Sandstone	1		1		2	3
	Quartzite	11	13			24	30
	Quartz		1	1		2	3
TOTAL		37	32	8	2	79	
%		47	41	10	3		

FACIAL ATRIBUTE

Level	Raw material	Unifacial	Bifacial	TOTAL	%
11	Flint	24	3	27	34
	Ferruginous mudstone	6	3	9	11
	Mudstone	7	8	15	19
	Sandstone	2		2	3
	Quartzite	18	6	24	30
	Quartz	1	1	2	3
TOTAL		58	21	79	
%		73	27		

EXTENSION

Level	Raw material	≤ 25%	>25 ≤50%	>50 ≤75%	Unknown	TOTAL	%
11	Flint	3	10	5	9	27	34
	Ferruginous mudstone	3	4	1	1	9	11
	Mudstone	5	4	3	3	15	19
	Sandstone	1		1		2	3
	Quartzite	1	8	7	8	24	30
	Quartz		1		1	2	3
TOTAL		13	27	17	22	79	
%		16	34	22	28		

LOCALITATION

Level	Raw material	Left	Distal	Right	Proximal	Unknown	TOTAL	%
11	Flint	12	6	10		7	35	34
	Ferruginous mudstone	5	1	5			11	11
	Mudstone	12	1	9	1		23	22
	Sandstone	1		1	1		3	3
	Quartzite	12	5	12	2		31	30
	Quartz	1		2			3	3
TOTAL		43	13	39	4	7	106	
%		41	12	37	4	7		

ANGLE

Level	Raw material	Abrupt	Semi abrupt	Simple	TOTAL	%
11	Flint	13	15	7	35	34
	Ferruginous mudstone	2	8	1	11	11
	Mudstone	4	15	4	23	22
	Sandstone		3		3	3
	Quartzite	9	18	4	31	30
	Quartz		1	2	3	3
TOTAL		28	60	18	106	
%		26	57	17		

DEEP OF RETOUCHED ON SURFACE

Level	Raw material	Very marginal	Marginal	Extensive	Very extensive	TOTAL	%
11	Flint	9	16	10		35	34
	Ferruginous mudstone		10	1		11	11
	Mudstone	5	14	3	1	23	22
	Sandstone			3		3	3
	Quartzite	2	19	9	1	31	30
	Quartz	2	1			3	3
TOTAL		18	60	26	2	106	
%		17	57	25	2		

DEEP OF RETOUCHED ON EDGE

Level	Raw material	Very marginal	Marginal	Deep	Very deep	TOTAL	%
11	Flint	5	19	11		35	34
	Ferruginous mudstone		8	3		11	11
	Mudstone	6	14	3		23	22
	Sandstone			3		3	3
	Quartzite	2	20	8	1	31	30
	Quartz		3			3	3
TOTAL		13	64	28	1	106	
%		12	60	26	1		

DIRECTION

Level	Raw material	Direct	Inverse	Alternate	Alternating	TOTAL	%
11	Flint	28	4	1	2	35	34
	Ferruginous mudstone	5	2	3	1	11	11
	Mudstone	11	5	3	4	23	22
	Sandstone	3				3	3
	Quartzite	23	2	4	2	31	30
	Quartz	1			2	3	3
TOTAL		71	13	11	11	106	
%		67	12	10	10		

DELINEATION

Level	Raw material	Continuous	Denticulate	TOTAL	%
11	Flint	12	23	35	34
	Ferruginous mudstone		11	11	11
	Mudstone	2	21	23	22
	Sandstone		3	3	3
	Quartzite	11	20	31	30
	Quartz		3	3	3
TOTAL		25	81	106	
%		24	76		

MORPHOLOGY

Level	Raw material	Straight	Convex	Concave	Sinuous	Denticulate	TOTAL	%
11	Flint	3	6	1	2	23	35	34
	Ferruginous mudstone					11	11	11
	Mudstone			1	1	21	23	22
	Sandstone					3	3	3
	Quartzite	3	1		7	20	31	30
	Quartz					3	3	3
TOTAL		6	7	2	10	81	106	
%		6	7	2	9	76		

Table 5.38. Retouched tools analysis.

Following the Laplace typology (Table 5.39), the retouched tools are grouped into two main groups: denticulates (n=62) and scrapers (n=17).

Amongst the denticulates, marginal denticulate retouch D1 (n=47, 59%) prevails, followed by denticulate scraper D23 (n=11, 14%), encoche D21(n=2, 3%) and spine D22 (n=2, 3%) in smaller percentages.

Amongst the scrapers, side scrapers with marginal retouch (R1) (n=10; 13%) prevails, followed by side scrapers with abrupt retouch (R21) (n=4; 5%). Less represented are transverse scrapers R22 (n=2; 3%), and side-transverse scrapers R23 (n=1; 1%).

LAPLACE TYPOLOGY											
Level	**Raw material**	**R1**	**R21**	**R22**	**R23**	**D1**	**D21**	**D22**	**D23**	**TOTAL**	**%**
11	**Flint**	5	2	2		15		1	2	27	34
	Ferruginous mudstone					8	1			9	11
	Mudstone					10		1	4	15	19
	Sandstone								2	2	3
	Quartzite	5	2		1	12	1		3	24	30
	Quartz					2				2	3
TOTAL		10	4	2	1	47	2	2	11	79	
%		13	5	3	1	59	3	3	14		

Table 5.39. Laplace Typology.

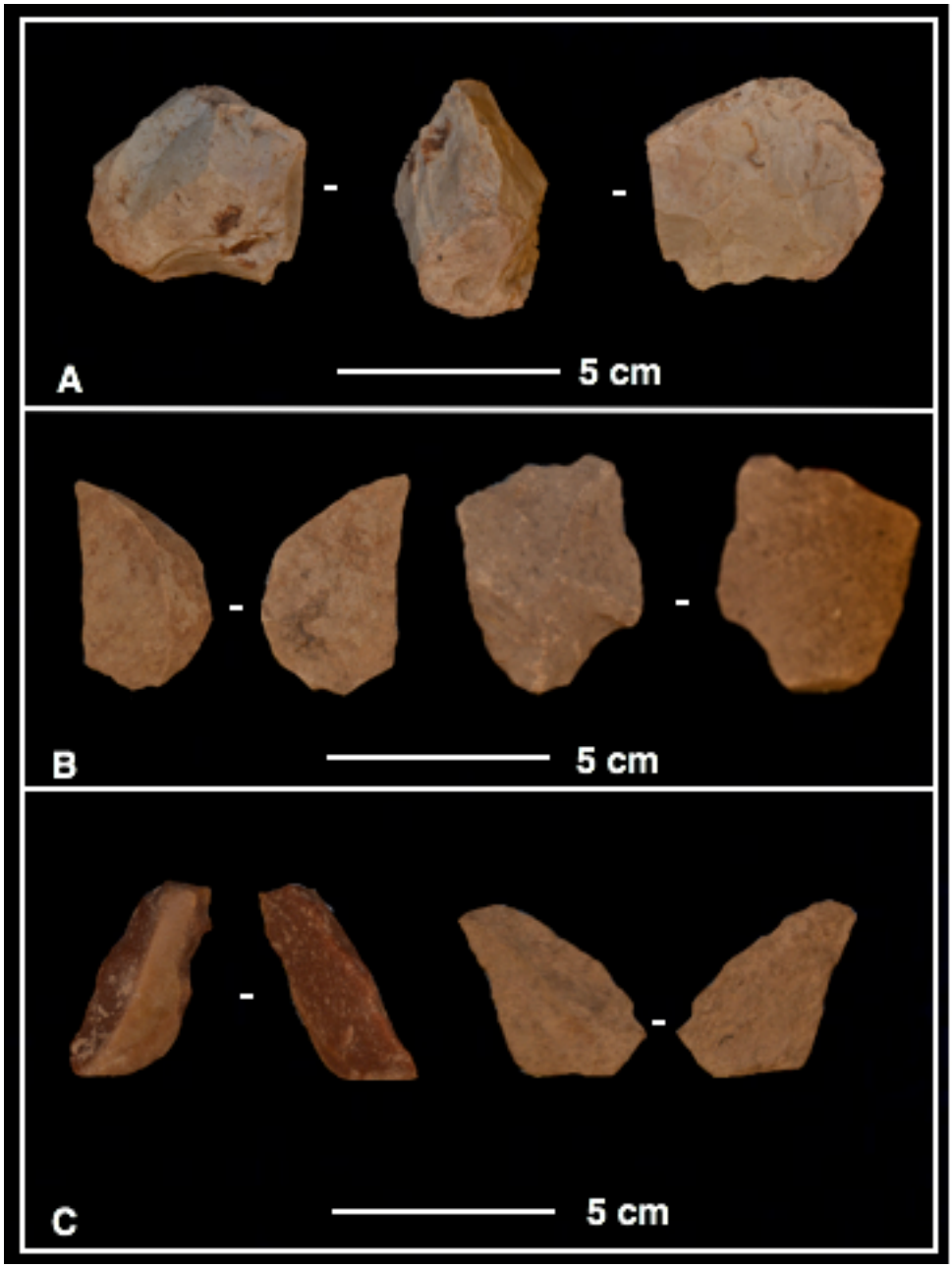


Figure 5.21. Detail of some lithic artefacts: A. Core, B. Flakes, and C. Retouched tools.

5.2.4. EL CASTILLO CAVE

5.2.4.1 Location

El Castillo Cave is located in the village of Puente Viesgo (Cantabria), on the Castillo Mountain at 195m a.s.l., around 24km inland from the coast. The cave is oriented north-northeast and is 760m long (Foyo *et al* 2006). The archaeological deposits are situated in the hall, which has an area of 18m x 20m and a sedimentary deposit approximately 21 m deep (Cabrera 1984). The site coordinates are 0º 16`40``W and 43º 17`25`` N.



Figure 5.22. View of El Castillo.

5.2.4.2. Geological Setting

The El Castillo Mountain is a conical and calcareous promontory. It includes many small holes and seven main cavities: El Castillo, Las Chimeneas, La Pasiega, La Flecha, Las Monedas, El Oso, El Lago. El Castillo Mountain belongs to a geological sequence of Carboniferous limestone, formed during the Namurian to Westfalian geological ages. The epikarts has been developed in favor of discontinuous type napes, generated during the Hercynic orogeny, and by fractures formed during the Alpine orogeny (Foyo *et al* 2010).

5.2.4.3. Historical Background

The site was discovered in 1903 by H. Alcalde del Río, who carried out the first excavations, unearthing the Magdalenian levels. Subsequent excavations between 1910 and 1914 were carried out by H. Breuil, H. Obermaier and H. Alcalde del Río under the auspices of the Institute of Human Palaeontology (IPH) in Paris. They described a long stratigraphy ranging from the Lower Palaeolithic to the Iron Age. However, research was cut short by the outbreak of World War I and the results were only summarily published (Breuil & Obermaier 1912, 1913, 1914; Obermaier 1916, 1924a,b, 1925). The archaeological material was deposited at the IPH. In 1973 these materials were returned to Spain, however the collection was divided mostly between the Museo Arqueológico Nacional (Madrid) and Museo de Arqueología de Cantabria (Santander). These materials were studied, partially (Level alfa) by Benito del Rey (1976) and in their entirety by Victoria Cabrera for her doctoral research (Cabrera 1984).

Between 1980 and 2004 a new interdisciplinary project led by Federico Bernaldo de Quirós and Victoria Cabrera focused on confirming the stratigraphy proposed by H. Obermaier and studying the transitions between the Middle and Upper Palaeolithic and the Lower and Middle Palaeolithic. This team is still studying the archaeological materials documented in the cave (Bernaldo de Quirós *et al* 2014, 2015)

5.2.4.4. Stratigraphic Sequence

The cave´s stratigraphy was originally described by Breuil and Obermaier (Obermaier 1924). Subsequently, a detailed sedimentological study was carried out by Butzer (1981), while the numerical layer designation was made by Cabrera Valdés (1984). The stratigraphic sequence is approximately 21m deep. There are 26 units. Unit 1: Middle Ages, Unit 2: Bronze Age, Unit 4: Azilian, Units 6 and 7: Upper Magdalenian, Unit 8: Lower Magdalenian, Unit 10: Solutrean, Units 12 and 14: Gravettian, Unit 16: Archaic Aurignacian, Unit 18: Transitional Aurignacian, Units 20 to 22: Mousterian, Units 24 to 26: Late Acheulean (Table 5.40).

Level	Composition	Thickness (cm)	Cultural attribution
1	modern debris		Middle Ages
2	modern debris	250-40	Bronze Age
3	detachment of the visor	20-40	Sterile
4	red level with debris from the visor	15-30	Azilian
5	yellowish silts and breccia	300	Sterile
6	black an wet sediment by organic waste	35-5	Magdalenian A
7	yellowish silts	50	Magdalenian
8a	black sediment wtih ash, bones and stones	40-60	Magdalenian B
8b	yellowish silts	40-60	Magdalenian B
8c	red sediments with hearths	40-60	Magdalenian B
9	yellowish silts	50	Sterile
10	sediment with hearths	13	Solutrean
11	yellowish silts	50	Sterile
12a	black silts with hearths	15	Aurignacian A
12b	silts with stones	35	Aurignacian A
13	silts with big stones	50-85	Sterile
14a	zones with hearths, blocks, breccia	10	Aurignacian B
14b	zones with hearths, blocks, breccia	10	Aurignacian B
14c	zones with hearths, blocks, breccia	2-4	Aurignacian B
15	yellowish silts	20	Sterile
16a	sandy silt	30-25	Aurignacian C
16b	sandy silt with hearths	30-25	Aurignacian C
16c	sandy silt with hearths	30-25	Aurignacian C
16d	sandy silt	30-25	Aurignacian C
17	silt	30-25	Sterile
18a	brown silt with hearth	0,6-0,8	Aurignacian D
18b	brown silt with hearth	15-20	Aurignacian D
18c	brown silt with hearth		Aurignacian D
19	stalagmitic crust	50-25	Sterile
20a	12 layers of ash intercalated by silt bands	35	Mousterian
20b	gray and black sediment matrix with hearths	20	Mousterian
21	yellowish silts	10	Sterile
22a	purplish layer with ashes and manganese	20-25	Mousterian
22b	silt with hearths	20-25	Mousterian
22c	layer with black hearths	20-25	Mousterian
23a	red silt with phosphate formation		Sterile
23b	stalagmitic crust with a level of clays	50	Sterile
23c	silt	5	Sterile
24	brown silt or clay	10-30	Acheulean
25a	clay with charcoal remains	15-40	Acheulean
25b	stony layer	110-130	Acheulean
26	clay	130	Acheulean

Table 5.40. Stratigraphic sequence description (Cabrera 1984).

5.2.4.5. Dating

There are dates for almost all the units, based on different methods and multiple samples, deriving from different years of excavation (Table 5.41).

Level	Cultural attribution	Material	Method	Lab. Ref.	Date	References
6	Upper Magdalenian	Bone	AMS	OxA-970	10,310 ± 120 BP	Barandarian 1988
6	Upper Magdalenian	Bone	AMS	OxA-972	12,390 ± 220 BP	Barandarian 1988
6	Upper Magdalenian	Bone	AMS	OxA-10296	31,800 ± 600 BP	Bernaldo de Quirós *et al* 2006
8	Lower Magdalenian	Bone	AMS	Beta 242618	15,540 ± 70 BP	Bernaldo de Quirós *et al* 2014
8	Lower Magdalenian	Bone	AMS	Beta 242620	15,160 ± 70 BP	Bernaldo de Quirós *et al* 2014
8	Lower Magdalenian	Antler	AMS	OxA-971	16,850 ± 50 BP	Barandarian 1988
10	Solutrean	Bone	AMS	Beta 242619	19,260 ± 90 BP	Bernaldo de Quirós *et al* 2014
12	Gravettian	Bone	AMS	Beta 242617	24,070 ± 150 BP	Bernaldo de Quirós *et al* 2015
12	Gravettian	Bone	AMS	Beta 298431	25,520 ± 140 BP	Bernaldo de Quirós *et al* 2015
12	Gravettian	Bone	AMS	Beta 298430	25,920 ± 140 BP	Bernaldo de Quirós *et al* 2015
14	Gravettian	Bone	AMS	Beta 298433	29,600 ± 180 BP	Bernaldo de Quirós *et al* 2015
14	Gravettian	Bone	AMS	Beta 298432	29,740 190 BP	Bernaldo de Quirós *et al* 2015
16	Aurignacian	Charcoal	AMS	GifA-95539	34,300 ± 1000 BP	Cabrera *et al* 2002
18 B	Aurignacian	Charcoal	AMS	AA 2407	37,700 ± 1800 BP	Cabrera & Bischoff 1989
18 B	Aurignacian	Charcoal	AMS	OxA-2473	37,100 ± 2200 BP	Hedges *et al* 1994
18 B	Aurignacian	Charcoal	AMS	AA 2406	38,500 ± 1800 BP	Cabrera & Bischoff 1989
18 B	Aurignacian	Charcoal	AMS	OxA-2474	38,500 ± 1300 BP	Hedges *et al* 1994
18 B	Aurignacian	Charcoal	AMS	OxA-2475	40,700 ± 1600 BP	Hedges *et al* 1994
18 C	Aurignacian	Charcoal	AMS	OxA-2476	40,700 ± 1500 BP	Hedges *et al* 1994
18 C	Aurignacian	Charcoal	AMS	OXA-2477	41,100 ± 1700 BP	Hedges *et al* 1994
18 C	Aurignacian	Charcoal	AMS	AA-2405	40,000 ± 2100 BP	Cabrera & Bischoff 1989
18 C	Aurignacian	Charcoal	AMS	OxA-2478	39,800 ± 1400 BP	Hedges *et al* 1994
18 C	Aurignacian	Charcoal	AMS	GifA-89147	39,500 ± 200 BP	Cabrera *et al* 2006
18 C	Aurignacian	Bone	ESR	93120A2	37,000± 4700 BP	Rink *et al* 1996
18 C	Aurignacian	Bone	ESR	93121A2	41,200 ± 5200 BP	Rink *et al* 1996
18 C	Aurignacian	Bone	ESR	93121A3	42,000 ± 5400 BP	Rink *et al* 1996
18 C	Aurignacian	Bone	ESR	93123AC	33,300 ± 4000 BP	Rink *et al* 1996
18 C	Aurignacian	Bone	ESR	93123AD	33,600 ± 4200 BP	Rink *et al* 1996
18 C	Aurignacian	Bone	ESR	93124A1C	34,600 ± 4400 BP	Rink *et al* 1996
18 C	Aurignacian	Bone	ESR	93124A2CD	31,400 ± 3900 BP	Rink *et al* 1996
20	Mousterian	Bone	AMS	OxA-10233	42,100 ± 1500 BP	Wood *et al* 2016
20	Mousterian	Bone	AMS	OxA-10328	45,700 ± 1700	Wood *et al* 2016
20	Mousterian	Bone	AMS	OxA-10327	> 45,700 BP	Wood *et al* 2016
20	Mousterian	Bone	AMS	OxA-10329	> 43,800 BP	Wood *et al* 2016
20	Mousterian	Bone	AMS	OxA-10187	42,900 ± 1400 BP	Wood *et al* 2016
20	Mousterian	Bone	AMS	OxA-10188	> 47,300 BP	Wood *et al* 2016
20 B	Mousterian	Charcoal	AMS	GifA-92506	43,300 ± 3800 BP	Cabrera *et al* 2006
20	Mousterian	Bone	ESR		42,700 ± 3500	Liberda *et al* 2010
21	Mousterian	Bone	ESR	90CST3A	(EU) 75,100 ± 4400 BP	Rink *et al* 1997
21	Mousterian	Bone	ESR	90CST4A	(EU) 62,500 ± 4300 BP	Rink *et al* 1997
22	Mousterian	Bone	ESR	90CST1A	(EU) 79,500 ± 4300 BP	Rink *et al* 1997
22	Mousterian	Bone	ESR	90CST1B	(EU) 76,200 ± 4700 BP	Rink *et al* 1997
22	Mousterian	Bone	ESR	90CST2A	(EU) 65,600 ± 4700 BP	Rink *et al* 1997
22	Mousterian	Bone	ESR	90CST2B	(EU) 59,100 ± 5000 BP	Rink *et al* 1997
23	Mousterian	stalagmitic crust	U-series		89,000 BP	Bischoff *et al* 1992
23	Mousterian		ESR		92,200 BP	Rink *et al* 1996,1997

Table 5.41. Dating from EL Castillo Cave

5.2.4.6. Archaeological Record

The latest Mousterian level corresponds to Unit 20. This level contained an assemblage of lithic artefacts variously attributed to Mousterian of Acheulean Tradiction (MTA), Typical, Charentian and Vasconian facies (Freeman 1964, 1969-70, 1981; Cabrera 1983, 1984). A total of 388 cleaver flakes were documented, according to Breuil and Obermaier (Cabrera

1984), as well as 31 bifaces of nucleiform, partial and atypical forms (Freeman 1964). This level is separated from the earlier Mousterian cultural level, level 22, by 10cm.

In the most recent excavation carried out by Cabrera and Bernaldo de Quirós, a new description of level 20 has been reached. This level was divided into 20 a/b, 20 d and 20 e. In almost every level lithics appear to have been generated by Discoidal methods of knapping in bifacial and unifacial modes. Levallois methods are also present in some levels such as 20e (Sánchez Fernández & Bernaldo de Quirós 2008). Typologically, artefacts are characterised by an average index of side-scrapers, few denticulates and little Quina retouch. Bernaldo de Quirós *et al* (2014) classify the lithic assemblage as standard Mousterian and also found similar cleavers on flake to those unearthed in the old excavations.

According to Vaufrey (Cabrera 1984) in level 20, deer dominates the faunal assemblage, followed by bovids, horses, goats, rhinos, wild boars and cave bears. The faunal species represented are known to prefer temperate climates, which is indicative of palaeoclimatic conditions. There are no severe-climate-preferred species present.

5.2.4.7. Lithic Assemblage

219 lithics were analysed in total, all derived from Level 20 and Obermaier´s excavations. This collection is currently housed at the Museum of Prehistory and Archaeology of Cantabria.

Raw Material

The raw material of the assemblage is derived from local and semi-local surroundings, with quartzite (91.3%) the dominant raw material. Around El Castillo Cave there is a high diversity of raw materials. The flint (3.7%) probably derives from surrounding areas, possibly as far away as the coastal flysh outcrops 24km to the north. Quartzite, sandstone, mudstone and limestone cobbles are abundant as secondary outcrops on the fluvial terraces of the river Pas, and as such would have been readily available (Figure 5.23).

The small, very fine-grained pebbles of flint and quartzite, were used for manufacturing flakes of small and medium size. However, for the large flakes, larger blanks of other raw

materials such as ophite and other coarse-grained rocks were used (Benito del Rey, 1976a).

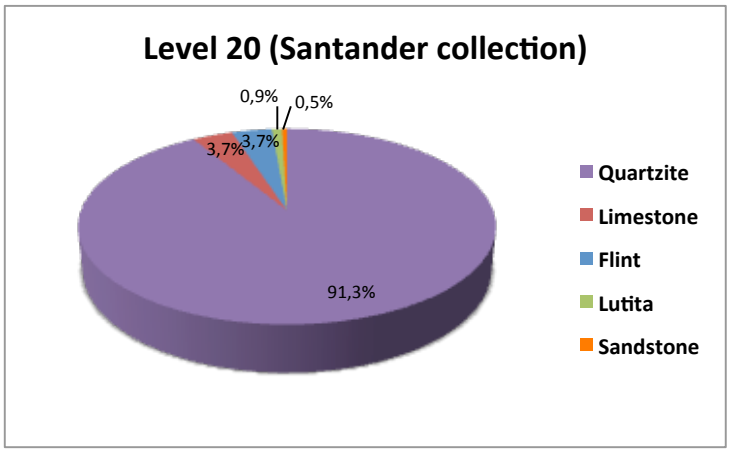


Figure 5.23. Raw material from level 20.

Technical Categories

The assemblage is composed mainly of flakes (n=175; 80.65%), followed by fragmented flakes (n=22; 10.14%), whereas the other blanks are less represented: cores (n=18; 8.29%), flake fragments (n=3; 1.38%) (Figure 5.24, Table 5.42). There is little debitage, and few flake fragments within the assemblage, probably because the excavators were only interested in collecting complete pieces or tools.

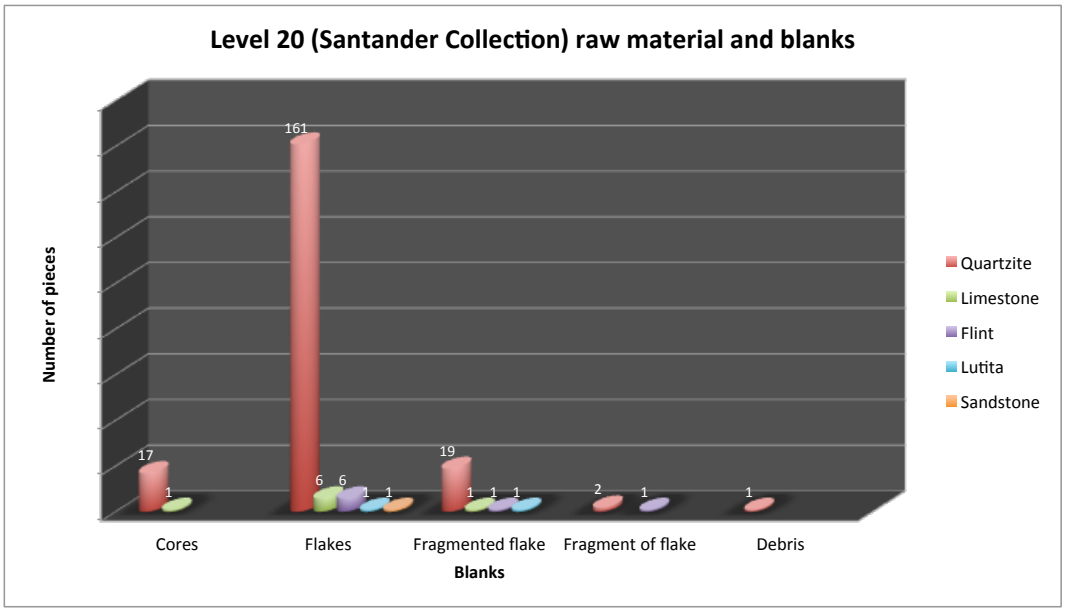


Figure 5.24. Raw material and blanks from level 20.

Level 20	Cores	Flakes	Fragmented flake	Fragment of flake	Debris	TOTAL	%
Quartzite	17	161	19	2	1	200	92,17
Limestone	1	6	1			8	3,69
Flint		6	1	1		8	3,69
Lutita		1	1			2	0,92
Sandstone		1				1	0,46
TOTAL	18	175	22	3	1	219	
%	8,29	80,65	10,14	1,38	0,46		100

Table 5.42. Raw material and blanks from level 20.

Analysis of cores

From level 20, 18 cores were studied. Quartzite cores are most abundant (n=17; 94%), followed by mudstone (n=1; 6%) (Table 5.43).

The majority of the core assemblage present cortex (n=15; 83%), only 3 (17%) cores do not present cortex. Of the cortical cores, 3 (17%) pieces present a low percentage of cortex (≤ 25%), 2 (10%) pieces of more than >50% cortex and 10 (56%) pieces of between >25 and ≤50% cortex (Table 5.43).

Regarding the stage of knapping sequence represented, the majority of cores (n=11; 61%) are from the exploitation stage, followed by those from the terminal stage (n=5; 28%) and those from the initial stage (n=2; 11%). No cores evidenced an intense degree of exploitation (Table 5.43).

Analysis of surface exploitation reveals that bifacial reduction strategies predominate (n=17; 94%) while only one piece (6%) corresponds to a unifacial strategy (Table 5.43). Centripetal knapping strategies predominated (n=15; 82%) followed by other strategies with only one example each: multidirectional (n=1; 6%), bidirectional (n=1; 6%), unidirectional (n=1; 6%) (Table 5.43).

Discoidal knapping of cores predominates (n=16; 89%). The Discoidal cores were organized by dividing them into two opposed surfaces, separated by an intersectional plane in order to obtain flakes through centripetal and bifacial removals. There are also 2 (11%) cores for which the knapping method could not be determined. The core assemblage is characterised by non-hierarchical surfaces (Table 5.43).



ANALYSIS OF CORES



TYPES OF CORES				
Level	**Raw material**	**Cores**	**TOTAL**	**%**
20	**Mudstone**	1	1	6
	Quartzite	17	17	94
TOTAL		18	18	
%		100		

AMOUNT OF CORTEX							
Level	**Raw material**	**0%**	**≤ 25%**	**>25 ≤50%**	**>50%**	**TOTAL**	**%**
20	**Mudstone**			1		1	6
	Quartzite	3	3	9	2	17	94
TOTAL		3	3	10	2	18	
%		17	17	56	10		

STAGE OF KNAPPING SEQUENCE						
Level	**Raw material**	**Initial**	**Exploitation**	**Terminal**	**TOTAL**	**%**
20	**Mudstone**			1	1	6
	Quartzite	2	11	4	17	94
TOTAL		2	11	5	18	
%		11	61	28		

FACIAL ATTRIBUTE					
Level	**Raw material**	**Bifacial**	**Unifacial**	**TOTAL**	**%**
20	**Mudstone**	1		1	6
	Quartzite	16	1	17	94
TOTAL		17	1	18	
%		94	6		

STRATEGIES OF KNAPPING							
Level	**Raw material**	**Centripetal**	**Multidirectional**	**Bidirectional**	**Unidirectional**	**TOTAL**	**%**
20	**Mudstone**	1				1	6
	Quartzite	14	1	1	1	17	94
TOTAL		15	1	1	1	18	
%		82	6	6	6		

METHOD OF KNAPPING					
Level	**Raw material**	**Discoidal**	**Indeterminate**	**TOTAL**	**%**
20	**Mudstone**	1		1	6
	Quartzite	15	2	17	94
TOTAL		16	2	18	
%		89	11		

Table 5.43. Analysis of cores.

Morphometric analysis of the cores gives a mean of 78mm length, 63mm width and 44mm thickness. The mean surface area is 5211mm^2. These measures indicate that on average cores are of medium size (Table 5.44).

		Length	Width	Thickness	Area
Number of cores		18	18	18	18
Mean		78	63	44	5211
Mode		54	49	45	2508
Median		76	62	45	4953
Maximum value		123	89	62	10867
Minimum value		50	43	31	2176
Kurtosis		-0,2	-0,6	-0,7	0,42
Standard deviation		23	14	9	2714
Percentile	25	61	52	38	2990
	50	76	62	45	4953
	75	85	71	49	5855

Table 5.44. Metric measures of the cores from level 20.

A scatter plot of the measurements (length and width) of the cores shows a concentration of points between 50mm x 80mm (length) and 40mm x 80mm (width) (Figure 5.25). Again, this shows that the majority of the cores are of medium size.

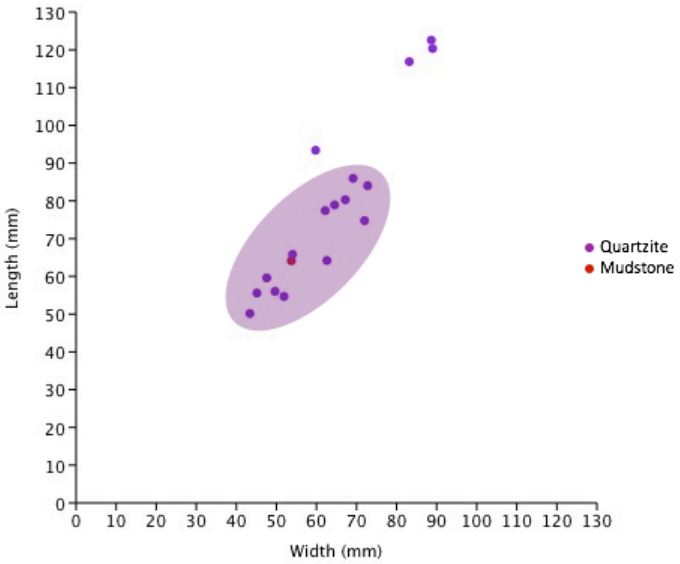


Figure 5.25. Scatter plot of the measurements of the cores from level 20.

The Flake Analyses

The flake assemblage of level 20 is composed of 175 flakes and 25 flake fragments. For this reason I consider that obtaining flakes was the main objective of the production sequence.

Ventral Face

Type of Bulb

Regarding the types of bulb of percussion present, the flake assemblage is dominated by the diffuse type (n=102; 58%) followed by the pronounced type (n=73; 42%). In the case of the quartzite flakes, a high proportion show both types of bulb (pronounced (n=68), diffuse (n=93)), which might be due to differences in the use of hammers, strike intensity or knapping method (Table 5.45).

Regarding the delineation of the ventral face, considerable diversity is present, although sinuous delineation (n=98; 56%) dominates, followed by straight (n=45; 26%), while fewer pieces present convex (n=22; 13%) and concave (n=10; 6%) delineation (Table 5.45).

Butt

Regarding butt surface, the assemblage (n=155; 89%) is almost entirely non-cortical, with only 19 (11%) showing cortex (Table 5.45). Platforms are most frequently represented (n=150; 86%), while cortical (n=19; 11%) and linear (n=5; 3%) butts are present in small numbers (Table 5.45).

Butt preparation in this assemblage is characterised by a frequent presence of plain butts (n=97; 55%), followed by multifaceted (n=33; 19%) and dihedral (n=25; 14%) butts (Table 5.45).

There are many different types of butt delineation within the assemblage. Straight delineation is most common (n=74; 42%), followed by sinuous (n=55; 31%), while other delineation types are represented in smaller proportion: uniangular (n=20; 11%), convex (n=2; 1%) and concave (n=4; 2%) (Table 5.45).



VENTRAL FACE AND BUTT



TYPE OF BUTT					
Level	Raw material	Marked	Difuse	TOTAL	%
20	Quartzite	68	93	161	92
	Limestone		6	6	3
	Flint	3	3	6	3
	Mudstone	1		1	1
	Sandstone	1		1	1
TOTAL		73	102	175	
%		42	58		

DELINEATION OF VENTRAL FACE							
Level	Raw material	Sinuous	Convex	Concave	Straight	TOTAL	%
20	Quartzite	91	21	10	39	161	92
	Limestone	2			4	6	3
	Flint	3	1		2	6	3
	Mudstone	1				1	1
	Sandstone	1				1	1
TOTAL		98	22	10	45	175	
%		56	13	6	26		

CORTICALITY OF BUTT						
Level	Raw material	Cortical	No cortical	Deleted	TOTAL	%
20	Quartzite	18	143		161	92
	Limestone		6		6	3
	Flint	1	4	1	6	3
	Mudstone		1		1	1
	Sandstone		1		1	1
TOTAL		19	155	1	175	
%		11	89	1		

TYPE OF BUTT							
Level	Raw material	Platform	Linear	Cortical	Deleted	TOTAL	%
20	Quartzite	139	4	18		161	92
	Limestone	6				6	3
	Flint	3	1	1	1	6	3
	Mudstone	1				1	1
	Sandstone	1				1	1
TOTAL		150	5	19	1	175	
%		86	3	11	1		

FACET OF BUTT								
Level	Raw material	Plain	Bifaceted	Multifaceted	Cortical	Deleted	TOTAL	%
20	Quartzite	85	25	33	18		161	92
	Limestone	6					6	3
	Flint	4			1	1	6	3
	Mudstone	1					1	1
	Sandstone	1					1	1
TOTAL		97	25	33	19	1	175	
%		55	14	19	11	1		

DELINEATION OF BUTT										
Level	Raw material	Sinuous	Convex	Concave	Straight	Uniangular	Cortical	Deleted	TOTAL	%
20	Quartzite	55	1	3	64	20	18		161	92
	Limestone			1	5				6	3
	Flint				4		1	1	6	3
	Mudstone		1						1	1
	Sandstone				1				1	1
TOTAL		55	2	4	74	20	19	1	175	
%		31	1	2	42	11	11	1		

Table 5.45. Ventral face and butt analysis.

Morphometric analysis of the angle of knapping of 174 flakes gives a mean of 108°, a mode of 110° and a median 109°. Again these data suggest a preference for obtuse knapping angles (Table 5.46).

Angle of knapping		
Number of flakes		174
Mean		108
Mode		110
Median		109
Maximum value		135
Minimum value		84
Kurtosis		-0,1
Standard deviation		10
Percentile	25	102
	50	109
	75	116

Table 5.46. Knapping angle of the flakes from level 20.

Dorsal Face

A study of the dorsal surface shows the degree of transformation within the knapping sequence. As regards cortex, the majority of flakes (n=92; 53%) do not have cortex present, 54 (31%) of them have less than 50% cortex on their dorsal surface, 25 (14%) pieces have more than 50% cortex and only 4 are fully cortical flakes. The presence of cortical pieces suggests that the primary reduction of the pebbles took place inside the cave (Table 5.47).

The direction of flake scars is highly diverse, with three categories frequently represented: unidirectional (n=71; 41%), multidirectional (n=47; 27%) and centripetal (n=46; 26%), while the bidirectional category is present upon 7 (4%) examples (Table 5.47).



DORSAL FACE

AMOUNT OF CORTEX							
Level	**Raw material**	**0%**	**≤50%**	**>50%**	**100%**	**TOTAL**	**%**
20	**Quartzite**	83	52	22	4	161	92
	Limestone	4	1	1		6	3
	Flint	4	1	1		6	3
	Mudstone	1				1	1
	Sandstone			1		1	1
TOTAL		92	54	25	4	175	
%		53	31	14	2		

DIRECTION OF SCARS								
Level	**Raw material**	**Centripetal**	**Unidirectional**	**Bidirectional**	**Multidirectional**	**Cortical**	**TOTAL**	**%**
20	**Quartzite**	41	68	6	42	4	161	92
	Limestone	2	2	1	1		6	3
	Flint	2	1		3		6	3
	Mudstone	1					1	1
	Sandstone				1		1	1
TOTAL		46	71	7	47	4	175	
%		26	41	4	27	2		

Table 5.47. Dorsal face analysis.

Regarding the number of flake scars, the flakes have a mean of 5, a mode of 4 and a median of 5. This indicates considerable reduction intensity because the scars show the previous removals and a mean of 5 scars on the dorsal face shows a high degree of reduction (Table 5.48).

Number of scars		
Number of flakes		174
Mean		5
Mode		4
Median		5
Maximum value		27
Minimum value		1
Kurtosis		9,1
Standard deviation		3
Percentile	25	3
	50	5
	75	7

Table 5.48. Number of scars of the flakes from level 20.

Measurements of the flakes show a mean of 59 mm length, 54 mm with and 18 mm thickness. The area analysis shows a mean of 3481 mm^2. These measures indicate that on average pieces are of medium size. The elongation index shows a mean of 1.17, meaning that there is no laminar tendency in the assemblage. The flattening index shows a mean of 0.37, which means that the flakes are thin (Table 5.49).

		Length	Width	Thickness	Area	Elongation index	Flattening index
Number of flakes		176	176	176	176	176	176
Mean		59	54	18	3481	1,17	0,37
Mode		51	36	9	2159	1,10	0,34
Median		56	48	15	2558	1,17	0,35
Maximum value		141	128	44	14858	2,25	1,02
Minimum value		26	19	6	734	0,40	0,15
Kurtosis		2,1	1,7	1,0	3,8	0,11	8,02
Standard deviation		20	23	8	2638	0,35	0,12
Percentile	25	45	39	12	1896	0,90	0,29
	50	56	48	15	2558	1,17	0,35
	75	70	59	21	3883	1,36	0,41

Table 5.49. Measures of the flakes from level 20.

A scatter plot of the flake measurements (length and width) shows a concentration of points between 24mm x 75mm (length) and 30mm x 60mm (width) in this assemblage (Figure 5.26). We can see that the majority of the flakes are of medium size. The flint flakes are smaller than flakes of other raw materials. The quartzite flakes are larger possibly because they were made on bigger blanks or simply appear larger because flint was reduced more intensively.

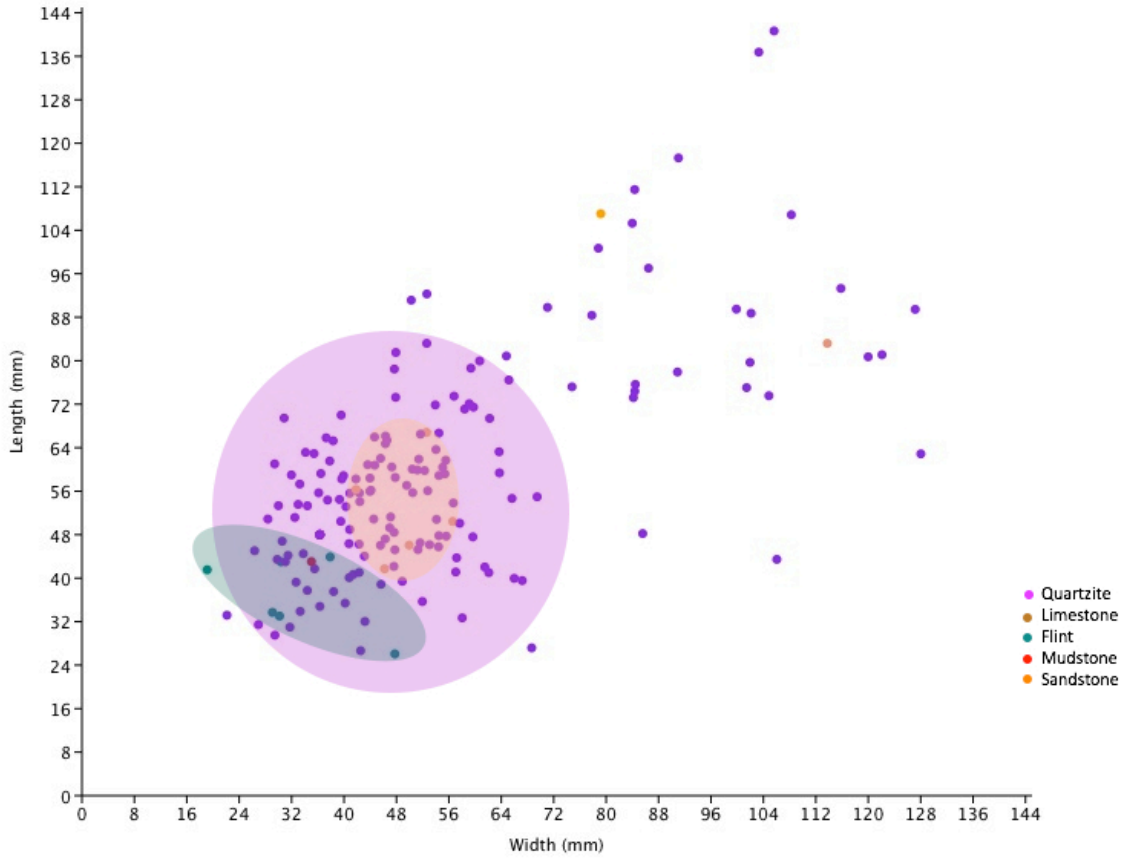


Figure 5.26. Scatter plot of the measurements of the flakes from level 20.

Retouched pieces

A total of 17 retouched pieces were studied from (Table 5.50). The kind of blanks that were selected for retouching are flakes (n=14; 82%), followed by fragmented flakes (n=2; 12%), and flake fragments (n=1; 6%). The majority of the pieces have unifacial retouch (n=12; 71%) with only 5 (29%) pieces showing bifacial retouch.

Regarding the extent of retouch found along the edge of the flakes, retouched pieces with >25 to ≤50% retouch predominate in the tool assemblage (n=8; 47%), followed by pieces with >50% to ≤ 75% (n=5; 29%) and ≤25% (n=2; 12%) respectively.

Although the sum of the individual number of retouched pieces analysed equals 17, the total number of shaped edges analysed is 24, as represented in Table 5.50. The majority of the retouch is located on the side (n=17; 71%). The left side is the predominant side with extensive retouch (n=9; 38%), followed by the right side (n=8; 33%) and the distal (n=4; 17%) area in smaller proportions.

Semi-abrupt retouch angles (n=17; 71%) are the dominant angles present in this assemblage, followed by abrupt angles (n=6; 25%) and simple angles (n=1; 4%).

With regard to the extent of retouch on the dorsal/ventral surfaces, marginal retouch is the most represented (n=9; 38%), followed by extensive retouch (n=10; 42%) and very extensive retouch (n=5; 21%). In relation to the depth of retouch on the dorsal/ventral surfaces, there is a similar proportion of marginal retouch (n=9, 38%) and deep retouch (n=9; 38%), less represented are very deep (n=5, 21%) and very marginal (n=1, 4%) retouch.

The predominant direction of retouch is direct (n=19; 79%), followed by alternate (n=3; 13%), and inverse (n=1; 4%) and alternating (n=1; 4%).

The delineation of the retouched edge is predominantly continuous (n=15; 63%), followed by denticulate retouch (n=9; 38%). The data obtained by these two attributes are in direct correlation with the type of tools within assemblage: scrapers and denticulates.

Regarding the morphology of the retouched edge, the convex denticulate type is the most common (n=13; 54%), followed by convex (n=6; 25%), sinuous (n=4; 17%), and finally straight (n=1; 4%).



RETOUCHED TOOL



TYPES OF BLANK						
Level	**Raw material**	**Flakes**	**Fragmented flake**	**Fragment of flake**	**TOTAL**	**%**
20	**Quartzite**	6	1		7	41
	Flint	6	1	1	8	47
	Mudstone	1			1	6
	Sandstone	1			1	6
TOTAL		14	2	1	17	
%		82	12	6		

FACIAL ATRIBUTE					
Level	**Raw material**	**Unifacial**	**Bifacial**	**TOTAL**	**%**
20	**Quartzite**	5	2	7	41
	Flint	6	2	8	47
	Mudstone		1	1	6
	Sandstone	1		1	6
TOTAL		12	5	17	
%		71	29		

EXTENSION							
Level	**Raw material**	**≤ 25%**	**>25 ≤50%**	**>50 ≤75%**	**Unknown**	**TOTAL**	**%**
20	**Quartzite**	1	5	1		7	41
	Flint		2	4	2	8	47
	Mudstone		1			1	6
	Sandstone	1				1	6
TOTAL		2	8	5	2	17	
%		12	47	29	12		

LOCALITATION							
Level	**Raw material**	**Left**	**Distal**	**Right**	**Unknown**	**TOTAL**	**%**
20	**Quartzite**	4	1	5		10	42
	Flint	4	2	3	3	12	50
	Mudstone	1				1	4
	Sandstone		1			1	4
TOTAL		9	4	8	3	24	
%		38	17	33	13		

ANGLE						
Level	**Raw material**	**Abrupt**	**Semi abrupt**	**Simple**	**TOTAL**	**%**
20	**Quartzite**	3	7		10	42
	Flint	3	8	1	12	50
	Mudstone		1		1	4
	Sandstone		1		1	4
TOTAL		6	17	1	24	
%		25	71	4		

DEEP OF RETOUCHED ON SURFACE						
Level	**Raw material**	**Marginal**	**Extensive**	**Very extensive**	**TOTAL**	**%**
20	**Quartzite**	5	3	2	10	42
	Flint	3	6	3	12	50
	Mudstone	1			1	4
	Sandstone		1		1	4
TOTAL		9	10	5	24	
%		38	42	21		

DEEP OF RETOUCHED ON EDGE							
Level	**Raw material**	**Very marginal**	**Marginal**	**Deep**	**Very deep**	**TOTAL**	**%**
20	**Quartzite**		5	3	2	10	42
	Flint	1	3	5	3	12	50
	Mudstone		1			1	4
	Sandstone			1		1	4
TOTAL		1	9	9	5	24	
%		4	38	38	21		

DIRECTION							
Level	**Raw material**	**Direct**	**Inverse**	**Alternate**	**Alternating**	**TOTAL**	**%**
20	**Quartzite**	**8**		2		10	42
	Flint	11			1	12	50
	Mudstone			1		1	4
	Sandstone		1			1	4
TOTAL		19	1	3	1	24	
%		79	4	13	4		

DELINEATION					
Level	**Raw material**	**Continuous**	**Denticulate**	**TOTAL**	**%**
20	**Quartzite**	7	3	10	42
	Flint	8	4	12	50
	Mudstone		1	1	4
	Sandstone		1	1	4
TOTAL		15	9	24	
%		63	38		

MORPHOLOGY							
Level	**Raw material**	**Straight**	**Convex**	**Sinuous**	**Denticulate**	**TOTAL**	**%**
20	**Quartzite**		3		7	10	42
	Flint	1	3	4	4	12	50
	Mudstone				1	1	4
	Sandstone				1	1	4
TOTAL		1	6	4	13	24	
%		4	25	17	54		

Table 5.50. Retouched tools analysis.

Following the Laplace typology (Table 5.51), the retouched tools are grouped into three main groups: scrapers (n=6), denticulates (n=10), and a burin (n=1).

Amongst the scrapers, there is a similar proportion of transverse scrapers (R22) (n=2; 12%) and carinated scrapers (R3) (n=2; 12%). Less represented are the side scraper R21 (n=1; 6%) and scraper with marginal retouch R1 (n=1; 6%) respectively.

Amongst the denticulates, two main types were identified; marginal denticulate retouch D1 (n=3; 18%) and denticulate scraper D23 (n=4; 24%), with carinated denticulate D3 (n=1; 6%), encoche D21 (n=1; 6%) and denticulate point D24 (n=1; 6%) also noted.

Within the tool assemblage analysed one burin (B4) was documented.

LAPLACE TYPOLOGY													
Level	**Raw material**	**R1**	**R3**	**R21**	**R22**	**D1**	**D3**	**D21**	**D23**	**D24**	**B4**	**TOTAL**	**%**
20	**Quartzite**		**1**		1	2	1	1	1			7	41
	Flint	1	1	1	1				2	1	1	8	47
	Mudstone					1						1	6
	Sandstone								1			1	6
TOTAL		1	2	1	2	3	1	1	4	1	1	17	
%		6	12	6	12	18	6	6	24	6	6		

Table 5.51. Laplace Typology.

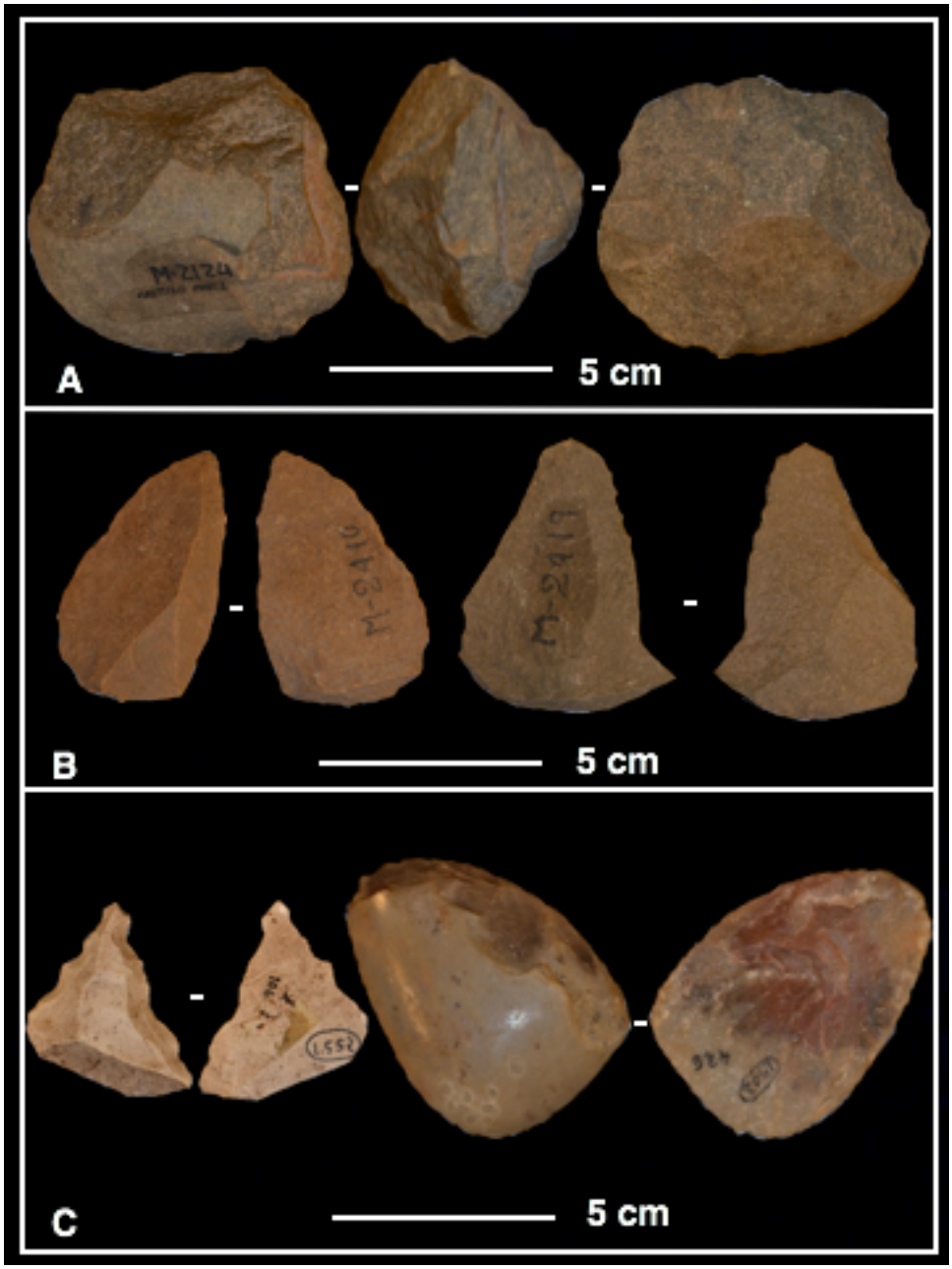


Figure 5.27. Detail of some lithic artefacts: A. Core, B. Flakes, and C. Retouched tools.

5.3. ANALYSES OF MOUSTERIAN LITHIC ASSEMBLAGES FROM THE BETIC REGION.

5.3.1. ABRIGO 3 (COMPLEJO DEL HUMO)

5.3.1.1 Location

The Humo Complex is located within the El Candado-La Araña karst complex along the eastern border of the city of Málaga. The complex is divided into two separate areas by a motorway and the neighborhood of La Araña. The first area is referred to as the Humo Complex and the second area as Cuervo Rock. Area 1 spans 314,378 m^2, encompassing a total of twelve rockshelters all situated approximately 9 asml. For this analysis I focused on Abrigo 3 Rockshelter, which spans about 30m in an east-west orientation, and with a known archaeological deposit of at least 10m (rock bottom has yet to be reached). The site was subsequently sub-divided into four distinct study zones, following the west-east orientation of the rockshelter: Z1 (Humo Cave), Z2, Z3 and Z4 respectively.



Figure 5.28. Abrigo 3 and Complejo del Humo (Photos from José Emilio Toro and Asosiación Yacimientos Arqueológicos de la Araña).

5.3.1.2 Geological setting

The area of La Araña is located within the Internal Zone of the Betic Mountains, in the so-called Maláguide Complex. It is an oligostromic chaotic complex dating from the Palaeogene, containing a large deposit of detritic materials from the Permo-Trias covered by a dolomitic-loamy series from the Trias-Eocene, and deeply modified by tectonic processes (Serrano *et al* 1995). Natural agents have produced a substantial process of karstification, not only on the surface ("lapies", doline-holes) but also within caves. The area of La Araña has six karstic complexes with numerous caves and shelters that have been consistently occupied by humans from the Lower Palaeolithic until modern times.

5.3.1.3 Historical Background

The first excavation of the Abrigo 3 rockshelter was carried out in 1965 by Gálvez Pacheco (Moreno *et al* 1973). In 1983 an emergency excavation was carried out as the site was under threat from the construction of the motorway, which now divides the archaeological complex. During these excavations, part of the Mousterian sediments and a small portion of the red sediments from the upper unit were excavated (Ramos Fernández 1989). From 1984 to 1986, measures were put in place to restrict access and therefore protect the sites and their archaeological deposits. The last intervention was in 2003-04, during which the deposits of Abrigo 3 rockshelter were profiled and the disturbed sediments were removed and systematically screened (Ramos Fernández *et al* 2012).

5.3.1.4 Stratigraphic sequence

The Abrigo 3 rockshelter has a sedimentary deposit 10 m. deep, composed of a succession of sandy levels containing angular clasts and blocks originating from the cave wall, and features an interstratified stalagmite formation, which preserved the archaeological layers from erosion and bioturbation. The archaeological levels were found to contain an abundance of lithic artefacts, fauna bones remains and marine shells. The Mousterian deposits occur in level 17 to 26 (Table 5.52; Figure 5.29) (Ramos Fernández *et al* 2012).

Unit	Level	Description	Cultural attribution
17	1	Layer of carbonated continental sediments of reddish matrix, with small and medium and large limestone stones.	**Mousterian**
	2	Shell midden, with gray coloration Matrix.	
18		Layer very carbonated, with stalagmite crust in some areas, continental sediments of reddish matrix with small limestone stones.	
19		Shell midden	
20	1	Continental sediments	
	2	Stalagmitic crust	
	3	Continental sediments	
21		Shell midden	
22		Layer very carbonated, with stalagmite crust in some areas, continental sediments of reddish matrix with small limestone stones.	

Table 5.52. Stratigraphic sequence from Abrigo 3.

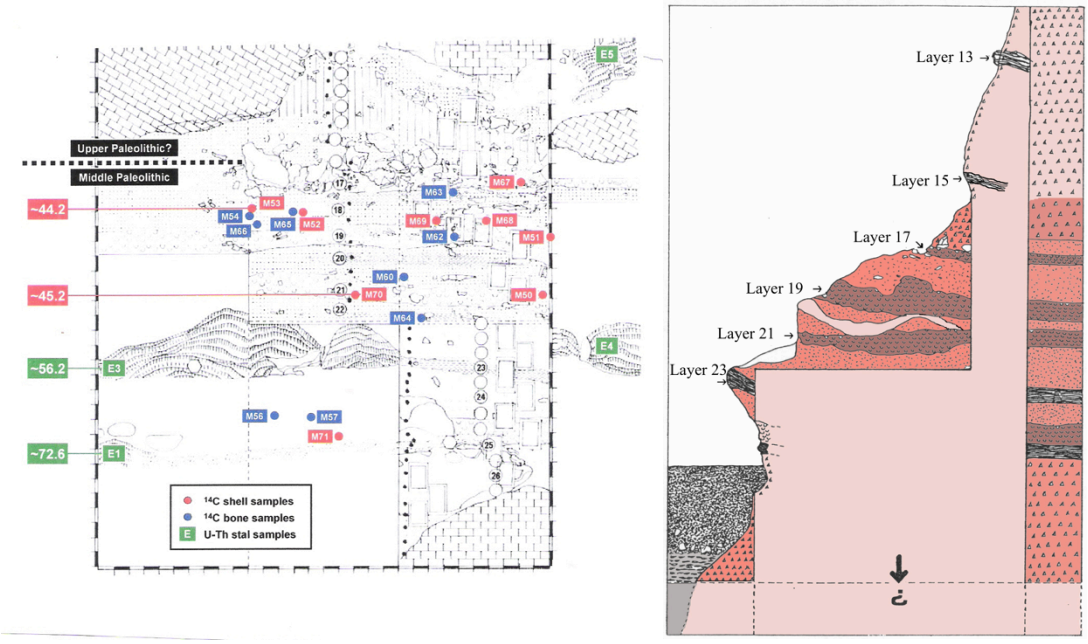


Figure 5.29. Stratigraphic sequence from Abrigo 3 (Ramos Fernández et al 2012).

5.3.1.5 Dating

The first and only dating results published from Abrigo 3 were presented by Ramos Fernández *et al* (2012). The first dates were obtained using the Thermoluminescence (TL) method on stalagmite samples, and gave a date of ~23ka for Level 15 and ~35ka for Level 23 respectively. New samples were taken in 2006, which included nine speleothem samples, and 71 bones and shell samples collected from three areas of the Abrigo 3 in order to obtain a chronology for the latest Mousterian deposits within this site. The results are presented in Table 5.53 and Figure 5.30.

Sadly, the last recorded Mousterian occupation of Abrigo 3 (Level 17) has been impossible to date reliably (Ramos Fernández *et al* 2012).

Level	Sample field	Material	Method	Lab. Ref.	Date	Cal BP	Cultural attribution
18	M53	Shell	14 C AMS	OxA-16803	40730 ± 310 BP	43590-44819	Mousterian
21	M70	Shell	14 C AMS	OxA-16804	42140 ± 360 BP	44580-45814	Mousterian
23	E3	Speleothem	U-th		56214/+2232-2250 (ka)		Mousterian
24	M71	Shell	14 C AMS	OxA-16805	32580 ± 180 BP	36325-37097	Mousterian
25	E1	Speleothem	U-th		72558/+2721/-2745 (ka)		Mousterian
25	E2	Speleothem	U-th		79737/+2875/-2908 (ka)		Mousterian

Table 5.53. Dating of Abrigo 3 taken from Ramos Fernández et al (2012).

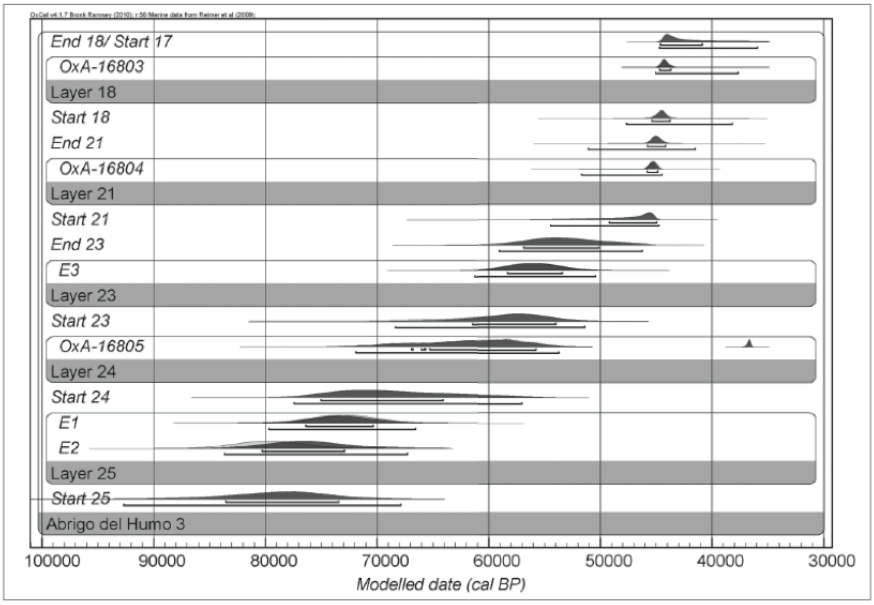


Figure 5.30. Dating of Abrigo 3 (Ramos Fernández et al 2012).

5.3.1.6 Archaeological record

The archaeological assemblages recovered from Levels 17 to 25 from Abrigo 3, made up of lithic artefacts (Mousterian techno-complex), animal bones and marine shells, have been attributed to a Middle Palaeolithic occupation. Most notable is the high density of marine shell deposits within levels 17, 19 and 21, which can be described as true shell middens. Such a high accumulation of marine shells has never been recorded for any other Middle Palaeolithic site, and there is no known Mousterian site with similar high densities. These levels are the subject of ongoing study.

Using the lithic artefacts recovered from Abrigo 3, Ramos Fernández *et al* (1998) were

able to distinguish two large groups: one consisting of basal layers with Mousterian artefacts, and the upper layers comprising an Upper Palaeolithic *sensu lato*.

Within the Mousterian lithic assemblage there is a notable presence of typical and atypical Levallois flakes, with centripetal recurrent Levallois and discoid cores and scrapers and denticulate retouched tools.

5.3.1.7. Lithic Assemblage

A total of 304 lithic pieces were analysed from this site, all recovered from Z4-Z3, sectors C33-C45, during the excavations carried out by Julian Ramos (Ramos Fernández 1989, *et al* 1998). The collection is currently housed at the Museum of Málaga and the La Araña Archaeological Interpretation Centre.

Raw Material

The raw material used is found locally in nearby alluvial deposits from the mouth of the Totalán River, about 200m from the rock-shelter. Flint is the predominant raw material used throughout all the archaeological levels, followed by quartzite (Figure 5.31). The availability of this raw material within the present alluvial deposits of the Totalán River continues to be very high. This, coupled with the high density of the lithic artefacts found within the different archaeological levels of the site´s occupation, leads one to surmise that there was a similar abundance of this raw material during its Palaeolithic occupation.

Many of the artefacts recovered retain some of the cortex of the raw material used, with the majority yielding a rounded shaped cortex. This suggests that the raw material originated from a river. The predominant sizes of the pebbles are between 10 and 15 cm long.

The presence of cortex remains in some of the recovered artefacts, as well as debris recovered during excavation, also indicates that knapping took place *in situ*. This activity was especially abundant in certain sectors that are now thought to be workshop areas. The abundance of local raw materials and both terrestrial and marine prey resources, as well as the plethora of rock-shelters and caves in this area, suggests that Neanderthal populations repeatedly occupied this site.

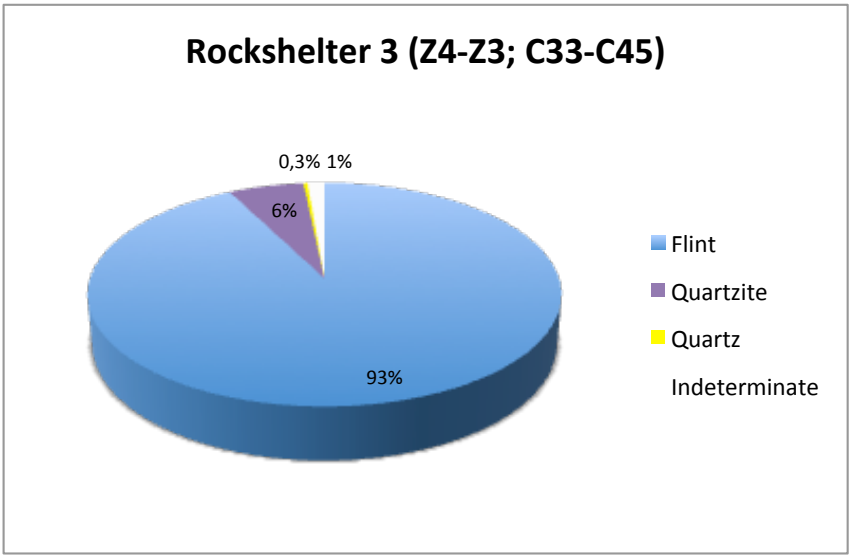
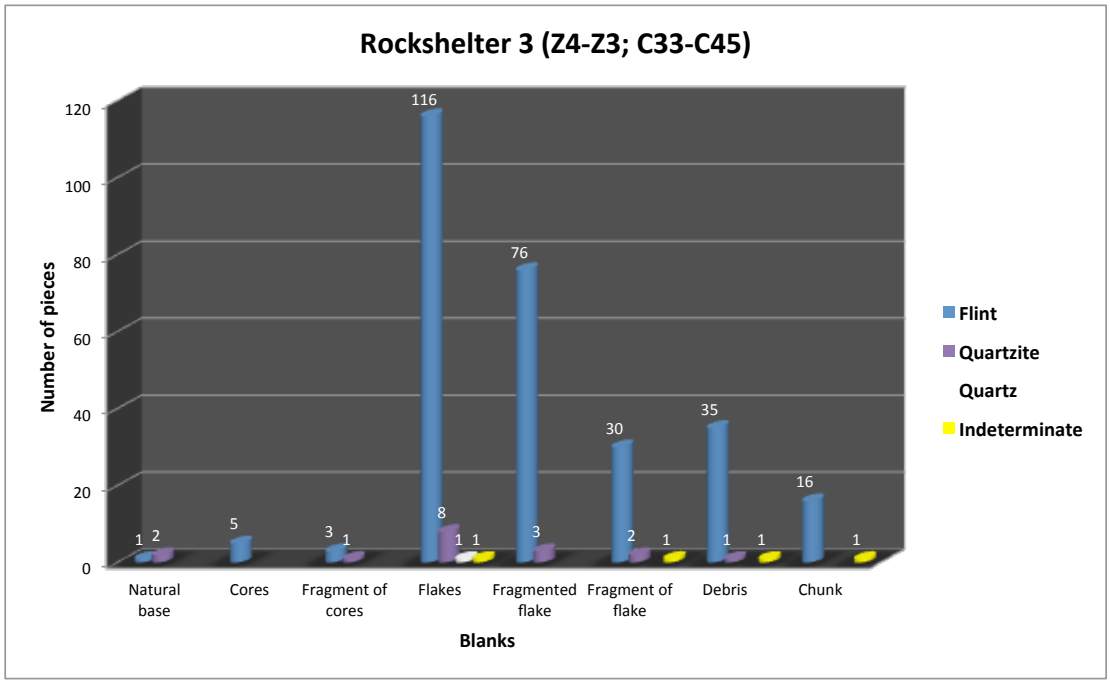


Figure 5.31 . Raw material from Abrigo 3 Z4-Z3, sectors C33-C45.

Technical Categories

The lithic assemblage analysed is primarily composed of flakes (n=126, 41%), with fragmented flakes (79, 25%), debris (n=37, 12%) and fragments of flakes (n=33, 10%) making up the remainder of the assemblage, with a limited number of cores (n=5, 1%) (Figure 5.32 and Table 5.54). This composition would suggest that the predominant knapping strategy employed at this site was the systematic production of flakes.



Abrigo 3	Natural base	Cores	Fragment of cores	Flakes	Fragmented flake	Fragment of flake	Debris	Chunk	TOTAL	%
Flint	1	5	3	116	76	30	35	16	282	92,46
Quartzite	2		1	8	3	2	1		17	5,57
Quartz				1					1	0,33
Indeterminate				1		1	1	1	4	1,31
TOTAL	3	5	4	126	79	33	37	17	304	
%	0,98	1,64	1,31	41,31	25,90	10,82	12,13	5,57		100

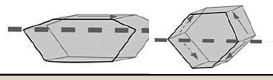
Figure 5.32 and Table 5.54 . Raw material and blanks from Abrigo 3 Z4-Z3, sectors C33-C45.

Analysis of cores

The cores (n=5) were recovered from zones Z4-Z3, sectors C33-C45. They are composed of flint, with the majority of them (n=4; 80%) still retaining remnants of their cortex (Table 5.55). Four of the cores were abandoned at the terminal stage of their knapping sequence, with only one core reaching an exploitation stage. No cores in the early stages of core reduction have been identified in this assemblage (Table 5.55). It is important to note that the predominance of cores in the terminal stage of knapping could be related to the economic behaviour evident by the technological system of this level.

Upon close analysis, we can determine that the predominant reduction strategy employed is that of bifacial reduction, identified predominantly in four of the five studied cores, with only 1 piece showing a unifacial reduction (Table 5.55). Two of the pieces show centripetal knapping, with the remaining three cores showing evidence of unidirectional knapping.

The Levallois centripetal recurrent method is the predominant knapping method observed (n=4; 80%), with only one core presenting an indeterminate methodology. The small size and intensive exploitation of the cores made their identification very challenging (Table 5.55).



ANALYSIS OF CORES



TYPES OF CORES				
Level	Raw material	Cores	TOTAL	%
Z4-Z3; C33-C45	Flint	5	5	100
TOTAL		5	5	
%		100		

AMOUNT OF CORTEX					
Level	Raw material	0%	>25 ≤50%	TOTAL	%
Z4-Z3; C33-C45	Flint	1	4	5	100
TOTAL		1	4	5	
%		20	80		

STAGE OF KNAPPING SEQUENCES					
Level	Raw material	Exploitation	Terminal	TOTAL	%
Z4-Z3; C33-C45	Flint	1	4	5	100
TOTAL		1	4	5	
%		20	80		

FACIAL ATTRIBUTE					
Level	Raw material	Bifacial	Unifacial	TOTAL	%
Z4-Z3; C33-C45	Flint	4	1	5	100
TOTAL		4	1	5	
%		80	20		

STRATEGIES OF KNAPPING					
Level	Raw material	Centripetal	Indeterminate	TOTAL	%
Z4-Z3; C33-C45	Flint	2	3	5	100
TOTAL		2	3	5	
%		40	60		

METHOD OF KNAPPING					
Level	Raw material	Levallois	Indeterminate	TOTAL	%
Z4-Z3; C33-C45	Flint	4	1	5	100
TOTAL		4	1	5	
%		80	20		

Table 5.55. Analysis of cores.

The cores show an average length of 35mm, average width of 32mm and 18mm thickness. The average overall area of the cores is 1157 mm^2, indicating that they are of a small size. Due to the small sample size of the cores studied, these data have not been analysed further with the use of a scatter plot or presented in a table.

The Flake Analyses

The flake assemblage is composed of 126 flakes, 79 fragmented flakes and 33 fragments of flakes, which suggests that the main objective of the production sequence was the manufacture of flakes.

Ventral Face

Type of Bulb

The flakes analysed feature either a diffuse bulb (n=66; 52%) or pronounced bulb (n=59; 47%) of percussion. The high proportion of both these types would suggest a differential use of hammers, strike intensity or knapping method (Table 5.56).

The delineation of the ventral face is diverse, although sinuous delineation (n=66; 52%) is the most common, followed by straight (n=35; 28%), concave (n=13; 10%) and convex (n=12; 10%) delineations (Table 5.56).

Butt

The majority of the pieces present no remnants of cortex on the butt surfaces (n=107; 85%), with only a small proportion (n=19; 15%) showing cortex (Table 5.56). A platform type of butt surface is the most common type represented in this assemblage (n=95; 75%), while the other categories are less represented: cortical (n=17; 13%), linear (n=8; 6%) and puntiform (n=3; 2%) (Table 5.56). The preparation of the butt is mostly characterised by plain butts (n=59; 47%), followed by bifaceted (n=23; 18%), cortical (n=17; 13%), multifaceted (n=16; 13%), and puntiform (n=3; 2%) (Table 5.56).

Amongst the different types of delineation of butts identified in this sample, straight delineation is the most common (n=49; 39%), followed by sinuous (n=34; 27%), uniangular (n=12; 10%), convex (n=3; 2%) and concave (n=3; 2%) (Table 5.56).



VENTRAL FACE AND BUTT



Type of bulb

Level	Raw material	Marked	Difuse	Missing	TOTAL	%
Z4-Z3; C33-C45	Flint	56	59	1	116	92
	Sandstone	3	6		9	7
	Quartz		1		1	1
TOTAL		59	66	1	126	
%		47	52	1		

Delineation of the ventral face

Level	Raw material	Sinuous	Convex	Concave	Straight	TOTAL	%
Z4-Z3; C33-C45	Flint	61	10	13	32	116	92
	Sandstone	5	1		3	9	7
	Quartz		1			1	1
TOTAL		66	12	13	35	126	
%		52	10	10	28		

Corticality of butt

Level	Raw material	Cortical	No cortical	TOTAL	%
Z4-Z3; C33-C45	Flint	17	99	116	92
	Quartzite	2	7	9	7
	Quartz		1	1	1
TOTAL		19	107	126	
%		15	85		

Type of butt

Level	Raw material	Platform	Linear	Puntiform	Cortical	Deleted	TOTAL	%
Z4-Z3; C33-C45	Flint	87	8	3	15	3	116	92
	Quartzite	7			2		9	7
	Quartz	1					1	1
TOTAL		95	8	3	17	3	126	
%		75	6	2	13	2		

Facets of butt

Level	Raw material	Plain	Bifaceted	Multifaceted	Point	Cortical	Indeterminated	TOTAL	%
Z4-Z3; C33-C45	Flint	54	22	14	3	15	8	116	92
	Quartzite	4	1	2		2		9	7
	Quartz	1						1	1
TOTAL		59	23	16	3	17	8	126	
%		47	18	13	2	13	6		

Delineation of butt

Level	Raw material	Sinuous	Convex	Concave	Straight	Uniangular	Cortical	Indeterminated	TOTAL	%
Z4-Z3; C33-C45	Flint	29	3	3	47	12	15	7	116	56
	Quartzite	5			2		2		9	4
	Quartz							1	1	1
TOTAL		34	3	3	49	12	17	8	126	
%		27	2	2	39	10	13	6		

Table 5.56 . Ventral face and butt analysis.

The analysis of the internal knapping angles of 126 flakes indicates a mean angle of 111°, mode of 124° and median of 112°. These data suggest a preference for obtuse angles (Table 5.57).

Angle of knapping		
Number of flakes		126
Mean		111
Mode		124
Median		112
Maximum value		137
Minimum value		88
Kurtosis		-0,7
Standard deviation		11
Percentile	25	103
	50	112
	75	119

Table 5.57. Angle of knapping of the total of the flakes.

Dorsal Face

Regarding the degree of cortex on the dorsal surface, 51% of the assemblage (n=64) does not present any cortex, with 29% (n=36) presenting less than 50% cortex on their surfaces, 13% (n=17) having more than 50% cortex and only 7% (n=9) being fully cortical flakes (Table 5.58). The presence of cortical pieces suggests that the primary reduction of the pebbles took place inside the cave.

The direction of scars shows a high diversity, with four main categories identified: unidirectional (n=46; 37%), multidirectional (n=33; 26%), centripetal (n=21; 17%) and bidirectional scars (n=15; 12%) (Table 5.58).



DORSAL FACE

Amount of cortex

Level	Raw material	0%	≤50%	>50%	100%	TOTAL	%
Z4-Z3; C33-C45	Flint	57	34	16	9	116	92
	Quartzite	7	1	1		9	7
	Quartz		1			1	1
TOTAL		64	36	17	9	126	
%		51	29	13	7		

Direction of scars

Level	Raw material	Centripetal	Unidirectional	Bidirectional	Multidirectiona	Indeterminate	TOTAL	%
Z4-Z3; C33-C45	Flint	17	41	14	33	11	116	92
	Quartzite	4	4	1			9	7
	Quartz		1				1	1
TOTAL		21	46	15	33	11	126	
%		17	37	12	26	9		

Table 5.58. Dorsal face analysis.

The analysis of the scars of 126 flakes indicates a mean of 5 scars, mode of 6 and median of 4. As scars are an indication of previous removals, a mean of 5 scars on the dorsal face suggests a high degree of reduction (Table 5.59).

Number of scars		
Number of flakes		126
Mean		5
Mode		6
Median		4
Maximum value		21
Minimum value		0
Kurtosis		5,4
Standard deviation		3
Percentile	25	2
	50	4
	75	6

Table 5.59. Number of scars of the dorsal face from Abrigo 3 (Z4-Z3, sectors C33-C45).

The measurement data of the flakes shows a mean length of 37mm, width of 31mm and a thickness of 10mm. The mode and median show similar measures (Mode: 37mm length, 30mm width, 9mm thickness; Median: 37mm length, 31mm width, 9mm thickness). The mean area is 1183mm^2. These measurements suggest that, on average, the pieces are of a small size. The elongation index shows a mean of 1.2, suggesting that there is no laminar tendency in the assemblage. The flattening index shows a mean of 0.3, suggesting the flakes are extremely thin (Table 5.60).

		Length	Width	Thickness	Area	Elongation index	Flattening index
Number of flakes		126	126	126	126	126	126
Mean		37	31	10	1183	1,2	0,3
Mode		37	30	9	782	0,9	0,3
Median		37	31	9	1112	1,2	0,3
Maximum value		69	63	21	2934	2,3	0,7
Minimum value		11	11	2	143	0,6	0,2
Kurtosis		0,1	1,6	0,2	0,6	-0,2	1,0
Standard deviation		12	9	3	609	0,4	0,1
Percentile	25	29	25	7	826	0,9	0,3
	50	37	31	9	1112	1,2	0,3
	75	43	36	12	1539	1,5	0,4

Table 5.60. Measures of the flakes from Abrigo 3 (Z4-Z3, sectors C33-C45).

A scatter plot of the measurements (length and width) of the flakes shows a concentration of points between 20mm x 55mm (length) and 10mm x 50 mm (width) for this assemblage (Figure 5.33). Once again this shows that the majority of the flakes are small and predetermined.

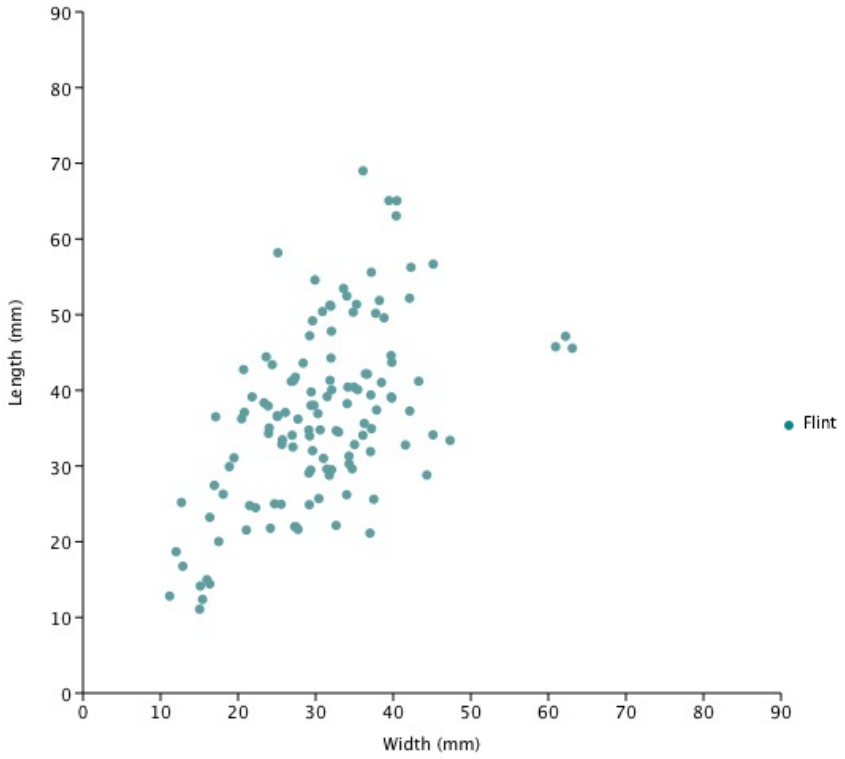


Figure 5.33. Scatter plot of the measurements of the flakes from Abrigo 3 (Z4-Z3, sectors C33-C45).

Retouched pieces

A total of 54 retouched pieces, recovered from sectors C33-C45 of the zones Z4-Z3, (Ramos) were studied (Table 5.61). The type of blank that was predominantly selected for retouch were flakes (n=31; 57%), followed by fragmented flakes (n=16; 30%), flake fragments (n=5; 9%) and chunk (n=2; 4%) in smaller proportions respectively. The majority of the pieces have unifacial retouch (n=52; 96%) with only 4% of pieces (n=2) showing bifacial retouch.

Regarding the extent of retouch found along the edge of the flakes, retouched pieces with a >25 to ≤50% extent of retouch predominate in the tool assemblage (n=27; 50%), followed

by pieces with a >50% to ≤ 75% extent (n=16; 30%), ≤25% extent (n=9; 17%) and >75 to ≤100% extent (n=2; 4%) respectively. It can be concluded that the retouching of flake tools was not very extensive at this site.

Although the sum of the individual number of retouched pieces analysed equals 54, the total number of shaped edges analysed is 77, as represented in Table 5.61. The majority of the retouch is located on sides of the pieces (n=70; 91%). The left side is the predominant side with extensive retouch (n=36; 47%), followed by the right side (n=34; 44%), with the distal (n=2; 3%) and proximal (n=1, 1%) areas in smaller proportions.

Semi-abrupt retouch angles (n=40; 52%) are the dominant angles present in this assemblage, followed by simple angles (n=27; 35%) and abrupt angles (n=10; 13%).

With regard to the extent of retouch on the dorsal/ventral surfaces, marginal retouch is the most represented (n=40; 52%), followed by extensive retouch (n=35; 45%) and very marginal retouch (n=2; 3%). In relation to the depth of retouch on the dorsal/ventral surfaces, marginal retouch prevails with (n=58; 75%), followed by deep retouch (n=18, 23%) and very marginal (n=1; 1%) retouch.

The predominant direction of retouch is direct (n=65; 84%), with inverse (n=8; 10%) and alternate (n=4; 5%) less represented.

The delineation of the retouched edge is predominantly continuous (n=65; 84%), followed by denticulate retouch (n=10; 13%), with encoche retouch (n=2; 3%) less represented. The data obtained by these two attributes are in direct correlation with the type of tools found within the assemblage: scrapers and denticulates.

Regarding the morphology of the retouched edge, the convex denticulate type is the most common (n=31; 40%), followed by straight (n=24; 31%), sinuous (n=12; 16%), and finally denticulate (n=10; 13%).

RETOUCHED TOOL

TYPES OF BLANK							
Levels	Raw material	Flakes	Fragmented flake	Fragment of flake	Chunk	TOTAL	%
Z4-Z3; C33-C44	Flint	31	16	5	2	54	100
TOTAL		31	16	5	2	54	
%		57	30	9	4		

FACIAL ATRIBUTE					
Level	Raw material	Unifacial	Bifacial	TOTAL	%
Z4-Z3; C33-C44	Flint	52	2	54	100
TOTAL		52	2	54	
%		96	4		

EXTENSION							
Level	Raw material	≤ 25%	>25 ≤50%	>50 ≤75%	>75 ≤100%	TOTAL	%
Z4-Z3; C33-C44	Flint	9	27	16	2	54	100
TOTAL		9	27	16	2	54	
%		17	50	30	4		

LOCALITATION								
Level	Raw material	Left	Distal	Right	Proximal	Unknown	TOTAL	%
Z4-Z3; C33-C44	Flint	36	2	34	1	4	77	100
TOTAL		36	2	34	1	4	77	
%		47	3	44	1	5		

ANGLE						
Level	Raw material	Abrupt	Semi abrupt	Simple	TOTAL	%
Z4-Z3; C33-C44	Flint	10	40	27	77	100
TOTAL		10	40	27	77	
%		13	52	35		

DEEP OF RETOUCHED ON SURFACE						
Level	Raw material	Very marginal	Marginal	Extensive	TOTAL	%
Z4-Z3; C33-C44	Flint	2	40	35	77	100
TOTAL		2	40	35	77	
%		3	52	45		

DEEP OF RETOUCHED ON EDGE						
Level	Raw material	Very marginal	Marginal	Deep	TOTAL	%
Z4-Z3; C33-C44	Flint	1	58	18	77	100
TOTAL		1	58	18	77	
%		1	75	23		

DIRECTION						
Level	Raw material	Direct	Inverse	Alternate	TOTAL	%
Z4-Z3; C33-C44	Flint	65	8	4	77	100
TOTAL		65	8	4	77	
%		84	10	5		

DELINEATION						
Level	Raw material	Continuous	Encoche	Denticulate	TOTAL	%
Z4-Z3; C33-C44	Flint	65	2	10	77	
TOTAL		65	2	10	77	
%		84	3	13		

MORPHOLOGY							
Level	Raw material	Straight	Convex	Sinuous	Denticulate	TOTAL	%
Z4-Z3; C33-C44	Flint	24	31	12	10	77	100
TOTAL		24	31	12	10	77	
%		31	40	16	13		

Table 5.61. Retouched tools analysis.

Following the Laplace typology (Table 5.62), the retouched tools are grouped into three main groups: scrapers (n=39), denticulates (n=14), and Mousterian points (n=1).

Amongst the scrapers, there is a similar proportion of side scrapers with abrupt retouch (R21) (n=20; 37%) and side scrapers with marginal retouch (R1) (n=17; 31%). Less represented are the side-transverse scrapers R23 (n=1; 2%), R22 (n=1; 2%) respectively.

Amongst the denticulates, two types were identified as marginal denticulate retouch D1 and D22, the rest of sample (N=12) could not be assigned conclusively to any type.

Within the tool assemblage analysed one Mousterian point was documented.

LAPLACE TYPOLOGY											
Level	**Raw material**	**R1**	**R21**	**R22**	**R23**	**Mousterian Point**	**D3**	**D22**	**Others**	**TOTAL**	**%**
Z4-Z3; C33-C44	**Flint**	17	20	1	1	1	1	1	12	54	100
TOTAL		17	20	1	1	1	1	1	12	54	
%		31	37	2	2	2	2	2	22		

Table 5.62. Laplace typology.

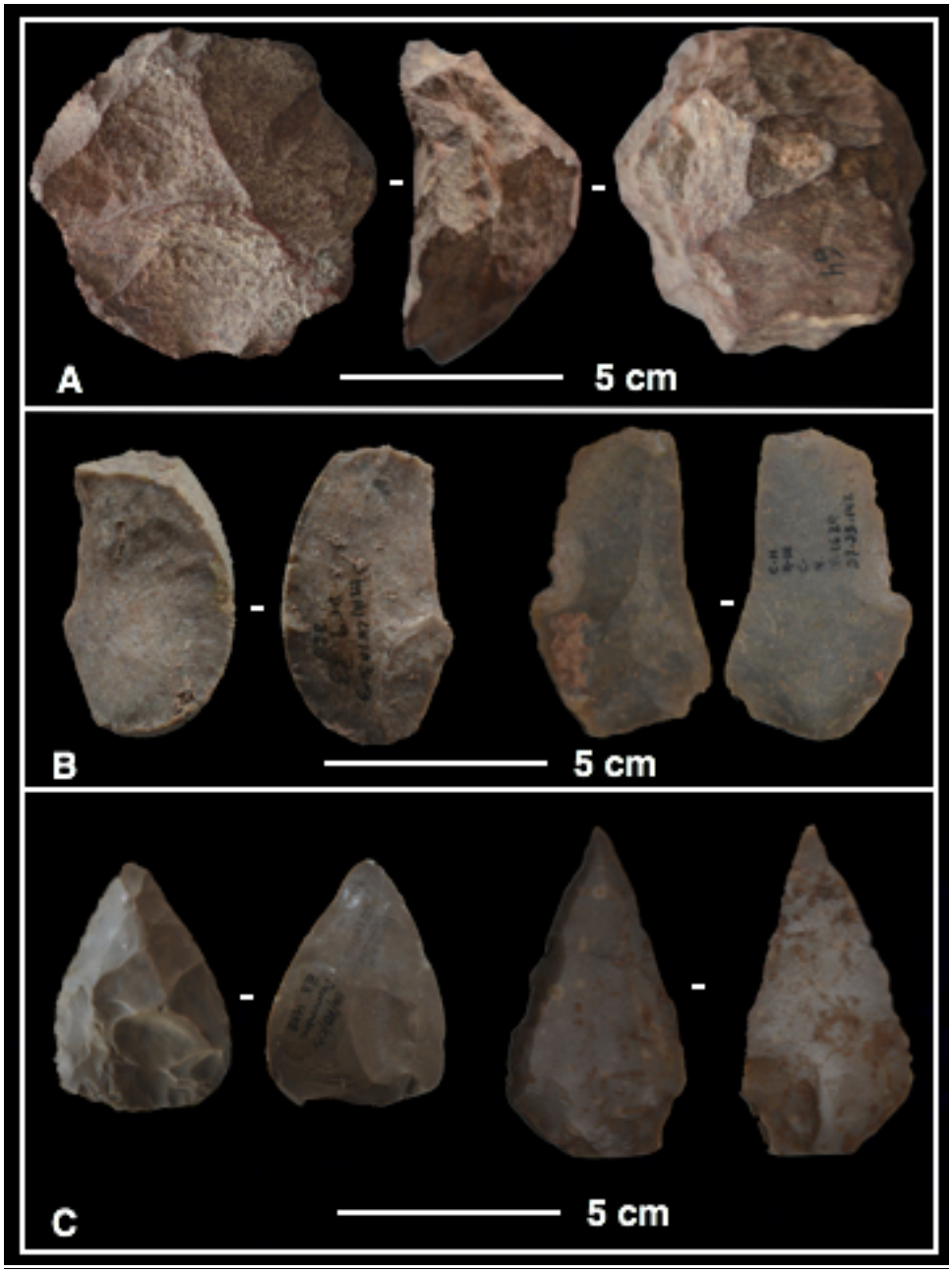


Figure 5.34. Detail of some lithic artefacts: A. Core, B. Flakes, and C. Retouched tools.

5.3.2. CARIHUELA CAVE

5.3.2.1 Location

Carihuela Cave is located within the province of Granada, to the north of the Sierra Arana Mountains, within the valley of the Píñar River at 1020 m.a.s.l. The cave has three separate entrances, with a south-east axis from its main entrance and is composed of five chambers (CI, CII, CIII, CIV, CV), with a total length of approximately 300m. Its geographical coordinates are 3º 25´47´ W, 37º 26´56´ N.

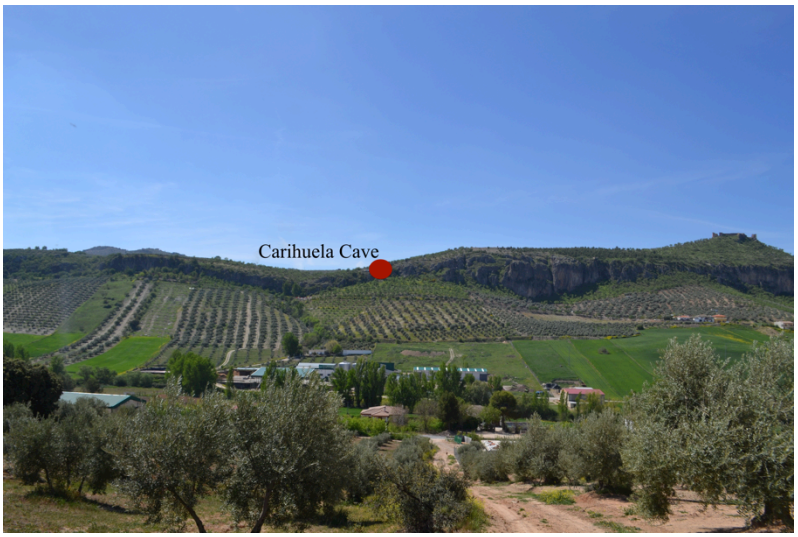


Figure 5.35. View of Carihuela Cave.

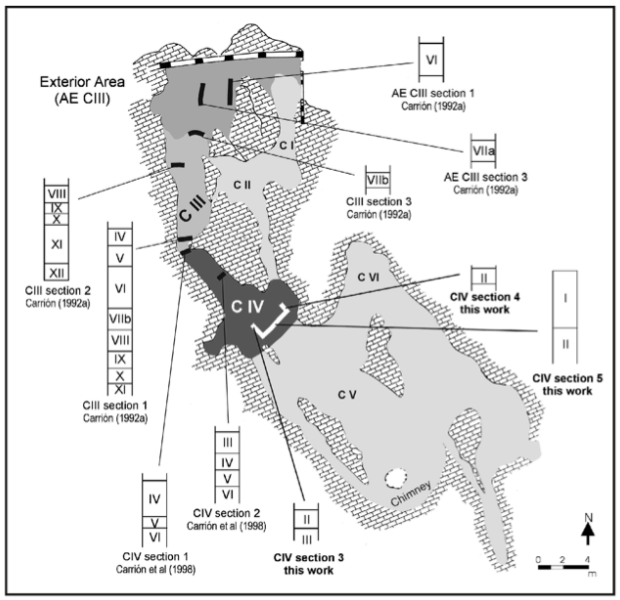


Figure 5.36. Section of chambers from Carihuela, taken from Fernández et al (2007).

5.2.2.2 Geological setting

The cave opens onto the scarp produced by the failure of the Piñar, a large elongated block of about 50 hectares. The materials from the olistolith are a sequence of limestone with flint, white limestone with fossils, oolitic limestones and organogenic red calcareous nodulose and breccia in some others sectors. The formation of the cave was caused by geological karst processes on the limestone from the Lower Lias age, belonging to the Middle Subbético stratigraphic sequence in the external zones of the Betic Cordillera (Sanz de Galdeano & Vera 1992).

5.3.2.3 Historical Background

Carihuela Cave was first recorded in 1918 by Hugo Obermaier, who identified the cave in his survey of Granada (Obermaier 1934). The first archaeological excavation carried out within it was conducted by Professor J. Ch. Spahni from 1954 to 1956 (Spahni 1955a). He focused primarily in Chambers I, II and III, which produced Pleistocene faunal and lithic assemblages (Spahni 1955 b, c, d; Koby and Spahni 1956). Both Neanderthal and Modern Human skeletal remains were also recovered from these assemblages (García Sánchez 1960).

Further excavations were conducted by M. Pellicer from 1959 to 1960, focusing on the the Post-Palaeolithic levels from Chamber IV (Pellicer 1964).

During the period 1969 to 1971, three excavations were conducted by H.T. Irwin and R. Fryxell (University of Washigton) and M. Almagro (University Complutense of Madrid) (Almagro *et al* 1970; Garralda 1970), during which sections from Chambers I, II, III and IV were cleaned. New excavations were conducted in the Chambers V, IV, III and outside area of the site (AE). The results of these excavations were never published.

5.2.2.4 Stratigraphic sequence

During his excavations, Vega Toscano identified 12 distinct sedimentary levels in Chamber III, with the following cultural attributions: Levels I-II Holocene; Level III Upper Palaeolithic; Levels IV to XII Mousterian (Table 5.63) (Vega Toscano 1988, *et al* 1997, 1999).

Level	Composition	Cultural attribution
I-II		Holocene
III	Alternate levels of gravels, clays and calcareous crusts	Upper Palaeolithic
IV	Alternate levels of gravels, clays and calcareous crusts	Mousterian
V	Alternate levels of gravels and blocks	Mousterian
VII	Block levels with evidence of washing	Mousterian
VIII	Sandy-clay levels with slabs	Mousterian
IX	Sandy-clay level with blocks	Mousterian
X	Phase of rock-fall	Mousterian
XI	Clay, blocks, organic materials, carbonatations, gravels	Mousterian
XII	Clay, crusts and organic materials	Mousterian

Table 5.63. Carihuela stratigraphic sequence taken from Vega Toscano et al (1999).

5.3.2.5 Dating

A series of thermoluminescence dates were provided by Fremlin (1974), Göksu *et al* (1974) and Vega Toscano (1988). The stratigraphic origin of the samples used for dating was never stipulated, and they were only loosely associated with lithic artefact typology. Carrión *et al* (1998,1999) took new samples of sediments within different sections (organic clays) as well as breccias and submitted them for radicarbon and Th/U dating respectively. A comparison of all the results can be found in Tables 5.64 to 5.66.

Sample no.	TL estimated (yr BP)	Suggested lithostratigraphy
B48	13,400 ± 600	III
B52	19,300 ± 500	IV
B6	20,200 ± 1200	IV
B47	20,950 ± 1200	IV
B43	21,100 ± 1300	V-IV
B44	37,350 ± 2200	VI-(V)
B54	42,400 ± 1500	VI
B49	49,200 ± 2500	VI
B53	68,000 ± 1800	X–VIII
B46	82,500 ± 4900	XI

Table 5.64. Thermoluminescence dating for Carihuela CIII Section 1 (Units XI–III)(Vega Toscano 1988).

Sample no.	Göksu et al. (1974)	Göksu (thesis)	Davidson (1989)	Cultural attribution	Unit
TB7	12,000 - 14,000	13,600 ± 800	11,200	Late Palaeolithic	III in CIII2
TB6	20,000 ± 3,000	20,200 ± 3,000	17,000	Late Palaeolithic	IV-III in CIV
TB8b	20,000 - 21,000	27,000 ± 1,000	23,000	Late Palaeolithic	V-IV in CIV
TB12	39,000	27,400 ± 1,000	25,700	Mousterian	V in CIII
TB2	28,000	28,000 ± 1,000	27,300	Mousterian	V in CIII
TB5	31,000 - 35,000	33,000 ± 1,200	25,200	Mousterian	V in CIII
TB1	32,000	39,400 ± 2,000	34,000	Mousterian	V-IV in CIII
TB3	46,000	57,700 ± 2,500	45,200	Mousterian	VI in CIII
TB9a	48,000	58,800 ± 2,500	47,800	Mousterian	VI in CIII
TB8a	80,000	-	-	Mousterian	XI in CIII

Table 5.65. *Thermoluminescence dating for Carihuela CIII and CIV chambers (Units XI–III) Göksu et al (1974) Davidson (1989).*

Lab number	Sample / Method	Years BP	Chamber	Levels	Zone	Archaeology/Human remains
Beta - 141048	Organic / 14C	1250 ± 60	CIV 5	I - 1	-	H. sapiens
Beta - 141049	Organic / 14C	5470 ± 90	CIV 5	I - 1	-	Neolithic / H. sapiens
Pta - 9162	Organic / 14C	5690 ± 30	CIV 5	I - 5	-	Neolithic / H. sapiens
Pta - 9163	Organic / 14C	6260 ± 20	CIV 5	II - 2	-	Neolithic / H. sapiens
Beta - 141050	Organic / 14C	6910 ± 70	CIV 4	II - 4	-	-
Pta - 9166	Organic / 14C	7700 ± 90	CIV 4	II - 5	-	-
Pta - 9165	Organic / 14C	8130 ± 100	CIV 3	II - 6	-	-
Beta - 74380a	Organic / AMS	12,320 ± 60	CIV 2	III	CIV 2-d	Late Palaeolithic / H.sapiens
Pta - 7892	Organic / 14C	15,700 ± 220	CIV 3	III	-	Upper Palaeolithic /H. Sapiens
Pta - 8745	Organic / 14C	21,430 ± 130	CIII 1	Uppermost V	M	Mousterian /Neanderthal
Pta - 8746	Organic / 14C	25,850 ± 180	CIII 1	Intermediate V	M	Mousterian /Neanderthal
Pta - 8733	Organic / 14C	28,440 ± 240	CIII 1	Basal V	N	Mousterian /Neanderthal
Beta - 74381a	Organic / AMS	45,200 ± 1,270	CIII AE 1	Basal VI	Q	Mousterian /Neanderthal
UABa	Breccia/ 230Th/234U	117,000 ± 41,000	CIII AE 3	VIIa	R	-

Table 5.66. Radiocarbon dating for CIII, CIII AE, and CIV, and Th/U dating for CIII.

The results derived from these dating samples suggested that the last Neanderthals of Carihuela Cave lived between ca. 28,440 and 21,430 BP, giving credence to the hypothesis that Carihuela, together with Zafarraya Cave, was the last refugium for Neanderthals in Europe. However, with the new dating results from several sites around Spain (Wood *et al* 2013, Higham *et al* 2014), the theories regarding the last Neanderthals in Iberia are constantly changing. Carihuela Cave would therefore benefit from new dating work carried out using modern methodologies.

5.3.2.6 Archaeological record

The first systematic study of the Mousterian lithic assemblages recovered from Carihuela cave, was made and published by Henry De Lumley in 1969. De Lumley described the assemblage as relatively homogeneous throughout the stratigraphic sequence, concluding that all the groups that occupied the site throughout its Mousterian occupation had the same technological culture. He further concluded that the index of the Levallois technique is more or less stable, and that when analysing the technical and typological characteristics of the artefacts the assemblage recovered from Middle Palaeolithic levels of Carihuela can be considered a typical Mousterian assemblage, rich in scrapers and blades of the Levallois tradition (De Lumley 1969).

Vega Toscano (1988) published a systematic study of the lithic assemblages recovered during his excavations as part of his doctoral thesis. He also attributed the lithic assemblages of the cave, recovered from units D and E, to the Typical Mousterian, with an abundance of scrapers and an index between 41% and 54%. His analyses showed that the predominant raw material in use was local flint, as the predominant knapping method was discoidal, with centripetal extractions, in order to obtain flakes. Once again, the lithic assemblage are characterised by its homogeneity, with limited changes, dominated by scrapers and denticulates, with only a few pieces having different attributes. Significantly, the assemblage recovered from Unit V is characterised by a greater presence of denticulates, earlier than 45,000 BP.

In terms of the faunal assemblage, a rich diversity of micromammal, macromammal and reptile species has been documented during the several excavations carried out at Carihuela. The micromammal assemblage has been systematically analysed by various authors over the years (Sevilla 1987, 1988; Ruiz Bustos & García 1997; Ruiz Bustos 2000). The macromammal assemblage has remained largely unstudied, save for one publication by Samper (2010), which focused on the equid remains.

Neanderthal skeletal remains have been recovered from Units VIII, VI, and V, as well as the lowermost levels of Unit IV. These remains include parietal and frontal bones of both adults and children. Skeletal remains attributed to Anatomically Modern Humans have also been recovered from Carihuela Cave, from Units III-I and the uppermost deposits of Unit IV. These include cranial and tibial fragments (García Sanchez 1960, Wigand 1978, Vega

Toscano 1988,).

5.3.2.7 Lithic Assemblage

The sample analysed was taken from Levels 3 and 4 from the Spahni excavations. During his excavations Professor Spahni selected only the more complete or diagnostic pieces, discarding the more fragmented pieces and debris, making this assemblage unnaturally skewed. Despite its limitations, the assemblage offers significant information regarding the technical aspects, the method of knapping used and the management of raw materials and the end products desired by its manufacturers. The sample size analysed consisted of 256 pieces from the collection currently housed at the Archaeological Museum of Granada.

Raw Material

The predominant raw material used at the site, as established by various authors (Spahni, Vega Toscano) is flint, which is available locally. There is a high diversity in the types of flint used as raw material and, although not quantified as part of this analysis, the quality of the flint used is very high and thus optimal for knapping.

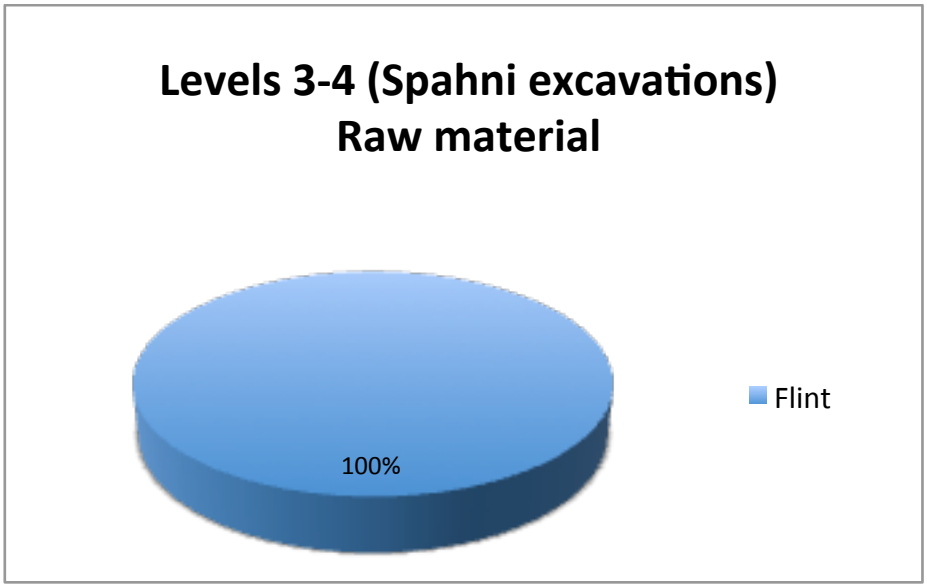
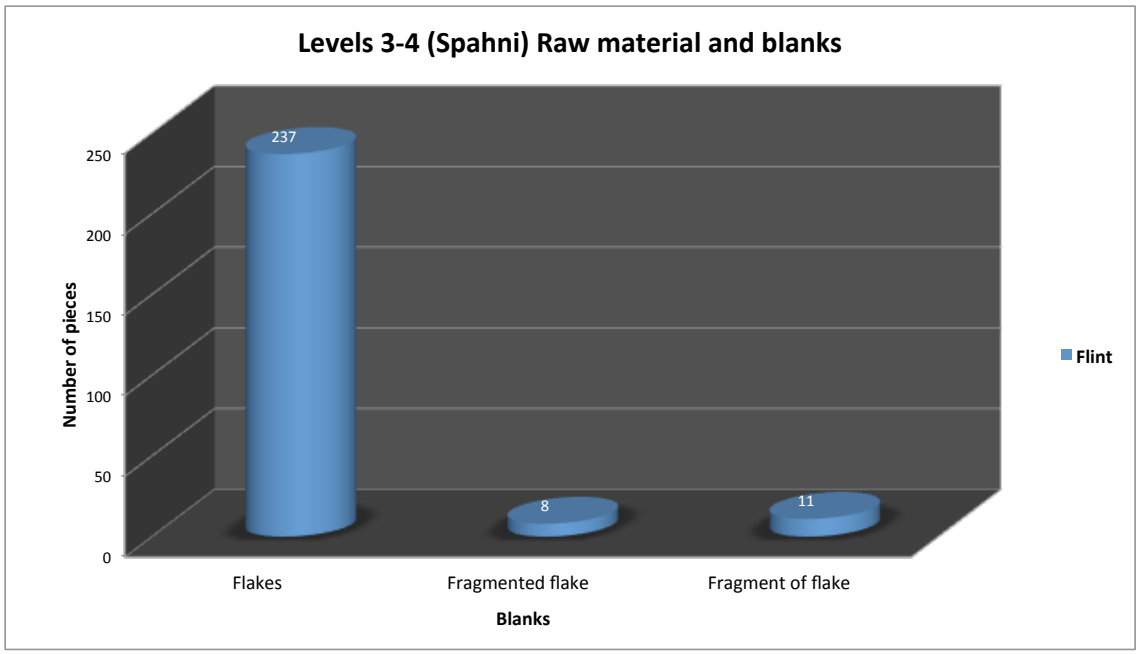


Figure 5.37. Raw material from level 3-4 from Spahni excavations.

Technical Categories

The majority of the assemblage is mainly composed of flakes (n=237; 92.58%), followed by fragmented flakes (n=8; 3.13%) and fragments of flakes (n=11; 4.30 %) both of which

amount to a very insignificant percentage of the total pieces analysed (Figure 5.38 and Table 5.67).



	Flakes	Fragmented flake	Fragment of flake	TOTAL	%
Flint	**237**	**8**	**11**	**256**	**100**
%	**92,58**	**3,13**	**4,30**		**100**

Figure 5.38 and Table 5.67. Raw material and blanks from Levels 3-4 from Spahni excavations.

The Flake Analyses

A total of 237 flakes were analysed. Although, as stated above, this assemblage is biased due to preferential collection of diagnostic pieces during early excavations, we believe that the main aim of the production sequence at this site was the manufacturing of flakes.

Ventral Face

Type of Bulb

Regarding the types of bulb present, the assemblage is dominated by the pronounced type (n=167; 70%), with fewer examples of the diffuse type (n=69; 29%). In relation to the delineation of the ventral face we can see some diversity, although sinuous delineation

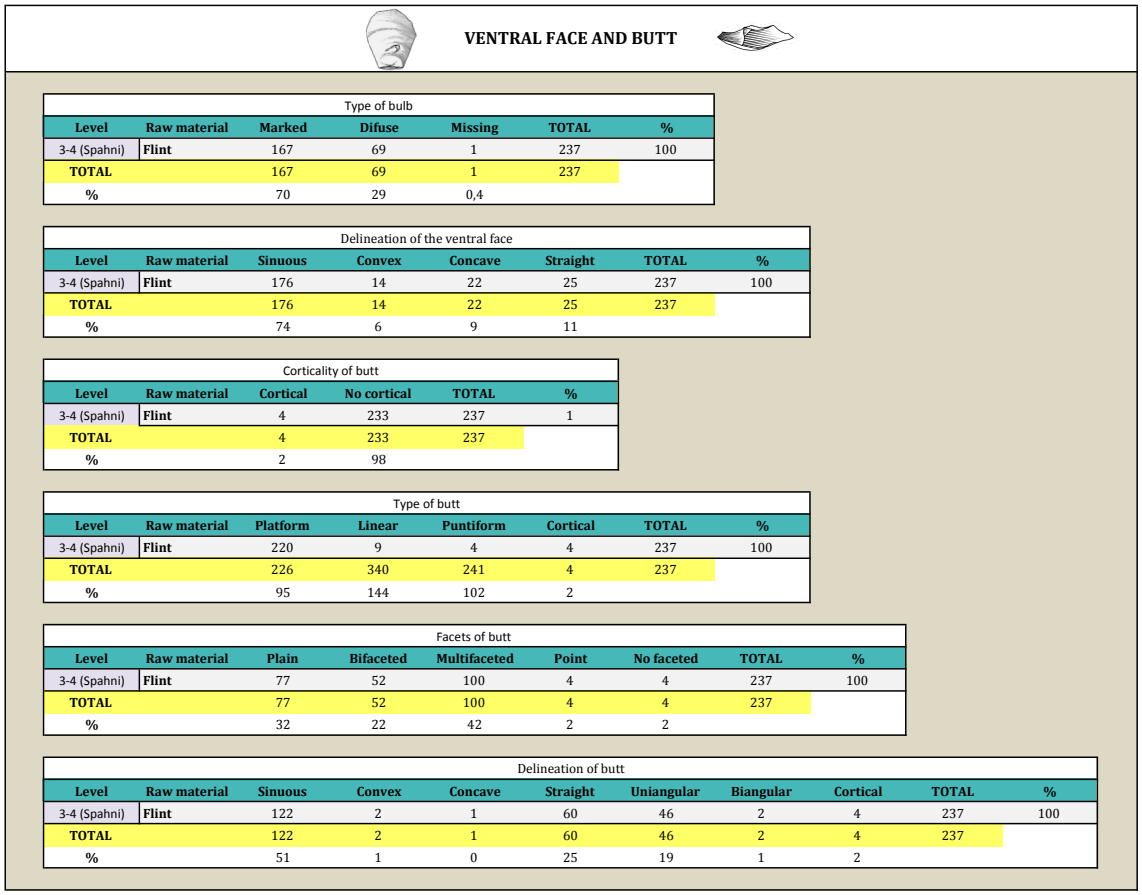
(n=176; 74%) is dominant, with the rest of the pieces showing straight (n=25; 11%), concave (n=22; 9%) and convex (n=14; 6%) delineation respectively (Table 5.68).

Butt

Regarding butt surfaces, the assemblage is almost entirely non-cortical (n=233; 98%), with only n=4 (2%) showing cortex (Table 5.68). Platforms are the most frequently represented type of butt (n= 220; 94,05%), while the other categories of linear (n=9; 4%), puntiform (n=4; 2%) and cortical (n=4; 2%) butt are present in smaller numbers (Table 5.68).

Butt preparation in this assemblage is characterised by a frequent presence of plain butts (n=77; 32%), followed by multifaceted (n=100; 42%) and dihedral (n=52; 22%) (Table 5.68), while fewer pieces show puntiform (n=4; 2%) and cortical (n=4; 2%) butts. These percentages may be related to the specific methods of knapping used, as multifaceted butts are closely related to the predetermined Levallois method.

The delineation of the ventral face is diverse, with sinuous delineation pieces (n=122; 51%) outnumbering straight (n=60; 25%) and uniangular (n=46; 19%) pieces, while fewer examples of cortical (n=4; 2%), convex (n=2; 1%), biangular (n=2; 1%) and concave delineation (n=1; 0.4%) are identified (Table 5.68).



VENTRAL FACE AND BUTT

Type of bulb

Level	Raw material	Marked	Difuse	Missing	TOTAL	%
3-4 (Spahni)	Flint	167	69	1	237	100
TOTAL		167	69	1	237	
%		70	29	0,4		

Delineation of the ventral face

Level	Raw material	Sinuous	Convex	Concave	Straight	TOTAL	%
3-4 (Spahni)	Flint	176	14	22	25	237	100
TOTAL		176	14	22	25	237	
%		74	6	9	11		

Corticality of butt

Level	Raw material	Cortical	No cortical	TOTAL	%
3-4 (Spahni)	Flint	4	233	237	1
TOTAL		4	233	237	
%		2	98		

Type of butt

Level	Raw material	Platform	Linear	Puntiform	Cortical	TOTAL	%
3-4 (Spahni)	Flint	220	9	4	4	237	100
TOTAL		226	340	241	4	237	
%		95	144	102	2		

Facets of butt

Level	Raw material	Plain	Bifaceted	Multifaceted	Point	No faceted	TOTAL	%
3-4 (Spahni)	Flint	77	52	100	4	4	237	100
TOTAL		77	52	100	4	4	237	
%		32	22	42	2	2		

Delineation of butt

Level	Raw material	Sinuous	Convex	Concave	Straight	Uniangular	Biangular	Cortical	TOTAL	%
3-4 (Spahni)	Flint	122	2	1	60	46	2	4	237	100
TOTAL		122	2	1	60	46	2	4	237	
%		51	1	0	25	19	1	2		

Table 5.68 . Ventral face and butt analysis.

The analysis of the internal knapping angles of the 237 sampled flakes indicates a mean of 106°, mode of 95° and median of 105°. These data suggest a preference for obtuse angles (Table 5.69).

Angle of knapping	
Number of flakes	237
Mean	106
Mode	95
Median	105
Maximum value	133
Minimum value	80
Kurtosis	-0,3
Standard deviation	11
Percentile 25	98
50	105
75	112

Table 5.69. Angle of knapping of the total of the flakes.

Dorsal Face

The study of the dorsal surface shows that the majority of flakes (n=219; 92%) do not present any cortex, with n=15 (6%) presenting less than 50% cortex on their surfaces and n=3 (1%) of the pieces presenting more than 50% cortex.

The direction of scars is mainly multidirectional (n=108, 46%), followed by unidirectional (n=58; 24%), while bidirectional (n=37, 16%) and centripetal (n=34; 14%) are less well represented (Table 5.70).



DORSAL FACE

Amount of cortex

Level	Raw material	0%	≤50%	>50%	TOTAL	%
3-4 (Spahni)	Flint	219	15	3	2	0
TOTAL		219	15	3	237	
%		92	6	1		

Direction of scars

Level	Raw material	Centripetal	Unidirectional	Bidirectional	Multidirectional	TOTAL	%
3-4 (Spahni)	Flint	34	58	37	108	237	45
TOTAL		34	58	37	108	237	
%		14	24	16	46		

Table 5.70 . Dorsal face analysis.

Regarding the number of scars on the 237 flakes, there is a mean of 10 scars, a mode of 9 and a median of 9. Such a high number of scars, particularly on the dorsal face, as indicated by these data, would suggest a high intensity of reduction of the pieces, with each scar being indicative of a removal event (Table 5.71).

Number of scars		
Number of flakes		237
Mean		10
Mode		9
Median		9
Maximum value		28
Minimum value		2
Kurtosis		2,4
Standard deviation		5
Percentile	25	7
	50	9
	75	12

Table 5.71. Number of scars of the flakes.

Morphometric analysis shows a mean length of 49mm, a mean width of 38mm and a mean thickness 10mm for the flakes, with an overall surface area of 1878mm^2. These measurements indicate that, on average, the pieces are small. The elongation index shows an average of 1.3, meaning that there is no laminar tendency in the assemblage. The flattening index shows a mean of 0.3, meaning that the flakes are very thin (Table 5.72).

		Length	Width	Thickness	Area	Elongation index	Flattening index
Number of flakes		237	237	237	237	237	237
Mean		49	38	10	1878	1,3	0,3
Mode		47	32	10	1844	1,1	0,27
Median		47	37	9	1721	1,3	0,3
Maximum value		98	79	21	4260	4	0,5
Minimum value		24	17	4	667	0	0,1
Kurtosis		0,8	1,8	1,9	0,6	2,5	0,6
Standard deviation		13	10	3	736	0,4	0,1
Percentile	25	39	32	8	1339	1,0	0,2
	50	47	37	9	1721	1,3	0,3
	75	56	43	11	2331	1,6	0,3

Table 5.72. Measures of the flakes.

A scatter plot of flake measurements (length and width) shows a concentration of points between 20mm x 75mm (length) and 20mm x 60 mm (width) for this assemblage (Figure 5.39). The absence of smaller measurements in the scatter plot further confirms the biased archaeological recovery of the assemblage, as smaller fragments and flakes were disregarded. Although skewed, this scatter plot does show that the flakes analysed are relatively standardised and of medium size.

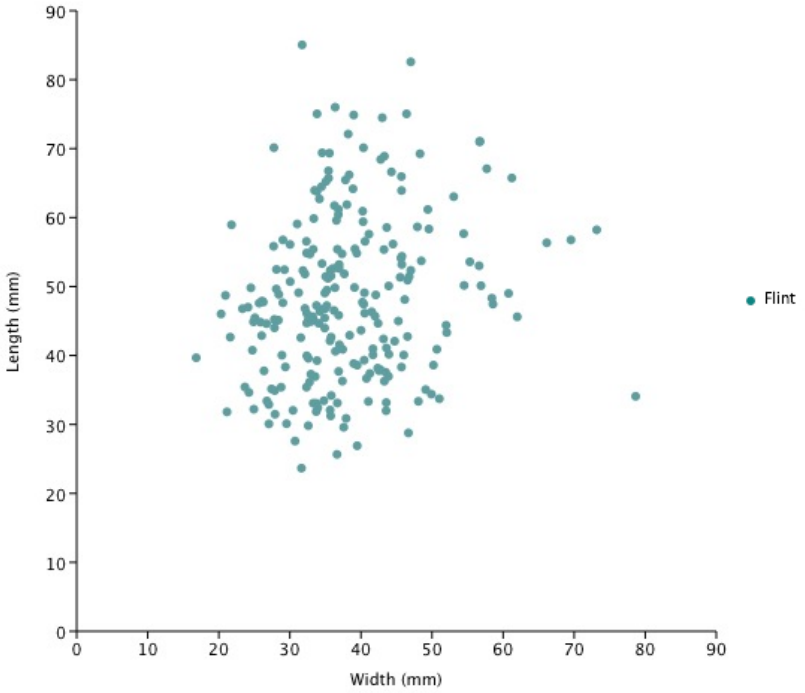


Figure 5.39. Scatter plot of the measurements of the flakes.

Retouched pieces

A total of 74 retouched pieces were studied from levels 3 and 4 from the excavations carried out by Spahni (1955) (Table 5.73). The kind of blanks that were selected for retouch are flakes (n=62; 84%), followed by flake fragments (n=8; 11%) and fragmented flakes (n=4; 5%) in smaller proportions respectively. The majority of the pieces have unifacial retouch (n=68; 92%) with only (n=6; 8%) pieces showing bifacial retouch.

Regarding the extent of retouch found along the edge of the flakes, retouched pieces with a >50 to ≤75% extent of retouch predominate in the tool assemblage (n=42; 57%), followed by pieces with ≤ 25% extent (n=6; 8%) and >75 to ≤100% extent (n=4; 5%) respectively. With these data we can conclude that the retouched tools assemblage has an intense degree of retouch.

Although the sum of the individual number of retouched pieces analysed equals 74, the total number of shaped edges analysed is 127, as represented in Table 5.73. The majority of the retouch is located on the side of the pieces (n=110; 86%). The right is the predominant side with extensive retouch (n=59; 46%) followed by the left side (n=51; 40%), and the distal area (n=17; 13%) respectively.

Semi-abrupt retouch angles (n=64; 50%) are the dominant angles present in this assemblage, followed by simple angles (n=56; 44%) and abrupt angles (n=7; 6%).

With regard to the extent of retouch on the dorsal/ventral surfaces, extensive retouch is the most represented (n=61; 48%), followed by marginal retouch (n=44; 35%), very marginal retouch (n=12; 9%) and very extensive retouch (n=10; 8%). In relation to the depth of retouch on the dorsal/ventral surfaces, marginal retouch prevailing with (n=64; 50%), followed by deep retouch (n=47, 37 %), very marginal (n=14; 11%) and very deep (n=2; 2%).

The predominant direction of retouch is direct (n=117; 92%), with alternate (n=4; 3%), inverse (n=3; 2%) and alternating (n=3; 2%) less well represented.

The delineation of the retouched edge is predominantly continuous (n=82; 65%), followed by denticulate retouch (n=44; 35%) with only one example (n=1; 1%) of an edge with no continuous retouching. The data obtained by these two attributes are in direct correlation with the type of tools found within assemblage: scrapers, double convergent scrapers and denticulates.

Regarding the morphology of the retouched edge, the denticulate type is the most common (n=44; 35%), followed by sinuous (n=30; 24%), convex (n=29; 23%), straight (n=21; 17%) and finally concave (n=3; 2%).



RETOUCHED TOOL



TYPES OF BLANK						
Levels	Raw material	Flakes	ragmented flak	ragment of flak	TOTAL	%
3-4 (Spahni)	Flint	62	4	8	74	74
TOTAL		62	4	8	74	
%		84	5	11		

FACIAL ATRIBUTE					
Levels	Raw material	Unifacial	Bifacial	TOTAL	%
3-4 (Spahni)	Flint	68	6	74	100
TOTAL		68	6	74	
%		92	8		

EXTENSION							
Levels	Raw material	≤ 25%	>25 ≤50%	>50 ≤75%	>75 ≤100%	TOTAL	%
3-4 (Spahni)	Flint	6	22	42	4	74	100
TOTAL		6	22	42	4	74	
%		8	30	57	5		

LOCALITATION						
Levels	Raw material	Left	Distal	Right	TOTAL	%
3-4 (Spahni)	Flint	51	17	59	127	100
TOTAL		51	17	59	127	
%		40	13	46		

ANGLE						
Levels	Raw material	Abrupt	Semi abrupt	Simple	TOTAL	%
3-4 (Spahni)	Flint	7	64	56	127	100
TOTAL		7	64	56	127	
%		6	50	44		

DEEP OF RETOUCHED ON SURFACE							
Levels	Raw material	Very marginal	Marginal	Extensive	Very extensive	TOTAL	%
3-4 (Spahni)	Flint	12	44	61	10	127	100
TOTAL		12	44	61	10	127	
%		9	35	48	8		

DEEP OF RETOUCHED ON EDGE							
Levels	Raw material	Very marginal	Marginal	Deep	Very Deep	TOTAL	%
3-4 (Spahni)	Flint	14	64	47	2	127	100
TOTAL		14	64	47	2	127	
%		11	50	37	2		

DIRECTION							
Levels	Raw material	Direct	Inverse	Alternate	Alternating	TOTAL	%
3-4 (Spahni)	Flint	117	3	4	3	127	100
TOTAL		117	3	4	3	127	
%		92	2	3	2		

DELINEATION						
Levels	Raw material	Continuous	Non continuous	Denticulate	TOTAL	%
3-4 (Spahni)	Flint	82	1	44	127	100
TOTAL		82	1	44	127	
%		65	1	35		

MORPHOLOGY								
Levels	Raw material	Straight	Convex	Concave	Sinuous	Denticulate	TOTAL	%
3-4 (Spahni)	Flint	21	29	3	30	44	127	100
TOTAL		21	29	3	30	44	127	
%		17	23	2	24	35		

Table 5.73 Retouched tools analysis.

Following the Laplace typology (Table 5.74), the retouched tools are grouped into three main groups: scrapers (n=39), denticulates (n=33), and Mousterian points (n=11).

Amongst the scrapers, there is a similar proportion of side scrapers with abrupt retouching (R21) (n=15; 8%) and side scrapers with marginal retouch (R1) (n=14; 17%). Less represented are the side-transverse scrapers R23 (n=6; 7%), R22 (n=3; 4%) and R2 (n=1, 1%).

Amongst the denticulates, the marginal denticulate retouch D1 (n=13; 16%) is predominant, followed by D25 (n=8; 10%) and D23 (n=7; 8%). Less represented are D21 (n=2; 2 %), D22 (n=2; 2%) and D24 (n=1; 1%).

Within the tool assemblage analysed n=11 (13%) Mousterian points were documented.

LAPLACE TYPOLOGY															
Level	Raw material	R1	R2	R21	R22	R23	Mousterian Point	D1	D21	D22	D23	D24	D25	TOTAL	%
3-4 (Spahni)	Flint	14	1	15	3	6	11	13	2	2	7	1	8	83	100
TOTAL		14	1	15	3	6	11	13	2	2	7	1	8	83	
%		17	1	18	4	7	13	16	2	2	8	1	10		

Table 5.74. Laplace Typology.

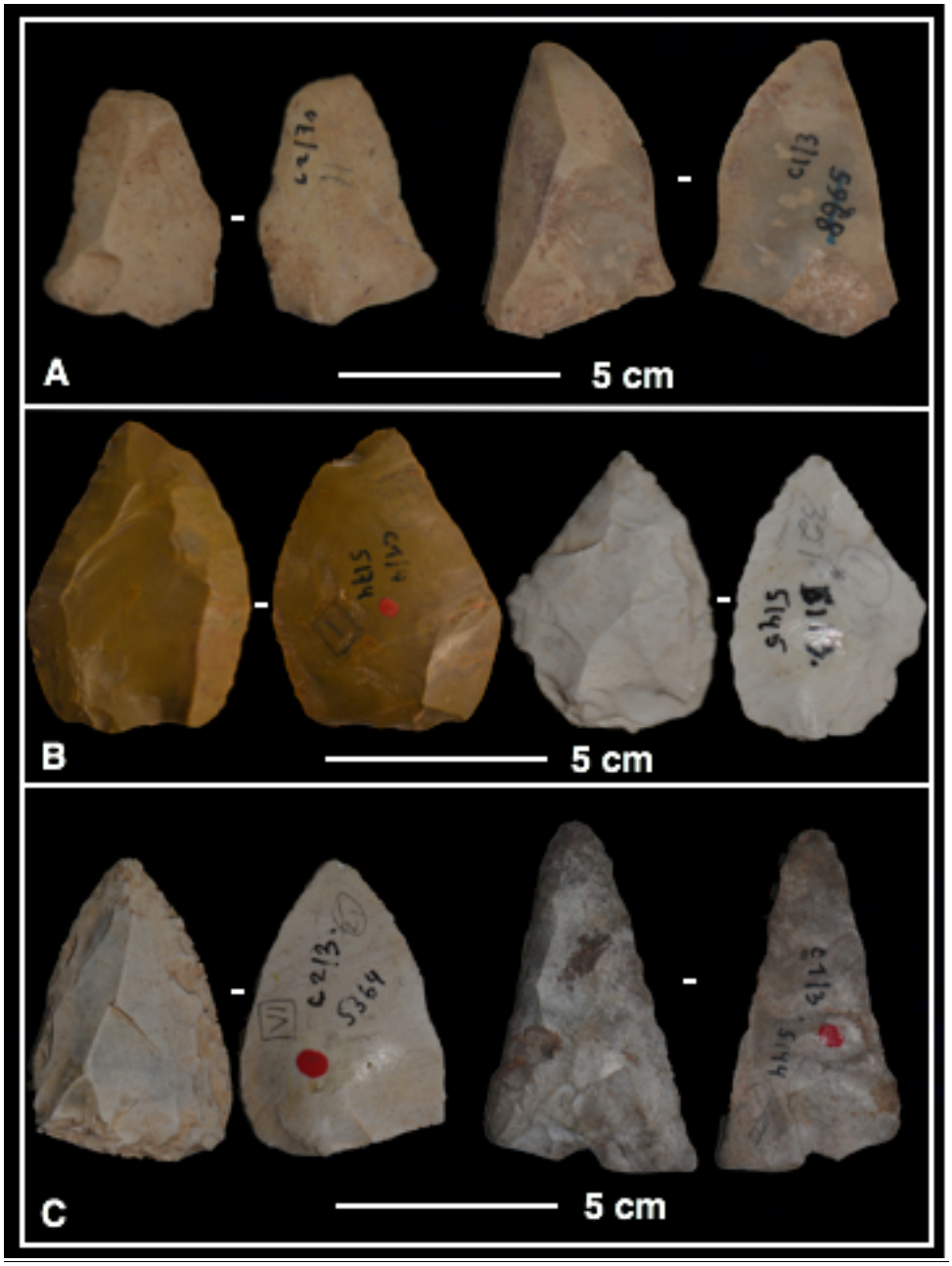


Figure 5.40. Detail of some lithic artefacts: A & B. Flakes, and C. Retouched tools.

5.3.3. ZAFARRAYA CAVE

5.3.3.1 Location

Zafarraya Cave is located within the Sierra de Alhama in the province of Málaga at an altitude of 1020m.a.s.l. and on the foot of a cliff with a steep slope below it. The cave is oriented in a south-east direction. The mouth of the cave has a large arch-shaped porch 30m high by 10m wide at the base. The interior of the cave has a length of 23m, and is 0.5 to 3.5m wide and from 1m to 1.95m high. It is divided into three zones: the entrance chamber, the back chamber, and a narrow chamber at the bottom. The site is located 25km inland from the Mediterranean shore. The coordinates are: 36º 56 58`` N 4º `7 40`` W (Barroso *et al* 2003, 2006, 2014).

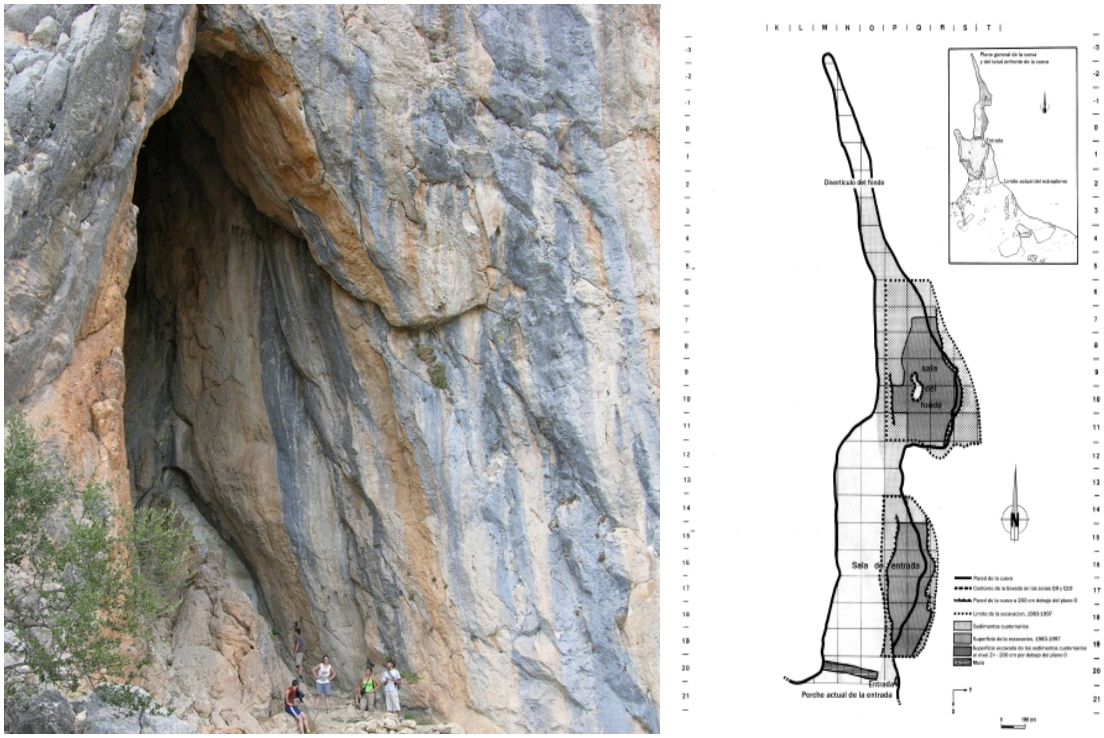


Figure 5.41. View of Zafarraya Cave and map.

5.3.3.2 Geological Setting

The Sierra Alhama mountain range is a limestone formation and presents an extremely irregular landscape, with the mountains dominating over very narrow valleys. The range is cut by a transverse valley named the Boquete de Zafarraya Pass, which connects, at its the northern end, the Zafarraya polje and an inland route, with several valleys and the route towards the coastline at its southern end.

Several geological units are located around the site including: Internal domain Subbetico (Sierra Gorda Unit), Zafarraya Unit, Zalia Unit), Flyschs Complex, Colmenar-Periana Complex, Maláguide Complex, Alpujárride Complex, Santana Formations, Neogene Formations of the Depression of Granada.

The limestone formations of the cave are from the Lower Lias and belong to the Zafarraya Unit (Vera 1969). The Middle Lias is represented by limestone and flint nodules of a grey colour, and a very compact texture (microsparite) located at the bottom of the slope of the cave (Barroso *et al* 2003).

5.3.3.3 Historical Background

This site was discovered by Cecilio Barroso in 1979. A total of eight archaeological excavations took place, the first from 1981 to 1983 and the second from 1990 to 1994, both led by C. Barroso and F. Medina (Barroso *et al* 1983, 1984). Zafarraya Cave is one of Iberia´s most important Middle Palaeolithic sites for its significant assemblage of *Homo neanderthalensis* fossils. A total of 16 Neanderthal bones were documented in layers D and E, at a depth of between 160 and 240 cm. According to Barroso (2003, *et al* 2014), there are at least nine individuals (two children and seven adults).

The cave was occupied very sporadically by Neanderthals, who spent very short periods of time within it, as suggested by the spatial distributions of the lithics and faunal bone assemblages recovered from each archaeological level. It has been suggested that the cave could have been utilised as a high elevation hunting station.

5.3.3.4. Stratigraphic Sequence

The stratigraphy includes two distinct parts: the top part attributed to the Neolithic/Upper Palaeolithic, with obvious disturbance in the sediments, and the bottom part, which is quite homogeneous and contains Mousterian lithic assemblages (Middle Palaeolithic). In the southern area (the entrance) 5 main layers A, B, C, D and E were documented in the Mousterian cemented deposits. The excavation was also extended towards the rear area of the cave, where the sediments do not show any signs of cementation and were very homogeneous. The archaeological deposits were divided into distinct levels at 5cm intervals and assigned to an identifying number from the top, following the example I1, I2, I3, etc (Table 5.75). The *in situ* sediments excavated yielded Mousterian assemblages along a section, which is already reaching almost two meters in depth (Barroso & Hublin 1994, Hublin *et al* 1995).

Stratigraphic Complex	Thickness (cm)	Composition	Stratigraphic Set		Level	Archaeological units	Cultural attribution
Upper	0-61	brown-black slity sands					Neolithic/ Upper Palaeolithic (Mix)
Middle	49-530	brown slity sands with smalls stones	I (49-230cm)	Ia	A	UA (-102 to -112 cm)	Mousterian
					B	UB (-112 to -122 cm)	
				Ib	C	UC (-122 to -162 cm)	
				Ic	D	UD (-162 to -167cm)	
				Id	E	UE (-167 to -212 cm)	
						UF (-212 cm)	
			II (230-530 cm)			UG (-248 cm)	
Lower	> 525	Clay with shell of ostracods					Sterile

Table 5.75 . Stratigraphic sequence from Zafarraya Cave (Barroso 2003).

5.3.3.5. Dating

A series of dating samples have been carried out since the cave´s discovery, the results of which have been published in several publications (Hublin *et al* 1995, Michel *et al* 2003, 2006, 2013, Wood *et al* 2013). The hypothesis identifying the south of Iberia as the last refuge for Neanderthal populations was based on the first 14C dates from Zafarraya Cave. These absolute dates showed a chronology between 30 ka and 33 ka BP (Hublin *et al* 1995). A new sequence of absolute dates was carried out a decade later (Michel *et al* 2003, 2006), which showed a chronological range from 30 ka to 45 ka, thus leaving the age of the last Neanderthals in the southern Spain unresolved. In 2013, the 2006 AMS dates were calibrated (Table 5.76) (Michel *et al* 2013), which showed that the layer where Neanderthal fossils were found dated from 38,763 to 40,604 Cal BP. The most recently published dates were obtained by using the ultrafiltration method derived from bone

collagen (Wood *et al* 2013), resulting in dates of >46.7 ka BP, >46.7 ka BP (for sample Z8os), 46,3±2,5 ka (for sample ZAF2) and >49,3 ka (for ZAF7) (Table 5.77). The results showed that previous AMS dates on the same samples were significant underestimates. When both Michel and Wood´s dates are considered together, it shows that the chronological range of the Mousterian layers at Zafarraya is between 38,7 and 49,3 ka. These newer results question the hypothesis that the south of Iberia served as a last refuge for the Neanderthals with a need to perform more dating, using new techniques, at other Middle Palaeolithic sites from southern Iberia.

Level	Sample field	Depth (cm)	Material	Method	Lab. Ref.	Date	Cal BP	Cultural attribution
UE	P-11, 70UG36 D	-194	Charcoal	AMS	OxA-7117	36,900 ± 3,000 BP	38,700 - 44,117 BP	Mousterian
UE?	R-16, 1 UE?	-217	Charcoal	AMS	OxA-9002	34,600 ± 800 BP	38,763 - 40,604 BP	Mousterian
UG	Q-17, 202 UG42 E	-234	Charcoal	AMS	OxA-7120	30,900 1,300 BP	34,038 - 36,839 BP	Mousterian
UG	Q-18,167 UG42 E	-235	Charcoal	AMS	OxA-7135	14,9300 ± 90 BP	18,262 - 18,489 BP	Mousterian

Table 5.76. Dating from Michel et al (2013).

Sample	Treatment	OxA-	Date (BP)
Z8os	AG	8,999	33,300 ± 1,200
	AF	23,198	>46,700
	AF	26.440	>46,700
ZAF2	AF	21.810	46,300 ± 2,500
ZAF3	AF		
ZAF7	AF	21,813	>49,300
ZAF8	AF		

Table 5.77. Dating from Wood et al (2013).

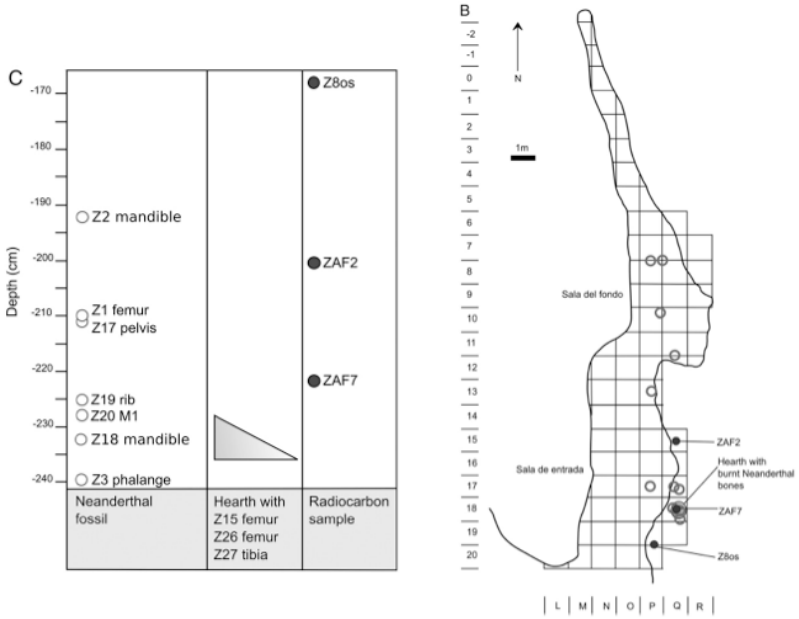


Figure 5.42. Location where samples were taken from for dating (Wood et al 2013).

5.3.3.6. Archaeological Record

The lithic assemblage was described as typical Mousterian (Medina 1984, Medina *et al* 1986), being both typologically and technologically very homogeneous. A small percentage of flakes were retouched, mainly side and transversal scrapers, Mousterian points, notches, and denticulates (Barroso & Hublin 1994).

The underrepresentation of secondary products, such as cortical flakes or cores, suggest that the bulk of the production was brought already finished to the site and that there was little knapping activity in the cave (Hublin *et al* 1995).

A rich set of faunal remains has been recovered from the whole archaeological sequence attributed to the Mousterian. The global assemblage as a whole comprises carnivores, herbivores, birds, and microfaunal remains. A substantial majority consists of mountain fauna predominantly goats, followed by deer. The taphonomy and zooarchaeological studies of the fauna indicates an interaction between Neanderthals and carnivores, with alternate occupations of the site (Caparrós *et al* 2012).

5.3.3.7 Lithic Assemblage

Raw Material

The raw materials used are mainly local flint, of the kind still found around the cave today. Several sources of flint, both from primary and secondary catchment sources, have been documented around the cave, some from fairly close by, but never exceeding a radius of 12km. Two of the most outstanding catchment areas, Alcolea and Alfarnate, are located 7 and 12km from of the cave respectively. These outcrops provided the finest flint and were preferred to other nearby sources.

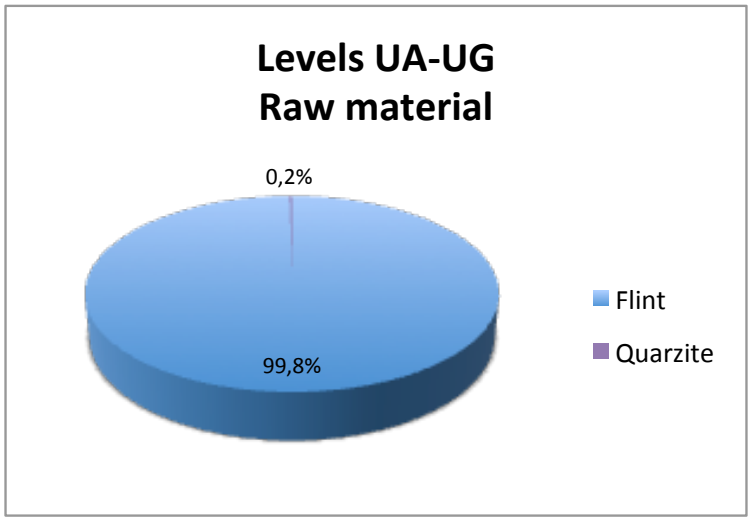


Figure 5.43. Raw material from levels UA-UG.

Technical Categories

The lithic assemblage is composed mainly of debris (n=512; 52.89%); flakes (n=207; 21.38%), fragmented flakes (n=139; 14.36%), fragment of flakes (n=67; 6.92%), cores (n=26; 2.69%), and chunks (n=19; 1.96%). A predominance of knapping products is observed, suggesting that the knapping strategy employed at the site was oriented towards the systematic production of flakes (Table 5.78; Figure 5.44).

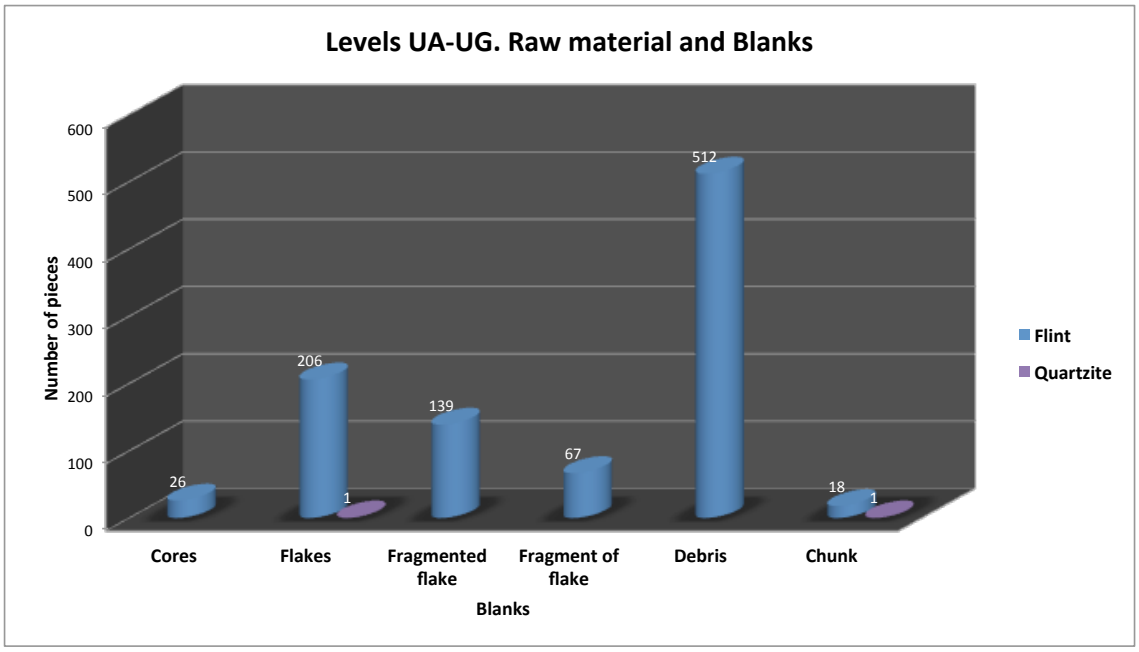


Figure 5.44. Raw material and blanks from levels UA-UG.

Levels UA-UG	Cores	Flakes	Fragmented flake	Fragment of flake	Debris	Chunk	TOTAL	%
Flint	26	206	139	67	512	18	966	99,79
Quartzite		1				1	2	0,21
TOTAL	26	207	139	67	512	19	968	
%	2,69	21,38	14,36	6,92	52,89	1,96		100

Table 5.78. Raw material and blanks from levels UA-UG.

Analysis of cores

A total of 26 cores were documented from levels UA-UG, all deriving from flint. Over half of the cores do not present any cortex (n=15; 57%), with the remainder of the cores retaining some of their cortex at the point they were abandoned n=8 (31%) with 25% of cortex, and n=3 (12%) with ≤50%.

With regard to the stages of the knapping sequence, we observe that the majority of the pieces are either at the exploitation stage (n=14; 54%), or the terminal stage (n=10; 38%). Cores attributed to the first stages of reduction are present within the assemblage, but are significantly less represented (n=2; 8%) (Table 5.79). It is important to note that the predominance of cores, in the exploitation stage of knapping, could be related to the sporadic occupation of the cave by Neanderthals.

In relation to the exploitation of surfaces we can see diversity within the assemblage, with a bifacial reduction strategy being dominant with n=18 (69%) pieces, while fewer pieces show trifacial (n=5, 19%), unifacial (n=2; 8%), and globular (n=1; 2%) reduction strategies (Table 5.79). The knapping strategies employed were also varied, the most common being centripetal with n=15 (58%) pieces, with multidirectional (n=5; 19%), orthogonal (n=2, 8%), unidirectional (n=2; 8%), and bidirectional (n=1; 4%) strategies being less common (Table 5.79).

The methods of knapping employed were also varied, with the most common being discoidal (n=11; 42%). There are 4 (15%) cores displaying evidence of the Levallois method of knapping, with two example of the globular (n=1; 4%) and Quina (n=1; 4%) methods respectively and 8 (31%) cores attributed to indeterminate methods. These eight were very difficult to identify due to the intensity of their exploitation (Table 5.79).



ANALYSIS OF CORES



TYPES OF CORES				
Levels	**Raw material**	**Cores**	**TOTAL**	**%**
UA-UG	**Flint**	26	26	100
TOTAL		25	26	
%		96		

AMOUNT OF CORTEX						
Levels	**Raw material**	**0%**	**≤ 25%**	**>25 ≤50%**	**TOTAL**	**%**
UA-UG	**Flint**	15	8	3	26	100
TOTAL		15	8	6	26	
%		58	31	23		

STAGE OF KNAPPING SEQUENCES						
Levels	**Raw material**	**Initial**	**Exploitation**	**Terminal**	**TOTAL**	**%**
UA-UG	**Flint**	**2**	14	10	26	100
TOTAL		**2**	14	10	26	
%		8	54	38		

FACIAL ATTRIBUTE							
Levels	**Raw material**	**Bifacial**	**Trifacial**	**Unifacial**	**Globular**	**TOTAL**	**%**
UA-UG	**Flint**	18	5	2	1	26	100
TOTAL		**18**	5	2	1	26	
%		69	19	8	4		

STRATEGIES OF KNAPPING									
Levels	**Raw material**	**Centripetal**	**Ortogonal**	**Unidirectional**	**Bidirectional**	**Multidirectional**	**Indeterminate**	**TOTAL**	**%**
UA-UG	**Flint**	15	2	2	1	5	1	26	100
TOTAL		15	2	2	1	5	1	26	
%		58	8	8	4	19	4		

METHOD OF KNAPPING								
Levels	**Raw material**	**Discoidal**	**Levallois**	**Quina**	**Globular**	**Indeterminate**	**TOTAL**	**%**
UA-UG	**Flint**	11	4	1	1	8	26	100
TOTAL		11	4	1	1	8	26	
%		42	15	4	4	31		

Table 5.79. Analysis of cores.

Morphometrically, the cores have a mean length of 66mm, a mean width 51mm and a mean thickness of 34mm, with a mean surface area of 3669mm^2. These measurements indicate that on average cores are a medium size (Table 5.80).

		Length	Width	Thickness	Area
Number of cores		26	26	26	26
Mean		66	51	34	3669
Mode		56	44	22	1483
Median		64	49	32	3239
Maximum value		121	99	72	9905
Minimum value		34	27	13	907
Kurtosis		0	1	1	2
Standard deviation		21	17	16	2287
Percentile	25	52	38	23	2227
	50	64	49	32	3239
	75	77	62	40	4872

Table 5.80. Metric analysis of the cores from levels UA-UG.

The scatter plot of the measurements (length and width) of the cores shows a concentration of points between 45mm x 80mm (length) and 30mm x 80mm (width) (Figure 5.45), reinstating that the majority of the cores are of medium size.

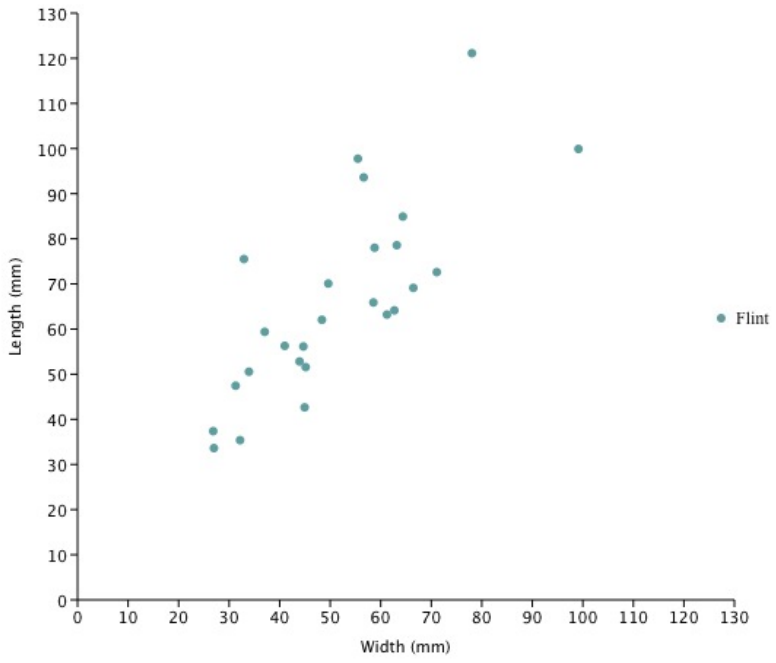


Figure 5.45. Scatter plot of the measurements of the cores from levels UA-UG.

The Flake Analyses

The sample assemblage analysed from levels UA-UG is composed of 207 flakes, suggesting that the production of flakes was the main objective of the production sequence at this site.

Ventral Face

Type of Bulb

Butt

The assemblage is dominated by flakes showing a pronounced bulb (n=125; 60%), with fewer showing a diffuse bulb (n=80; 39%). The delineation of the ventral face is diverse, with sinuous delineation pieces (n=91; 44%) outnumbering concave (n=67; 32%) convex (n=26; 13%), and straight (n=23; 11%) delineation (Table 5.81).

With regard to the butt surface of lithics analysed, the assemblage is almost entirely non-cortical (n=203; 98%), with only 4 (2%) showing any cortex (Table 5.81). Platform is the predominant type of butt present (n=192; 93%), while the other categories of linear (n=10; 5%) and puntiform (n=1; 0.1%) butts are less represented (Table 5.81).

Butt preparation in this assemblage is characterised by a frequent presence of plain butts (n=107; 52%), followed by multifaceted (n=54; 26%) and dihedral (n=40; 19%) butts (Table 5.81). There are many different types of butt delineation within the assemblage. Straight delineation is most common (n=85; 41%), followed by sinuous (n=70; 34%), while other delineation types are represented in smaller proportions: uniangular (n=31; 15%), convex (n=10; 5%) and concave (n=7; 3%) (Table 5.81).



VENTRAL FACE AND BUTT



Type of bulb						
Levels	**Raw material**	**Marked**	**Difuse**	**Missing**	**TOTAL**	**%**
UA-UG	**Flint**	124	80	2	206	99,5
	Quartzite	1			1	0,5
TOTAL		125	80	2	207	
%		60	39	1		

Delineation of the ventral face							
Levels	**Raw material**	**Sinuous**	**Convex**	**Concave**	**Straight**	**TOTAL**	**%**
UA-UG	**Flint**	91	26	67	22	206	99,5
	Quartzite				1	1	0,5
TOTAL		91	26	67	23	207	
%		44	13	32	11		

Corticality of butt					
Levels	**Raw material**	**Cortical**	**No cortical**	**TOTAL**	**%**
UA-UG	**Flint**	4	202	206	99,5
	Quartzite		1	1	0,5
TOTAL		4	203	207	
%		2	98		

Type of butt							
Levels	**Raw material**	**Platform**	**Linear**	**Puntiform**	**Cortical**	**TOTAL**	**%**
UA-UG	**Flint**	191	10	1	4	206	99,5
	Quartzite	1				1	0,5
TOTAL		192	10	1	4	207	
%		93	5	0	2		

Facets of butt								
Levels	**Raw material**	**Plain**	**Bifaceted**	**Multifaceted**	**Point**	**No faceted**	**TOTAL**	**%**
UA-UG	**Flint**	106	40	54	1	5	206	99,5
	Quartzite	1					1	0,5
TOTAL		107	40	54	1	5	207	
%		52	19	26	0,5	2		

Delineation of butt									
Levels	**Raw material**	**Sinuous**	**Convex**	**Concave**	**Straight**	**Uniangular**	**Cortical**	**TOTAL**	**%**
UA-UG	**Flint**	70	10	7	84	31	4	206	99,5
	Quartzite				1			1	0,5
TOTAL		70	10	7	85	31	4	207	
%		34	5	3	41	15	2		

Table 5.81. Ventral face and butt analysis.

Morphometric analysis of the angle of knapping of 207 flakes, gives a mean of 108°, a mode of 108° and a median 108°. Again these data suggest a preference for obtuse knapping angles (Table 5.82).

Angle of knapping		
Number of flakes		207
Mean		108
Mode		108
Median		108
Maximum value		134
Minimum value		68
Kurtosis		-0,3
Standard deviation		11
Percentile	25	99
	50	108
	75	117

Table 5.82. Knapping angle of the flakes from levels UA-UG.

Dorsal Face

Regarding dorsal surface, the majority of flakes (n=183; 88%) do not present any cortex, with 17 (8%) presenting less than 50% cortex on its surfaces, and 7 (3%) pieces presenting more than 50% (Table 5.83).

There is a high diversity identified in the direction of scars, with centripetal scarring (n=122; 59%) being the most frequent category present, followed by unidirectional (n=37; 18%) multidirectional (n=35, 17%) and bidirectional (n=12; 6%) (Table 5.83).



DORSAL FACE

Amount of cortex

Levels	Raw material	0%	≤50%	>50%	TOTAL	%
UA-UG	Flint	182	17	7	206	99,5
	Quartzite	1			1	0,5
TOTAL		183	17	7	207	
%		88	8	3		

Direction of scars

Levels	Raw material	Centripetal	Unidirectional	Bidirectional	Multidirectional	Indeterminate	TOTAL	%
UA-UG	Flint	121	37	12	35	1	206	99,5
	Quartzite	1					1	0,5
TOTAL		122	37	12	35	1	207	
%		59	18	6	17	0,5		

Table 5.83. Dorsal face analysis.

The analysis of the scars of 207 flakes indicates a mean of 5 scars, a mode of 5 and a median of 5. As scars are an indication of previous removals, a mean of 5 scars on the dorsal face suggests a high degree of reduction (Table 5.84).

Number of scars		
Number of flakes		207
Mean		5
Mode		5
Median		5
Maximum value		23
Minimum value		1
Kurtosis		7,0
Standard deviation		3
Percentile	25	3
	50	5
	75	7

Table 5.84. Number of scars of the dorsal face from levels UA-UG.

The measurement data of flakes show a mean length of 40mm, a mean width of 32mm and a mean thickness of 10mm. The mode and median show similar measures. The mean area is 1345mm^2. These measurements suggest that on average, the pieces are of a small size. The elongation index shows an average of 1.3, suggesting that there is no laminar tendency in the assemblage. The flattening index shows an average of 0.3, suggesting the flakes are extremely thin (Table 5.85).

		Length	Width	Thickness	Area	Elongation index	Flattening index
Number of flakes		207	207	207	207	207	207
Mean		40	32	10	1345	1,3	0,3
Mode		25	28	9	907	0,90	0,23
Median		39	32	9	1283	1,2	0,3
Maximum value		81	60	27	3959	4,6	1,0
Minimum value		7	9	1	30	0	0,1
Kurtosis		-0,2	-0,4	0,5	0,4	6,8	3,6
Standard deviation		16	11	4	811	0,6	0,1
Percentile	25	30	24	6	798	0,9	0,2
	50	39	32	9	1283	1,2	0,3
	75	50	39	12	1802	1,5	0,4

Table 5.85. Measures of the flakes from levels UA-UG.

A scatter plot of the measurements (length and width) of flakes shows two concentrations of points, the first between 10mm x 20mm (length) and 10mm x 20 mm (width) and the second group between 25mm x 50mm (length) and 20mm x 50 mm (width) for this assemblage (Figure 5.46). The majority of the flakes are small and medium in size, indicating that the flakes had a predetermined configuration.

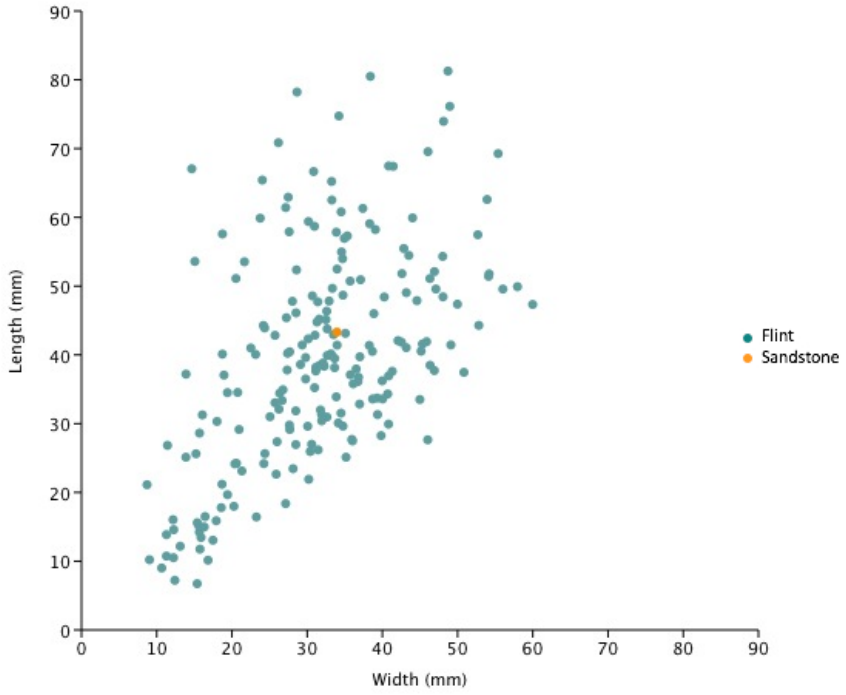


Figure 5.46. Scatter plot of the measurements of the flakes from levels UA-UG.

Retouched pieces

A total of 50 retouched pieces were studied from Levels UA-UG (Table 5.86). The type of blanks selected for retouching were flakes (n=31; 57%), followed by fragmented flakes (n=16; 30%), flake fragments (n=5; 9%) and chunks (n=2; 4%) in smaller proportions respectively. The majority of the pieces have unifacial retouch (n=52; 96%) with only n=2 (4%) pieces showing a bifacial retouch.

Regarding the extent of retouch found along the edge of the flakes, retouched pieces with

≤25% extent of retouch predominate in the tool assemblage (n=23; 46%), followed by pieces with >25 to ≤50% (n=12; 24%), >50% to ≤ 75% extent (n=10; 20%), and >75 to ≤100% extent (n=5; 10%) respectively. These data suggest that the retouched tool assemblage does not have an extensive degree of retouching.

Although the sum of the individual number of retouched pieces analysed is 50, the total number of shaped edges analysed is 70, as represented in Table 5.86. The majority of the retouch is located on both sides of the pieces (n=55; 78%). The left side is the predominant side with extensive retouch (n=31; 44%), followed by the right side (n=24; 34%), and the distal (n=15; 21%) area in smaller proportions.

Semi-abrupt retouch angles (n=31; 44%) are the dominant angles present in this assemblage, followed by simple angles (n=23; 33%) and abrupt angles (n=16; 23%).

With regard to the extent of retouch on the dorsal/ventral surfaces, marginal retouch is the most represented (n=45; 64%), followed by extensive retouch (n=16; 23%) and very marginal retouch (n=9; 13%). In relation to the depth of retouch on the dorsal/ventral surfaces, marginal retouch prevails with (n=46, 66%), followed by deep retouch (n=16; 23%) and very marginal (n=8, 11%).

The predominant direction of retouch is direct (n=49; 49%), with inverse (n=10; 10%), alternate (n=6; 6%) and alternating (n=5; 5%) being less represented.

The delineation of the retouched edge is predominantly continuous (n=49; 70%), followed by denticulate retouch (n=17; 24%), encoche retouch (n=3; 4%) and non-continuous (n=1; 1%) being less represented. The data obtained by these two attributes are in direct correlation with the type of tools within assemblage: scrapers and denticulates.

Regarding the morphology of the retouched edge, the sinuous type is the most common (n=36; 51%), followed by convex (n=15; 21%), straight (n=12; 17%), and finally concave (n=7; 10%).



RETOUCHED TOOL



TYPES OF BLANK						
Levels	Raw material	Flakes	Fragmented flake	Fragment of flake	TOTAL	%
UA-UG	Flint	30	11	9	50	100
TOTAL		30	11	9		
%		60	22	18		

FACIAL ATRIBUTE					
Level	Raw material	Unifacial	Bifacial	TOTAL	%
UA-UG	Flint	39	11	50	100
TOTAL		39	11	50	
%		78	22		

EXTENSION							
Level	Raw material	≤ 25%	>25 ≤50%	>50 ≤75%	>75 ≤100%	TOTAL	%
UA-UG	Flint	23	12	10	5	50	100
TOTAL		23	12	10	5	50	
%		46	24	20	10		

LOCALITATION						
Level	Raw material	Left	Distal	Right	TOTAL	%
UA-UG	Flint	31	15	24	70	100
TOTAL		31	15	24	70	
%		44	21	34		

ANGLE						
Level	Raw material	Abrupt	Semi abrupt	Simple	TOTAL	%
UA-UG	Flint	16	31	23	70	100
TOTAL		16	31	23	70	
%		23	44	33		

DEEP OF RETOUCHED ON SURFACE						
Level	Raw material	Very marginal	Marginal	Extensive	TOTAL	%
UA-UG	Flint	9	45	16	70	100
TOTAL		9	45	16	70	
%		13	64	23		

DEEP OF RETOUCHED ON EDGE						
Level	Raw material	Very marginal	Marginal	Deep	TOTAL	%
UA-UG	Flint	8	46	16	70	100
TOTAL		8	46	16	70	
%		11	66	23		

DIRECTION							
Level	Raw material	Direct	Inverse	Alternate	Alternating	TOTAL	%
UA-UG	Flint	49	10	6	5	70	100
TOTAL		49	10	6	5	70	
%		70	14	9	7		

DELINEATION							
Level	Raw material	Continuous	Non continuous	Denticulate	Encoche	TOTAL	%
UA-UG	Flint	49	1	17	3	70	100
TOTAL		49	1	17	3	70	
%		70	1	24	4		

MORPHOLOGY							
Level	Raw material	Straight	Convex	Concave	Sinuous	TOTAL	%
UA-UG	Flint	12	15	7	36	70	100
TOTAL		12	15	7	36	70	
%		17	21	10	51		

Table 5.86. Retouched tools analysis.

Following the Laplace typology (Table 5.87), the retouched tools are grouped into three main groups: scrapers (n=35), denticulates (n=21), and Mousterian points (n=1).

Amongst the scrapers, there is a similar proportion of side scrapers with abrupt retouch (R21) (n=15; 26%) and side scrapers with marginal retouch (R1) (n=11; 19%). Less represented are the side-transverse scrapers R23 (n=7; 12%) and R22 (n=2; 4%).

Amongst the denticulates, the marginal denticulate retouch D11 (n=7; 12%) is predominant, followed by D22 (n=6; 11%) and D13 (n=5; 9%). Less represented are the D1 (n=1; 2 %), D21 (n=1; 2%) and D23 (n=1; 2%).

Within the tool assemblage analysed one Mousterian point was documented.

LAPLACE TYPOLOGY												
Level	**Raw material**	**R1**	**R21**	**R22**	**R23**	**Mousterian Point**	**D1**	**D13**	**D22**	**D23**	**TOTAL**	**%**
UA-UG	**Flint**	11	12	2	7	1	7	5	4	1	50	100
TOTAL		11	12	2	7	1	7	5	4	1	50	
%		22	24	4	14	2	14	10	8	2		

Table 5.87. Laplace Typology

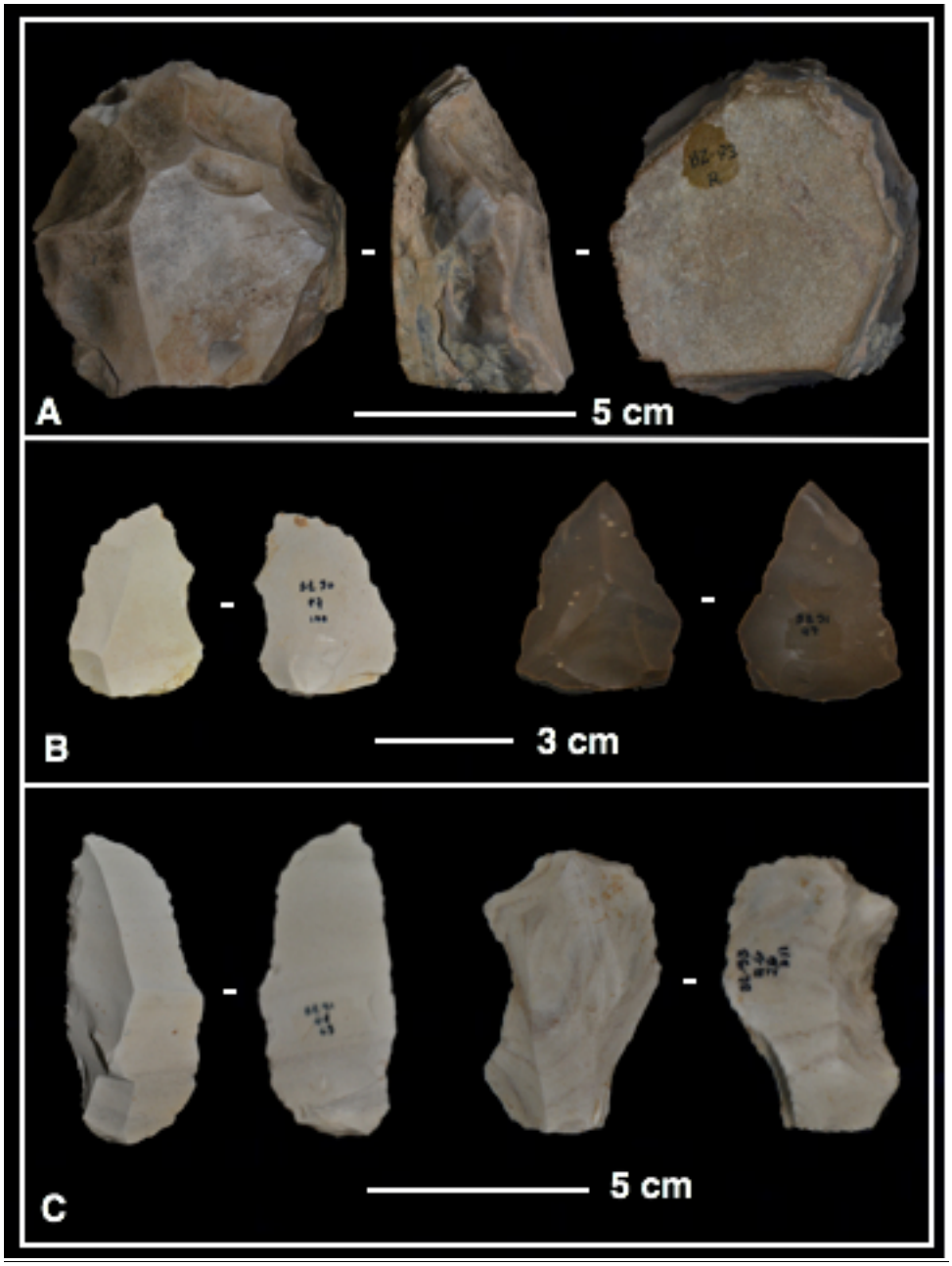


Figure 5.47. Detail of some lithic artefacts: A. Core, B. Flakes, and C. Retouched tools.

5.3.4. GORHAM´S CAVE

5.3.4.1 Location

Gorham´s Cave is located on the eastern side of the Rock of Gibraltar, on the shores of the Sea Mediterranean, at the base of an impressive cliff within the area locally referred to as Governor´s Beach. Its length is approximately 100m, with an entrance approximately 35m high and 30m wide at its base. The cave follows the conformation of a vertical fracture, with an east-west orientation, thus facilitating the development of a dome-shaped top cone (Díaz del Olmo 1994). The cave is silted up by a heterogeneous detrital filler of 17 m of depth, made up of sand, breccias, concretionary levels, stalagmite columns, etc.



Figure 5.48.View of Gorham´s Cave.

5.3.4.2. Geological Setting

The Rock of Gibraltar is a large Jurassic carbonate block, long and narrow and with a N-S orientation. Its length is 5.2 km and its average width is 1.6km, with a total area of 6km^2. Its maximum height is 424m (Rose & Rosenbaum 1991). The genesis of the Rock is due to

the action of a tectonic accident that caused its elevation from the Pliocene to the present (Rodríguez-Vidal 2001). The dynamic modelling processes that caused the Rock´s formation are: the coastal dynamics and the development of the slopes linked to the sea level. These processes are controlled by the tectonic structure in the Mesozoic limestone series that serves as bedrock. The karst morphology according to Rodríguez Vidal & Gracia (2000) is strongly influenced by the exo-karstic evolution; in addition this also influences the endo-karstic evolution. The eastern side of the Rock has always been prone to aggressive sea erosion of its cliffs, which has resulted, over time, in a complex of large caves (including Gorham´s) forming along the shoreline.

5.3.4.3. Historical Background

Gorham´s Cave was first discovered in 1907 by A. Gorham, but was promptly forgotten about until 1945, when George Baker Alexander carried out a thorough geological survey of Gibraltar. Alexander also carried out the first excavations at Gorham´s Cave, although his work was not approved by the Gibraltar Museum Committee. New excavations were subsequently carried out from 1950 to 1954 by John D´Arcy Waechter (Waechter 1951,1964), followed by a sounding conducted at the bottom of the inner gallery during the late 1950s. Other interventions were carried out by G. Palao in 1968 and D. Devenish in 1969 (Gutierrez *et al* 2001). A new phase of the research of archaeological investigation began in 1989 when Christopher B. Stringer of the Natural History Museum of London, in collaboration with Jill Cook of the British Museum and Joaquin Bensusan, the then Gibraltar Museum director, conducted a small survey in Gorham's Cave. Unfortunately this project did not develop any further and was abandoned (Stringer 2012). In 1990, multidisciplinary investigation at Gorham´s Cave resumed, once again led by the co-direction of Christopher Stringer, together with Nick Barton and Clive Finlayson, with work during 1995-1997 focusing on revisiting Waechter´s excavations. The investigation of the outer area of the cave was published by Barton *et al* (2012). In 1997, the investigative project expanded to include Francisco Giles and Joaquín Rodríguez-Vidal, and new excavations were carried out towards the rear of the cave. Their initial results were subsequently published (Finlayson *et al* 2006).

5.3.4.4. Stratigraphic Sequence

The stratigraphic sequence of the outer area spans more than 17 m in depth. The deposit consists primarily of sand, interstratified with occasional clayey and/or stalagmitic layers. The sand deposit is the result of aeolian transport and deposition of sand, from an extensive coastal dunes that migrated during MIS 3 high-stand substages and/or cold, arid periods. The clayey and stalagmitic levels show relatively high levels of organic residues, associated with conditions of warm temperatures and humidity (Barton 1988; Jiménez-Espejo *et al* 2013).

ZEUNER (1963) & WAECHTER (1961,1964)	CURRANT (2012)
	Bem 17 (16,18-16,01) earth
	USFm 12 (16, 05-15,90) stalagmite
A (17,40-17,30) EARTH +Stal 4 Holocene	CHm 34 (15,96-15,54) cemented stony hearths, pseudo-pebbles in CHm.3
B (17,30-17,10) cemented sand & angular limestone UP	
D (17,10-16,80) sand & charcoal & "pebbles" mid-way UP	
E (16,80-16,70) cemented light sand (but less than lower beds), limestone lenses, organic matter UP	UBSm 180 (15,58-13,75) bioturbated sands
(16,70-16,60) cementation "Stal 3"	
F (16,60-16,20) banded well sorted medium sand, cemented with minor limestone lenses at top UP in upper	
G (16,20-15,45) streaky, slightly sticky sand, silty well sorted medium sand at top MP	
H (15,45-15,00) yellow sand, basal cementation & angular rock fragments	BeSm OSsm 110 (14,08-12,66) orange bedded sand
(15,00-14,90) cementation "Stal 2"	
J (14,90-14,70) touch brown clayey silty/sand, phosphate, at top; softer & sandier & orange below	
(14,70-14,65) thin hard crust, composed largely of sand, "Stal 1"	BeSm PLSm 30+ (12,69 - 12,36) pale loose bedded sand
K (14,65-14,15) tough, dark sand, minor limestone lenses Common MP	
L (14,15-13,75) rather stony, clean yellow sand, widely cemented	
M (13,75-13,10) dark sand Common MP	LBSm 135 (12,44-11,30) bioturbated sands, fine/coarse facies
N/O (13,10 -12,40) clean sand with anguar limestone gravel	
P (12,40-12,30) darker sand, rising inwards MP	SSLm Usm 110 (11,74-10,32) sand & stony lenses, upper
Q (12,30-12,00) clean yellow sand, minor limestone lenses at top	
R (12,00-11,00) light yellow sand, sticky dark lenses, pebbles, patches of fallen stalagmite, fine angular limestone lenses in upper part	SSLm Lsm 112 (11,17-9,65) sand & stony lenses, lower
SI (11,00-10,60) dark, rather tough clayey sand	
SII (10,60-10,35) interstratified light/dark sand	VSSm 55 (10,05-9,12) variegated sands & silts
SIII (10,35-9,90) sticky brown sandy clay	
T (9,90-9,70) cemented bed, shell & bone	RSSm 112 (9,55-8,20) reddish sits & sands
U (9,70-down) "fine" beach sand (but much coarser than above), while wth black grains, MP	
	CSSm 165 (8,82-6,98) carbonate sands & silts
	CSm (7,00 down) coarse sands

Table 5.88. Stratigraphic sequence of Gorham´s Cave (outer sector) according to Zeuner (1953) & Waechter (1951, 1964), Collcutt & Currant (2012), taken from Barton et al (2012).

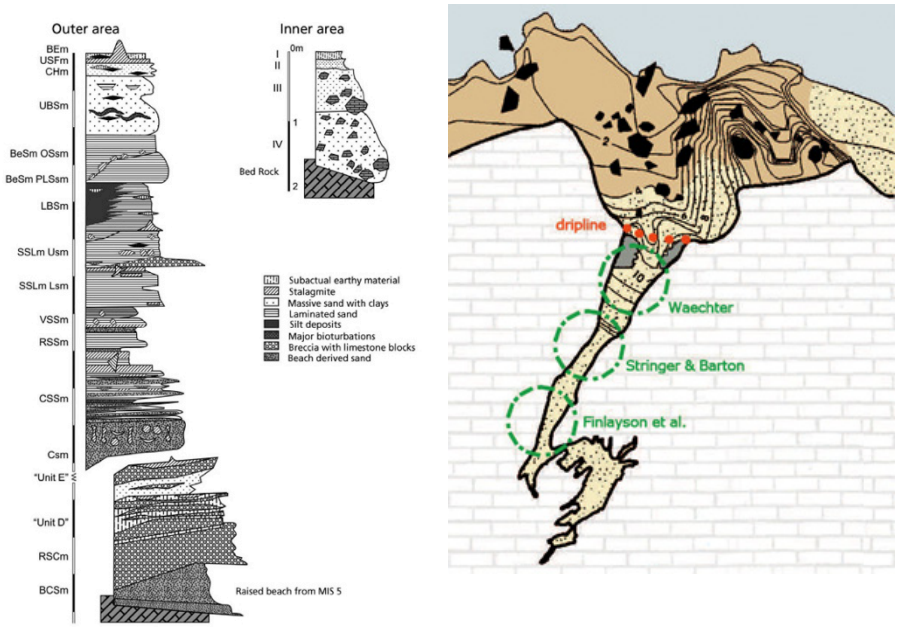


Figure 5.49. Stratigraphic profile of Gorham´s Cave (left) and map with different areas of excavations (right) (Barton et al 2012).

5.2.4.5. Dating

The cave has been extensively dated, using a myriad of different methods, and with multiple samples derived from all archaeological units, throughout its archaeological investigation (Tables 5.89 and 5.90). The Groningen Laboratory analysed three charcoal samples attributed to Level G, which Waechter assigned to the last Mousterian layer during his excavations, resulting in dates of 49, 200 ± 3,200 BP (GrN-1556), 47,700 ± 1,500 BP (GrN-1473) and 47,000 BP (humic fraction) (GrN-1678) (Waechter 1964, Oakley 1964).

From the excavations in the inner area, Finlayson *et al* (2006), presented the results of 30 AMS dates from individual fragments of charcoal samples taken from levels IV and III. The 22 AMS dates from Level IV offer dates between 33 and 23 ka BP. According to these authors, these dates indicate a Neanderthal occupation of the site until at least 28 ka BP and possibly as recent as 24 ka BP. The date of 28 ka BP is a much more conservative date, extensively corroborated by other evidence.

According to Higham *et al* (2012), the latest radiocarbon dates, of between ca 29 and 51 ka BP, obtained from UBSm.7 and BeSm.1 and the dates from the underlying layers LBSmff.1-5 ca 42 and 56 ka BP, pose a problem. They suggest that most of the charcoal fragments could have been derived from lower stratigraphic sequence of the Middle Palaeolithic levels in Gorham´s Cave, having been disturbed by bioturbation and taphonomic factors. This further complicates the interpretation of the Late Middle Palaeolithic in the south of the Iberian Peninsula.

Project manager	LEVEL	AMS 14C	U/th OSL	ESR EU	ESR LU	Sample field	Lab. Ref.
Finlayson	Inside of the cavity L-IV	24,01 ± 0,32				Charcoal	Beta-196775
		32,56 ± 0,78				Charcoal	Beta-196771
Barton, Stringer & Finlayson	Area I Ctx.24 & Ctx.16 transition	32,28 ± 0,42				Charcoal	OxA-7857
	Area I Ctx. 18	42,2 ± 1,1				Charcoal	OxA-7791
		23,8 ± 0,6				Charcoal	OxA-7979
	Area I Ctx. 18/19	42,8 ± 2,1				Juniperus/Tetraclinis	OxA-8542
	Area I Ctx. 19	31,9 ± 1,4				Charcoal	OxA-8541
		43,8 ± 1,3				Juniperus/Tetraclinis	OxA-8525
		47,9 ± 2,1				Pistacea sp.	OxA-205
		46,7 ± 1,9				Pistacea sp.	OxA-8526
	Area I Ctx. 22b/hearth	45,3 ± 1,7				Charcoal	OxA-6075
			26,5 ± 5,0			Sediment	JR95 GorOSL3
	Area I Ctx. 22b			39,4 ± 5,0	39,5 ± 5,0	Tooth of Goat	Gor ESR 49
				35,0 ± 4,0	43,6 ± 5,0	Tooth of Equus	Gor ESR 43
	Area I Ctx. 22d	51,7 ± 3,3				Charcoal	OxA-7790
	Area I A98/B98		50 ± 9			Sediment	Gor OSL 2
	Area III D18		57 ± 21			Sediment	Gor OSL 1
Waechter	G	49,2 ± 3,2				Charcoal	GrN-1556
		47,7 ± 1,5				Charcoal	GrN-1473
		47				Charcoal	GrN-1678
				29,7 ± 4,4	33,1 ± 5,1	Tooth	Muestra 1
				23,6 ± 1,9	26,3 ± 2,3	Tooth	Muestra 2
	K			32,7 ± 2,7	36,2 ± 2,3	Tooth	Muestra 5
				36,4 ± 3,4	41,3 ± 4,1	Tooth	Muestra 6
				32,5 ± 6,7	37,4 ± 7,9	Tooth	Muestra 7
				32,8 ± 2,8	6,3 ± 3,3	Tooth	Muestra 9
	M			34,8 ± 3,0	41,3 ± 3,9	Tooth	Muestra 15
				29,5 ± 2,6	34,1 ± 3,1	Tooth	Muestra 18
				29,0 ± 2,9	33,0 ± 3,5	Tooth	Muestra 21
	P			31.1 ± 2,5	36,1 ± 3,1	Tooth	Muestra 24
				20,7 ± 1,2	25,9 ± 1,7	Tooth	Muestra 31
				27,5 ± 2,9	32,8 ± 3,6	Tooth	Muestra 33
	R			56,5 ± 4,9	62,4 ± 5,1	Tooth	Muestra 7
			97,1 ± 1,3			Calcite	JR95 GOR MSUS5?1
			96,1 ± 0,9			Calcite	JR95 GOR MSUS5?2
	PG-39 (beach)		81,0 ± 0,9			*¿Venus sp?* (SA)	PG-39
	PG-40 (beach)		53,8 ± 0,5			Pelecipodo (SA)	PG-40
	GO-ST-2		15,3 ± 1,4			Speleothem	

Table 5.89. Dating from Gorham´s Cave, taken from Cortés (2007); Waechter (1951); Oakley (1964); Waechter (1964); Díaz del Olmo (1994); Barton et al (1999); Pettit & Bailey (2000); Barton (2000); Rink et al (2000); Finlayson et al (2006).

LEVEL	DATING (Barton et al. 2012) AMS	OSL
UBSm.4	35-32 ka BP	
UBSm.6	38-35 ka BP	38 ka BP
UBSm.7	48-43 ka BP	
BeSm (Ossm).1	62-40 ka BP	
BeSm (Ossm).2 & (PLSsm).3		48 ka BP
LBSmff.1		
LBSmff.2		
LBSmff.4 & LBSmcf.2	51 ka BP	
LBSm cf.4, mcf.5, mcf 6 & mcf 7	55-45 ka BP	
LBSmff.8 &LBSmcf.9		
LBSmff.10 & LBSmcf.11		
LBSmff.11 & LBSmcf.12		
LBSmcf.13		
SSLm (Usm).1		
SSLm (Usm).2		
SSLm (Usm).3		
SSLm (Usm).4		
SSLm (Usm).5		67 ka BP
SSLm (Usm).6		

Table 5.90. Dating from Gorham´s Cave (Barton et al 2012)

5.3.4.6. Archaeological Record

The Middle Palaeolithic levels are characterised by a rich collection of stone tools, a wide array of faunal remains, including mammals, birds, fish, molluscs, amphibians, and reptiles, as well as burnt nuts and charcoal.

In terms of the macro-mammals, two ungulate species predominate - *Cervus elaphus* and *Capra ibex* – (Currant *et al* 2012), whereas the small mammal assemblage is dominated by five species through the sequence – *Oritolagus cuniculus, Apodemus sylvaticus, Eliomiys quercinus, Microtus brecciencis* and *Terricola duodecimcostatus* (López-García *et al.* 2011). In addition, a significant assemblage of bird remains was recovered in the different excavations (seabirds, ducks, partridges, waders, pigeons, swifts, crows…).

A staggering 9,850 lithic pieces were documented during the Waechter excavations of the outer stratigraphic sequence during 1950-1954 (Waechter 1951, 1964), of which 9,074 pieces were found within the Middle Palaeolithic levels (G, K, M, P, R, S1, T and U). During the excavations conducted by Barton, Stringer and Finlayson (1995-1998) a total of 1757 pieces were documented from Middle Palaeolithic levels (UBSm.4 to SSLm.(Lsm).6) (Barton *et al* 2012), with the knapping method mainly following discoidal and centripetal recurrent Levallois reduction sequences. Within the inner areas of the cave, a total of 222 pieces were documented from Level IV, corresponding to a Mousterian technocomplex (Giles *et al* 2012; Shipton *et al* 2013). The retouched tools of the different assemblages show a predominance of side-scrapers and denticulates.

5.3.4.7 Lithic Assemblage

The data for this site were derived from lithic analyses carried out as part of my Master´s thesis, which has subsequently been published (Bernal 2012, 2015; Shipton *et al* 2013), as well as a collection of 847 pieces recovered during the Waechter excavations (1951,1964) and those carried out by Barton, Stringer and Finlayson (Barton *et al* 2012). This collection is currently housed at the Gibraltar Museum.

Raw Material

All the lithic assemblages recovered from the different areas of the cave come from

autochthonous raw materials found in the fossil beach deposits near the caves, from alluvial deposits of the Guadarranque or Palmones River, within a maximum radius of 17km, and from the layers of flint embedded within the Jurassic units of the rock, although only a few pieces were identified as originating from this source. Analysis of the cortex from different lithic pieces shows a preference towards secondary deposits from specific catchment areas.

It is important to note that the metrics of the flakes could be conditioned by size of the raw pebbles used, especially in the case of flint, as they are predominantly in the form of rounded pebbles and small cobbles. Today, many of them can still be seen embedded within the beach breccias.

Pieces recovered from Levels G-S (Waechter 1951, 1964), and Area I-III (Stringer *et al* 2000, Barton *et al* 2012), suggest flint as the predominant raw material (62%), followed by sandstone (37%), and in lesser proportions, limestone (1%) and quartz (0.24%) (Figure 5.50).

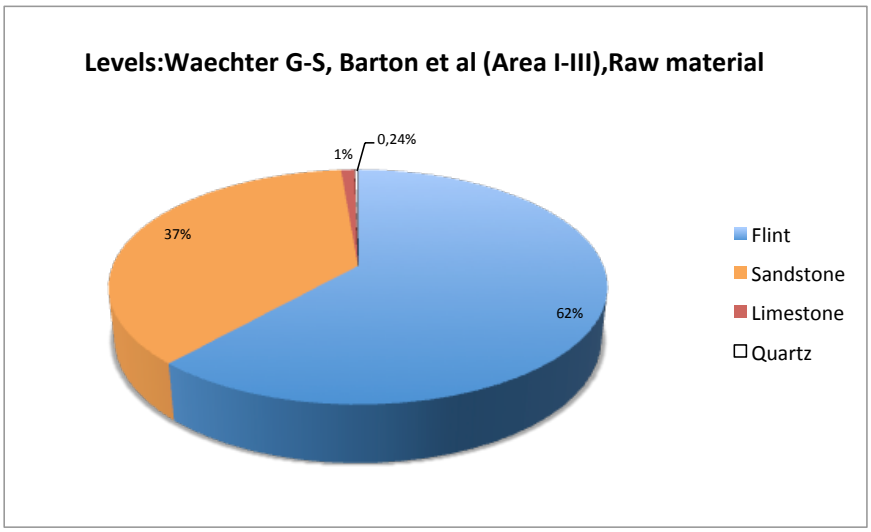


Figure 5.50. Raw material from Levels G-S (Waechter 1951, 1964) and Area I-III (Stringer et al 2000, Barton et al 2012).

Technical Categories

The bulk of the assemblage is composed of flakes (n=357; 42%), followed by fragmented flakes (n=175; 21%), fragment of flakes (n=157; 19%) and debris (n=117; 14%) whereas natural bases (n=22; 3%) and cores are limited (n=19; 2%) (Figure 5.51 and Table 5.91). Knapping products predominate in the assemblage, suggesting that the knapping strategy employed at the site was orientated towards the systematic production of flakes.

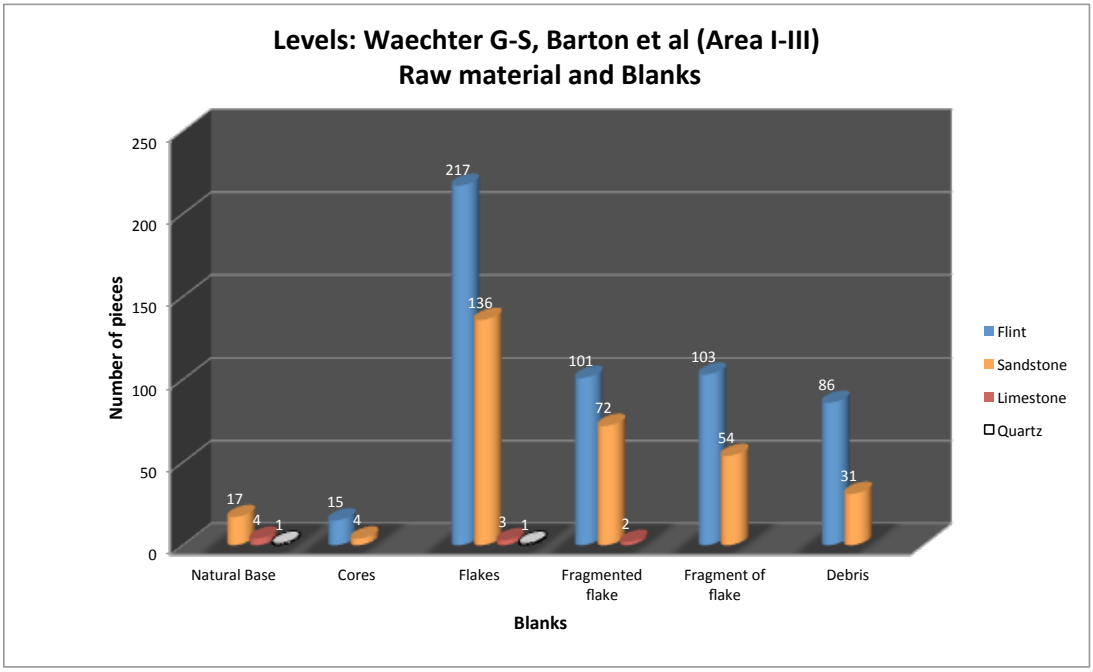


Figure 5.51. Raw material and blanks from Levels G-S (Waechter 1951, 1964) and Area I-III (Stringer et al 2000, Barton et al 2012).

	Natural Base	Cores	Flakes	Fragmented flake	Fragment of flake	Debris	TOTAL	%
Flint		15	217	101	103	86	522	62
Sandstone	17	4	136	72	54	31	314	37
Limestone	4		3	2			9	1
Quartz	1		1				2	0,2
TOTAL	22	19	357	175	157	117	847	
%	3	2	42	21	19	14		100

Table 5.91. Raw material and blanks from Levels G-S (Waechter 1951, 1964) and Area I-III (Stringer et al 2000, Barton et al 2012).

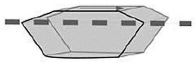
Analysis of cores

A total of 19 cores were identified with flint cores being the most abundant (n=14; 74%), followed by sandstone (n=5; 26%). Only three (16%) pieces do not present any cortex, with the rest of the cores presenting some cortex (n=5; 26%) pieces with ≤ 25% cortex, and 11 (58%) pieces with >25 and ≤50% of cortex over their surfaces (Table 5.92).

Regarding the stage of knapping sequence represented, a large proportion of the cores (n=13; 68%) are in the terminal stage, followed by 3 (16%) cores in the early stage and 3 (16%) in the exploitation stage of the reduction. This shows that there was an intense degree of exploitation of the cores (Table 5.92).

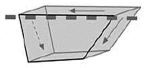
Analyses of the exploitation of surfaces show that the assemblage is divided into two types of reduction strategies: bifacial (n=10; 53%) and unifacial (n=9; 47%). Regarding the knapping strategies the centripetal strategy (n=16; 84%) dominates, while the multidirectional reduction strategy is identified in fewer cores (n=3; 16%) (Table 5.92).

The predominant method of knapping represented is centripetal recurrent Levallois (n=16; 84%) followed by a few examples of Discoidal (n=3; 16%) (Table 5.92).



ANALYSIS OF CORES





AMOUNT OF CORTEX						
Level	**Raw material**	**0%**	**≤ 25%**	**>25 ≤50%**	**TOTAL**	**%**
Waechter G-S	**Flint**	3	4	7	14	74
Barton Stringer (Area I-III)	**Sandstone**		1	4	5	26
TOTAL		3	5	11	19	
%		16	26	58		

STAGE OF KNAPPING SEQUENCES						
Level	**Raw material**	**Initial**	**Exploitation**	**Terminal**	**TOTAL**	**%**
Waechter G-S	**Flint**	2	2	10	14	74
Barton Stringer (Area I-III)	**Sandstone**	1	1	3	5	26
TOTAL		3	3	13	19	
%		16	16	68		

FACIAL ATTRIBUTE					
Level	**Raw material**	**Bifacial**	**Unifacial**	**TOTAL**	**%**
Waechter G-S	**Flint**	8	6	14	74
Barton Stringer (Area I-III)	**Sandstone**	2	3	5	26
TOTAL		10	9	19	
%		53	47		

STRATEGIES OF KNAPPING					
Level	**Raw material**	**Centripetal**	**Multidirectional**	**TOTAL**	**%**
Waechter G-S	**Flint**	11	3	14	74
Barton Stringer (Area I-III)	**Sandstone**	5		5	26
TOTAL		16	3	19	
%		84	16		

METHOD OF KNAPPING					
Level	**Raw material**	**Discoidal**	**Levallois**	**TOTAL**	**%**
Waechter G-S	**Flint**	3	11	14	74
Barton Stringer (Area I-III)	**Sandstone**		5	5	26
TOTAL		3	16	19	
%		16	84		

Table 5.92. Analysis of cores.

Morphometrically, the cores have a mean length of 42mm, a mean width of 37mm and a mean thickness of 18mm with a mean surface area of 1626mm^2. These measurements indicate that, on average, the cores are of small size (Table 5.93).

		Length	Width	Tchickness	Area
Number of cores		19	19	19	19
Mean		42	37	18	1626
Mode		45	40	17	1600
Median		45	38	17	1656
Maximum value		65	61	26	3965
Minimum value		26	20	8	520
Kurtosis		0,1	2	-0,8	4
Standard deviation		10	9	5	776
Percentile	25	36	34	14	1056
	50	45	38	17	1656
	75	48	41	22	1928

Table 5.93. Metric measures of the cores.

A scatter plot of the measurements (length and width) of the cores shows a concentration of points between 35mm x 50mm (length) and 30mm x 50mm (width) (Figure 5.52), reiterating that the majority of the cores are of small size.

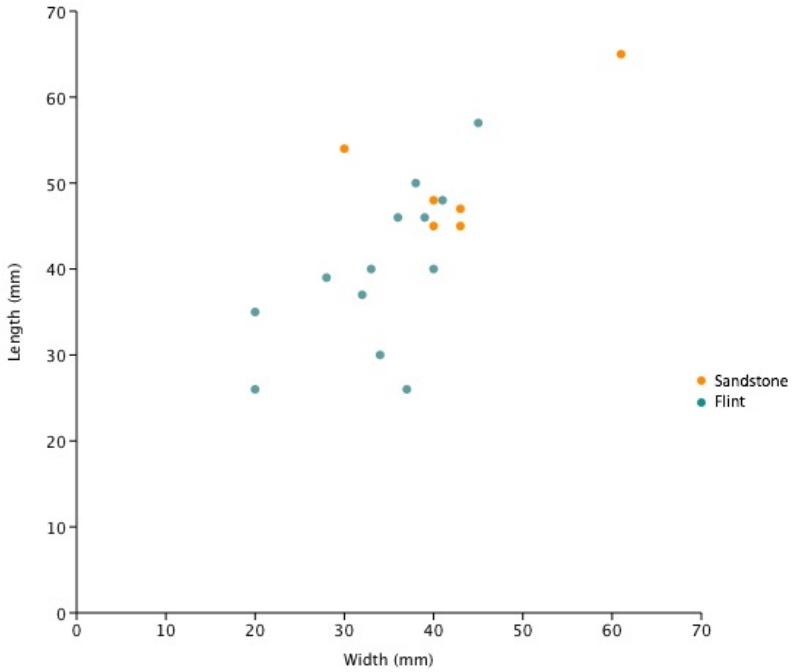


Figure 5.52. Scatter plot of the measurements of the cores.

The Flake Analyses

The flake assemblage is composed of 357 flakes and 332 flake fragments. For this reason we can consider that the obtaining of flakes was the main objective of the production sequence.

Ventral Face

Type of Bulb

Regarding the types of bulb present, the flake assemblage is dominated by the pronounced type (n=214; 60%) while the diffuse type is represented by 143 (40%) pieces (Table 5.94). In relation to the delineation of the ventral face we can see diversity; concave (n=138; 39%) is dominant, followed by straight (n=122; 34%) and sinuous delineation (n=73; 20%), while fewer pieces show convex delineation (n=20; 6%) (Table 5.94).

Butt

Regarding butt surfaces, the assemblage is almost entirely non-cortical (n=333; 93%), with only n=24 (7%) showing cortex (Table 5.94). Platforms are the most frequently represented type of butt (n=301; 84%), while the other categories of linear (n=29; 8%), puntiform (n=26; 7%) and cortical (n=25; 7%) butt are present in smaller numbers (Table 5.94).

The preparation of butts is characterised by a frequent presence of plain (n=147; 41%), followed by multifaceted (n=120; 34%) butts. The other categories occur at a lesser frequency: not faceting (n=50; 14%) and dihedral (n=49; 14%) (Table 5.94).

Among the different types of delineation of butt, the most represented type is the sinuous (n=178; 50%) delineation, followed by straight (n=108; 30%), convex (n=22; 6%), uniangular (n=14; 4%), and concave (n=6; 2%) (Table 5.94).



VENTRAL FACE AND BUTT



Type of bulb					
Level	**Raw material**	**Marked**	**Difuse**	**TOTAL**	**%**
Waechter G-S	**Flint**	143	74	217	61
Barton Stringer (Area I-III)	**Sandstone**	70	66	136	38
	Limestone	1	2	3	1
	Quartz		1	1	0,3
TOTAL		214	143	357	
%		60	40		

Delineation of the ventral face							
Level	**Raw material**	**Sinuous**	**Convex**	**Concave**	**Straight**	**TOTAL**	**%**
Waechter G-S	**Flint**	51	8	86	72	217	61
Barton Stringer (Area I-III)	**Sandstone**	26	12	49	49	136	38
	Limestone			3		3	1
	Quartz				1	1	0,3
TOTAL		73	20	138	122	357	
%		20	6	39	34		

Corticality of butt					
Level	**Raw material**	**Cortical**	**No cortical**	**TOTAL**	**%**
Waechter G-S	**Flint**	17	200	217	61
Barton Stringer (Area I-III)	**Sandstone**	6	130	136	38
	Limestone	1	2	3	1
	Quartz		1	1	0,3
TOTAL		24	333	357	
%		7	93		

Type of butt							
Level	**Raw material**	**Platform**	**Linear**	**Puntiform**	**Cortical**	**TOTAL**	**%**
Waechter G-S	**Flint**	168	19	13	17	217	61
Barton Stringer (Area I-III)	**Sandstone**	109	8	13	6	136	38
	Limestone	1	1		1	3	1
	Quartz		1			1	0,3
TOTAL		301	29	26	25	357	
%		84	8	7	7		

Facets of butt							
Level	**Raw material**	**Plain**	**Bifaceted**	**Multifaceted**	**nf**	**TOTAL**	**%**
Waechter G-S	**Flint**	89	26	85	17	217	61
Barton Stringer (Area I-III)	**Sandstone**	73	22	35	6	136	38
	Limestone	1	1		1	3	1
	Quartz				1	1	0,3
TOTAL		147	49	120	50	357	
%		41	14	34	14		

Delineation of butt										
Level	**Raw material**	**Sinuous**	**Convex**	**Concave**	**Straight**	**Uniangular**	**Cortical**	**Indeterminate**	**TOTAL**	**%**
Waechter G-S	**Flint**	120	10	3	61	6	17		217	61
Barton Stringer (Area I-III)	**Sandstone**	57	11	3	46	8	6	5	136	38
	Limestone	1	1				1		3	1
	Quartz				1				1	0,3
TOTAL		178	22	6	108	14	24	5	357	
%		50	6	2	30	4	7	1		

Table 5.94. Ventral face and butt analysis.

The analysis of the internal knapping angles of 357 flakes indicates a mean of 105°, mode of 95° and median of 120°. These data suggest a preference for obtuse angles (Table 9).

Angle of knapping		
Number of flakes		357
Mean		105
Mode		95
Median		102
Maximum value		178
Minimum value		85
Kurtosis		2,70
Standard deviation		12,19
Percentile	25	95
	50	102
	75	112,3

Table 5.95. Angle of knapping of the total of the flakes.

Dorsal Face

Regarding degree of cortex on the dorsal surface, the majority of flakes (n=258; 72%) do not present any cortex, with 55 (15%) presenting less than 50% cortex on their surfaces and 19 (5%) pieces presenting more than 50% cortex; only 4 (1%) are fully cortical flakes (Table 5.96). The presence of cortical pieces suggests that the primary reduction of the pebbles also took place inside the cave.

The direction of scars is highly diverse, with three categories being highly represented: multidirectional (n=220; 62%), centripetal (n=62; 17%), unidirectional (n=55; 15%) with the bidirectional category (n=8; 2%) being far less frequently represented (Table 5.96).



DORSAL FACE

Amount of cortex							
Level	**Raw material**	**0%**	**≤50%**	**>50%**	**100%**	**TOTAL**	**%**
Waechter G-S Barton Stringer (Area I-III)	**Flint**	153	53	9	2	217	61
	Sandstone	103	22	9	2	136	38
	Limestone	1	1	1		3	1
	Quartz	1				1	0,3
TOTAL		258	55	19	4	357	
%		72	15	5	1		

Direction of scars								
Levels	**Raw material**	**Centripetal**	**Unidirectional**	**Bidirectional**	**Multidirectional**	**Indeterminate**	**TOTAL**	**%**
Waechter G-S Barton Stringer (Area I-III)	**Flint**	43	27	7	135	5	217	61
	Sandstone	19	26	1	84	6	136	38
	Limestone		1		2		3	1
	Quartz		1				1	0,3
TOTAL		62	55	8	220	11	357	
%		17	15	2	62	3		

Table 5.96. Dorsal face analysis.

With regard to the number of scars, the flakes have a mean of 6 scars, a mode of 5, and median of 5. This is indicative of high reduction intensity because the scars show the previous removals and a mean of 6 scars on the dorsal face is consistent with a high degree of reduction (Table 5.97)

Number of scars		
Number of flakes		357
Mean		6
Mode		5
Median		5
Maximum value		16
Minimum value		1
Kurtosis		0,9
Standard deviation		3
Percentile	25	4
	50	5
	75	7

Table 5.97. Number of scars of the flakes.

Morphometrically, the flakes have a mean length of 35mm, a mean width of 28mm and a mean thickness of 8mm, with both the mode and the median being similar. The mean surface area is 1113 mm^2. These measurements indicate that, on average, pieces are of a small size. The elongation index shows an average of 1, indicating that there is no laminar tendency in the assemblage. The flattening index shows an average of 4 meaning that the

flakes are very thin (Table 5.98).

	Length	Width	Tchickness	Area	Elongation index	Flattening index
Number of flakes	357	357	357	357	357	357
Mean	35	28	8	1113	1	4
Mode	31	30	10	120	1	3
Median	34	28	8	995	1,2	3
Maximum value	83	58	26	4180	4	11
Minimum value	7	6	1	72	0,3	0,5
Kurtosis	-0,22	-0,58	1	0,73	3,5	4
Standard deviation	16	11	4	790	0,5	1,3
Percentile 25	22	19	5	459	1,0	2,7
50	34	28	8	995	1,2	3,3
75	46	36	10	1550	1,5	4,2

Table.5.98. Measures of the flakes.

A scatter plot of the measurements (length and width) of flakes shows a concentration of points between 10mm x 60mm (length) and 5mm x 55 mm (width) for this assemblage (Figure 5.53) further confirming that the majority of the flakes are small and predetermined.

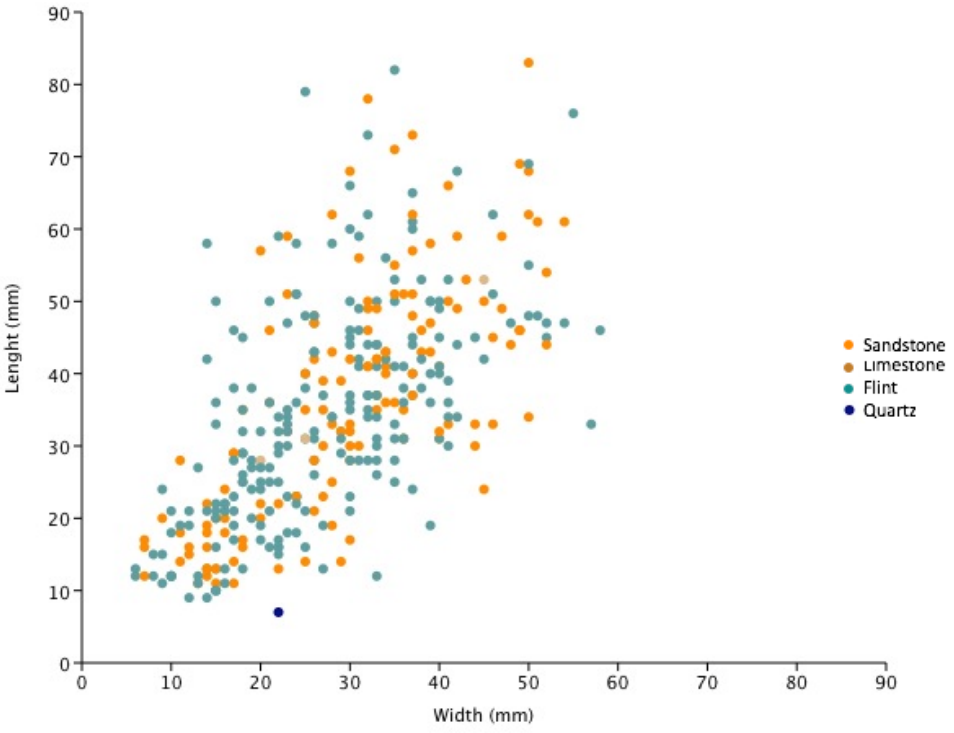


Figure 5.53. Scatter plot of the measurements of the flakes.

Retouched pieces

A total of 57 retouched pieces were studied from levels G-S (Waechter 1951, 1964) and Area I-III (Stringer *et al* 2000, Barton *et al* 2012)(Table 5.99). The type of blanks that were selected for retouching are flakes (n=41; 72%), followed by fragmented flakes (n=8; 14%), and flake fragments (n=8; 14%) in smaller proportions respectively. The majority of the pieces have unifacial retouch (n=45; 79%) with only 12 (21%) pieces showing bifacial retouch.

Regarding the extent of retouch found along the edge of the flakes, retouched pieces with ≤25% extent of retouch predominate in the tool assemblage (n=25; 44%), followed by pieces with >25 to ≤50% (n=18; 32%), >50% to ≤ 75% (n=9; 16%), and >75 to ≤100% (n=5; 9%) respectively. I can conclude that the retouched tools assemblage does not have an extensive degree of retouching.

Although the sum of the individual number of retouched pieces analysed equalled 57, the total number of shaped edges analysed was 86, as represented in Table 5.99. The majority of the retouch is located on both sides of the pieces (n=71; 83%). The left side is the predominant side with extensive retouch (n=36; 42%), followed by the right side (n=35; 41%), the distal area (n=11; 13%), and the proximal area (n=4; 5%) in smaller proportions.

Simple retouch angles (n=34; 40%) are the dominant angles present in this assemblage, followed by semi-abrupt angles (n=38; 44%) and abrupt angles (n=14; 16%).

With regard to the extent of retouch on the dorsal/ventral surfaces, marginal retouch is the most represented (n=38; 44%), followed by very marginal retouch (n=27; 31%), extensive retouch (n=19; 22%) and very extensive retouch (n=2; 2%). In relation to the depth of retouch on the dorsal/ventral surfaces, marginal retouch prevailing with (n=37, 43%), followed by very marginal (n=34, 40%) and deep retouch (n=15, 17%).

The predominant direction of retouch is direct (n= 54; 63%), with inverse (n=17; 20%), alternate (n=11; 13%) and alternating (n= 4, 5%) being less represented.

The delineation of the retouched edge is predominantly continuous (n=57; 66%), with denticulate retouch (n=24; 28%), and non-continuous (n=5; 6%) less well represented. The data obtained by these two attributes are in direct correlation with the type of tools found

within this assemblage: scrapers and denticulates.

Regarding the morphology of the retouched edge, the sinuous type is the most common (n=64; 74%), followed by convex (n=10; 12%), straight (n=8; 9%), and finally concave (n=4; 5%).

RETOUCHED TOOL





TYPES OF BLANK

Level	Raw material	Flakes	ragmented flak	ragment of flak	TOTAL	%
Waechter G-S	**Flint**	28	6	7	41	72
Barton Stringer (Area I-III)	**Sandstone**	13	2	1	16	28
TOTAL		41	8	8	57	
%		72	14	14		

FACIAL ATRIBUTE

Level	Raw material	Unifacial	Bifacial	TOTAL	%
Waechter G-S	**Flint**	31	10	41	72
Barton Stringer (Area I-III)	**Sandstone**	14	2	16	28
TOTAL		45	12	57	
%		79	21		

EXTENSION

Level	Raw material	≤ 25%	>25 ≤50%	>50 ≤75%	>75 ≤100%	TOTAL	%
Waechter G-S	**Flint**	16	11	9	5	41	72
Barton Stringer (Area I-III)	**Sandstone**	9	7			16	28
TOTAL		25	18	9	5	57	
%		44	32	16	9		

LOCALITATION

Level	Raw material	Left	Distal	Right	Proximal	TOTAL	%
Waechter G-S	**Flint**	29	10	25	4	68	79
Barton Stringer (Area I-III)	**Sandstone**	7	1	10		18	21
TOTAL		36	11	35	4	86	
%		42	13	41	5		

ANGLE

Level	Raw material	Abrupt	Semi abrupt	Simple	TOTAL	%
Waechter G-S	**Flint**	12	20	36	68	79
Barton Stringer (Area I-III)	**Sandstone**	2	14	2	18	21
TOTAL		14	34	38	86	
%		16	40	44		

DEEP OF RETOUCHED ON SURFACE

Level	Raw material	Very marginal	Marginal	Deep	Very deep	TOTAL	%
Waechter G-S	**Flint**	26	26	14	2	68	79
Barton Stringer (Area I-III)	**Sandstone**	1	12	5		18	21
TOTAL		27	38	19	2	86	
%		31	44	22	2		

DEEP OF RETOUCHED ON EDGE

Level	Raw material	Very marginal	Marginal	Deep	TOTAL	%
Waechter G-S	**Flint**	32	25	11	68	79
Barton Stringer (Area I-III)	**Sandstone**	2	12	4	18	21
TOTAL		34	37	15	86	
%		40	43	17		

DIRECTION

Level	Raw material	Direct	Inverse	Alternate	Alternating	TOTAL	%
Waechter G-S	**Flint**	44	11	10	3	68	79
Barton Stringer (Area I-III)	**Sandstone**	10	6	1	1	18	21
TOTAL		54	17	11	4	86	
%		63	20	13	5		

DELINEATION

Level	Raw material	Continuous	Non continuous	Denticulate	TOTAL	%
Waechter G-S	**Flint**	51	4	13	68	79
Barton Stringer (Area I-III)	**Sandstone**	6	1	11	18	21
TOTAL		57	5	24	86	
%		66	6	28		

MORPHOLOGY

Level	Raw material	Straight	Convex	Concave	Sinuous	TOTAL	%
Waechter G-S	**Flint**	8	8	4	48	68	79
Barton Stringer (Area I-III)	**Sandstone**		2		16	18	21
TOTAL		8	10	4	64	86	
%		9	12	5	74		

Table 5.99. Retouched tools analysis.

Following the Laplace typology (Table 5.100), the retouched tools are grouped into three main categories: scrapers (n=29), denticulates (n=25), and Mousterian points (n=3).

Amongst the scrapers, side scrapers with marginal retouch (R11) (n=22; 39%) prevail in the assemblage. Less represented are side scrapers with abrupt retouch (R21) (n=4; 7%), and the side-transverse scrapers R23 (n=2; 4%) and R22 (n=1; 2%).

Amongst the denticulates, the marginal denticulates D13 (n=9; 16%) and D11 (n=3, 5%) are predominant, followed by D21 (n=5; 9%), D23 (n=3; 5%), D22 (n=2; 4%), and D24 (n=2; 4%).

Within the tool assemblage analysed Mousterian points (n=3; 5%) and G11 (endscraper) (n=1; 2%) were documented.

LAPLACE TYPOLOGY															
Level	**Raw material**	**R11**	**R21**	**R22**	**R23**	**Mousterian Point**	**D11**	**D13**	**D21**	**D22**	**D23**	**D24**	**G11**	**TOTAL**	**%**
Waechter G-S	**Flint**	20	2	1	2	3	2	3	3	1	2	1	1	41	72
Barton Stringer (Area I-III)	**Sandstone**	2	2				1	6	2	1	1	1		16	28
TOTAL		22	4	1	2	3	3	9	5	2	3	2	1	57	
%		39	7	2	4	5	5	16	9	4	5	4	2		

Table 5.100. Laplace Typology.

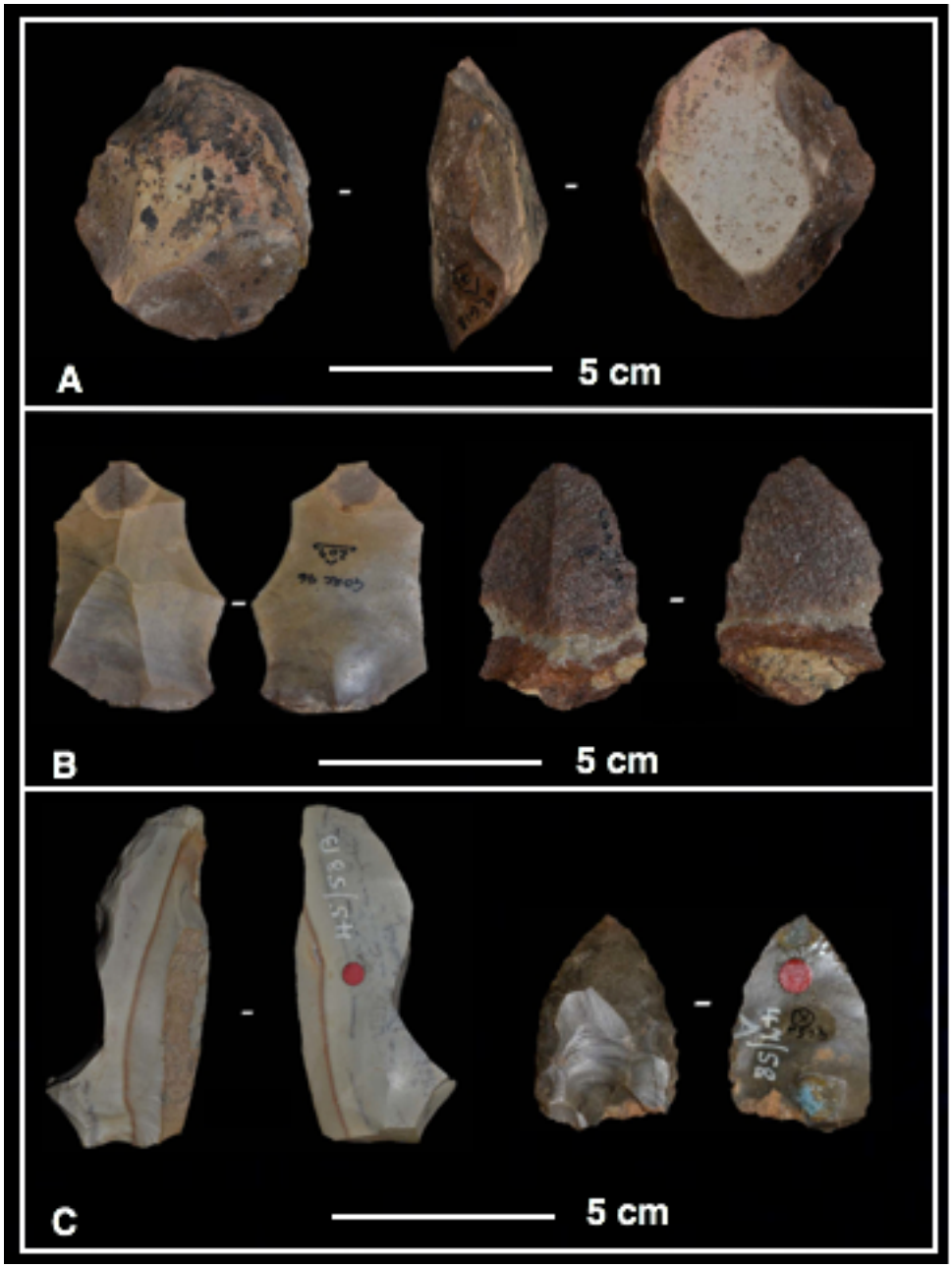


Figure 5.54. Detail of some lithic artefacts: A. Core, B. Flakes, and C. Retouched tools.

5.4. COMPARISON BETWEEN LITHIC ASSEMBLAGES FROM BETIC AND CANTABRIAN REGIONS.

In order to best address the objectives of this study (Chapter 3), regarding the technical behaviour of Neanderthals, a comparison between the lithic assemblages of the Betic and the Cantabrian regions was conducted. Particular focus was given to two variables *raw materials and technical categories from cores, flakes and retouched tools,* which could have a significant effect on the technological variability of the operating system employed within these regions.

5.4.1 Raw Material

Within both regions of study there is a great variety of lithic raw materials available, and this study has aimed to focus on establishing the ones most commonly used. The lithic artefacts recovered from Palaeolithic sites are the only definite proof available for establishing which raw materials were preferred by Neanderthal groups and their sources.

For this section, the aim is to provide an overview of the raw materials used by Neanderthals within both study areas in order to better understand the relationship between the raw materials used and their local availability. An extensive study into the mineralogical composition or the different variants of each raw material is not relevant here.

The raw materials used within each area are different for geological reasons. In the Betic region flint is the predominant raw material, whereas in the Cantabrian region quartzite, followed by flint, are the most commonly used raw materials.

Cantabrian Mountain System

From a geological point of view, the Cantabrian Mountain System originates from the convergence of two adjoining bedrock lithologies: the Palaeozoic to the west and the Mesozoic and Cenozoic to the east.

The raw materials documented in the Middle Palaeolithic sites within the Cantabrian

region are varied including quartzite, flint, sandstone, limestone, mudstone, quartz, ferruginous, and ophite.

Flint appears in different areas within the Cantabrian region: in the east, along the coast within Flysch (País Vasco y Cantabria), further inland along the southern mountains of the region Urbasa (Navarra) and Treviño (Álava), and in the western area as outcrops around Piloña (Asturias). A clear and distinct divide between the eastern and western territories of the Cantabrian mountain range, in terms of the availability of flint, has been well documented. However, according to Tarriño *et al* (2015) this needs to be reassessed, as flint outcrops have been newly discovered in some areas of the Western Cantabrian mountain range, such as Piloña in Asturias.

According to Tarriño (Tarriño 2001, *et al* 2015) the main flint source areas in the Cantabrian Region are:

Flysch: Located in different outcrops along the Cantabrian and Basque county coastlines, of differing geological age and environments: Jurassic Marine Platform Flint; Urgonian Recifal Platform flint (Lower Cretaceous), Upper Cretaceous Flysch Flint.

Urbasa: Located in the karst of the Sierra of Urbasa (Navarra). These flint units were formed in external marine platform environments from the Paleocene.

Treviño: Located south of Alava and north of Burgos. The flint outcrops are formed in lacustrine-palustrine environments, with compact limestones and dolomites.

Piloña: Located in the Oviedo Basin. Two types of flint have been identified, one Cenozoic (Piedramuelle´s flint) and the other Mesozoic (Piloña´s flint) (Tarriño *et al* 2013)

The quartzite usually originates as rolled pebbles, although in some areas it appears in veins. The presence of neocortex in many artefacts suggests the exploitation of secondary deposits in procurement areas along the river basin. Given its high quality and fine grain, this quartzite is frequently used as raw material in Middle Palaeolithic sites (Cabrera & Bernaldo de Quirós 1992). Quartz is also used for the production of lithic artefacts, mainly in Axlor (País Vasco), El Castillo (Cantabria), and Cova Eiros (Galicia), and was usually used for the production of small artefacts (De Lombera & Fábregas 2011). Quartz was also procured from secondary deposits along river basins.

When analysing the predominant raw material utilised in Middle Palaeolithic sites within the Cantabrian mountain system, two distinct patterns emerge: with quartzite predominating in the western area and flint in the eastern area (Figure 5.55).

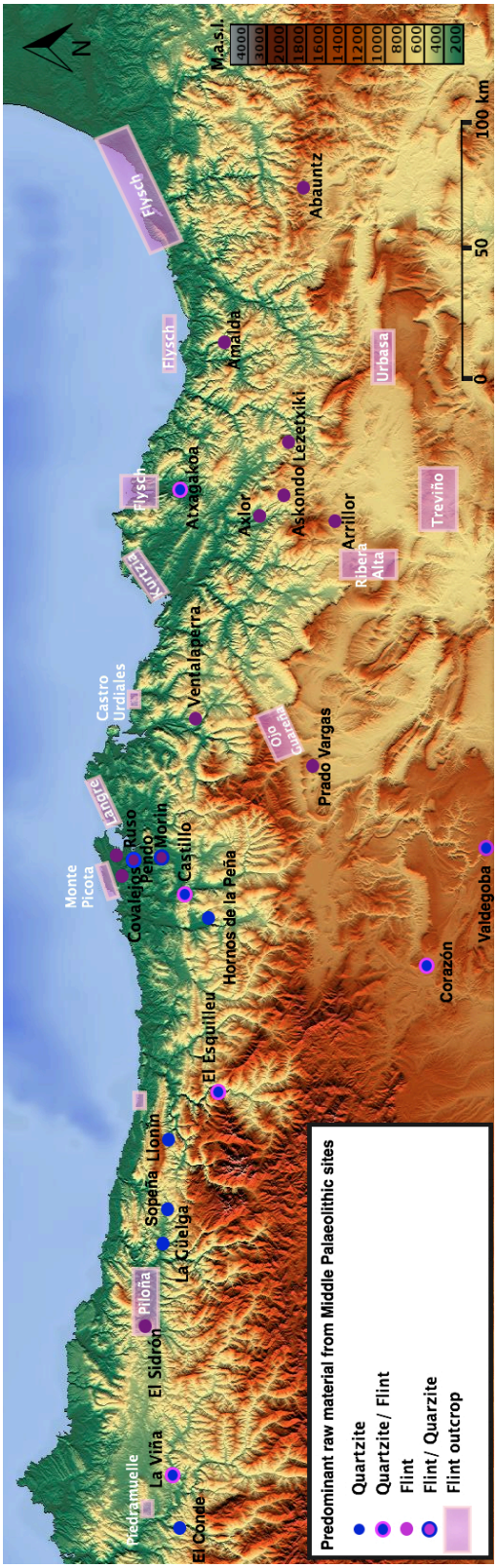
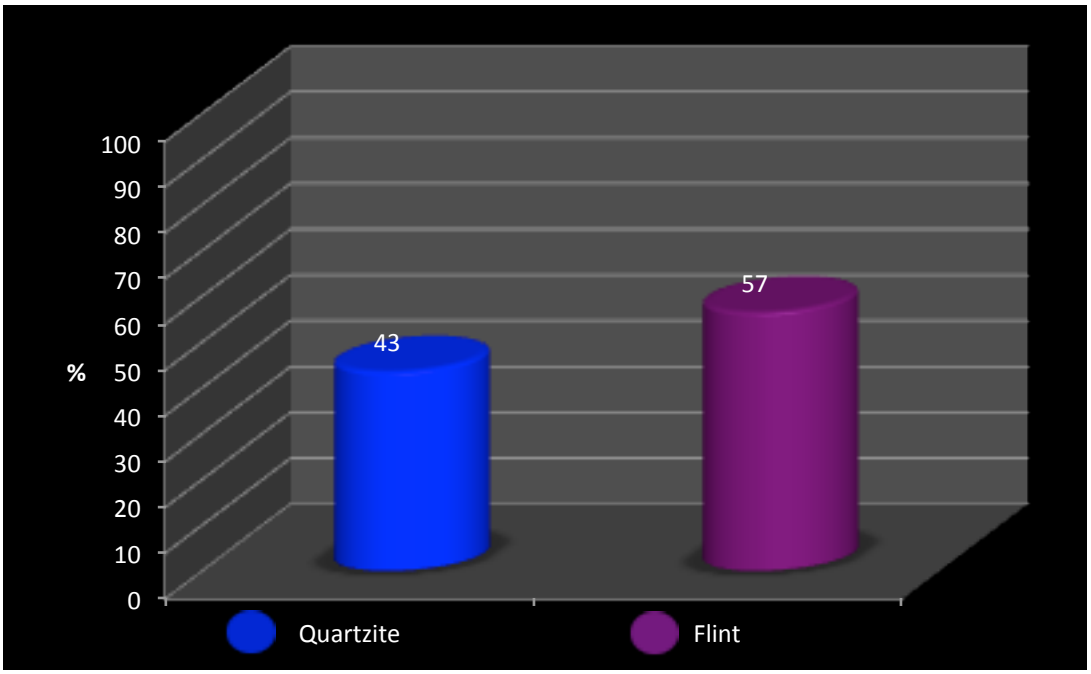


Figure 5.55. Map of principal raw materials sources in the Cantabrian region.

From 23 Middle Palaeolithic sites, there are 10 sites (43%) where quartzite is the predominant raw material used, all located within the western Cantabrian area (Figure 5.56 and Table 5.101). The sites are: El Conde, La Viña, La Güelga, Sopeña, Llonín, El Esquilleu, Hornos de la Peña, El Castillo, Cueva Corazón, and Valdegoba.

The remaining 13 sites (57%), for which flint is the dominant raw material used (Figure 5.56 and Table 5.101), are located in the eastern Cantabrian area. The sites are: Covalejos, El Ruso, El Pendo, Morín, Ventalaperra, Prado Vargas, Arrillor, Askondo, Axlor, Amalda, and Abauntz.



Predominant raw material	Quartzite	Flint	Total
Middle Palaeolithic Sites	10	13	23
%	43	57	100

Figure 5.56 and Table 5.101. Predominant raw material in the Middle Palaeolithic sites of the Cantabrian region.

The Betic Mountain System

The Betic Mountain System is formed by three large geological units (Vega Torres 2004); the external areas containing Mesozoic and Cenozoic material, the internal areas containing older materials from the Palaeozoic, and finally the *Campo de Gibraltar*

Complex from the Tertiary Era. The Betic region is one of the richest sources of flint in the Iberian Peninsula. The main source areas of flint are:

Area of Grazalema: located northeast from the province of Cádiz, it is formed by high mountains with carbonated lithologies (mudstones and dolomites) from the Jurassic to the Cretaceous period (Subbetic Units). It acts as the source of various river systems such as the Guadalete, Guadarranque and Palmones Rivers, providing them with lithological materials and therefore forming Quaternary fluvial-aluvial deposits, which contain and transport flint pebbles and other raw materials along their course towards their mouth (Ramos Muñoz *et al* 2006).

Turón area: located northwest of Málaga, it contains numerous documented outcrops of flint, primarily in the Sierra Llana, Sierra Valle of Abdalajís, Torcal of Antequera, Sierra of Humilladero, Sierra of Tablón, Sierras of Cañete Real and Sierra of Alcaparín. Within the Guadalteba region, there are various river systems, such as the Guadalhorce, Turón, Guadalteba and Corbones. As in the Grazalema systems, these rivers also form fluvial-aluvial deposits and transport raw materials through their courses, depositing them into larger areas such as the Guadalquivir Valley (from the Corbones River) and the Bay of Málaga (from the Guadalhorce River) for example. A distinctive type of black flint, characteristic of this area and sourced from the Turón River, has been documented in various Middle Palaeolithic sites within this area (Medianero *et al* 2012).

Alhama: Sierra de Alhama is a mountain range of the Penibetic System along the provinces of Málaga and Granada. This mountain range forms part of the Axarquia area, which in turn comprises different Sierras such as Jobo, Tejada, and Alhama. Various river sources are found here, such as Seco, Cueva, Guaro, Alcaucín, Bermuza, Almanchares and Rubite Rivers. All these rivers are tributaries of the Velez River (Yus 2005). According to Barroso *et al* (2003), different flint outcrops were documented in areas near Zafarraya Cave, such as Casa del Ferrocaril, Mesa de Zalia, Cerro López, Cerro del Pedernal, Marchamona, Alcolea, Alfarnate, and Navazo.

Pedernales: located northeast of Málaga, in the Cuevas de San Marcos area. Loma de los Pedernales is located near the Sierra del Camorro. According to Ramos Fernández (1982), an abundant outcrop of high quality flint was located in this area.

Milanos: this geological formation has been identified by the holostratotype present in the Arroyo Milanos in Loja (Granada). Its lithistratigraphic sequence has different sedimentary facies. In some areas, the flint within the facies "erupts" and become exposed to erosion, allowing nodules and tabular flint to be easily extracted. Some notable outcrops within this formation are Los Gallumbares (Loja), Cerro del Reloj (Montefrío), Puerto del Zegrí (Iznalloz), El Cuarterón (Iznalloz), Cerrillo de Orca (Píñar), and Carrizal (Píñar) (Morgado *et al* 2011)

Murcia: Flint is not an abundant raw material within the local geography of Murcia, where the lithology is varied, being composed of Palaeozoic materials, in particular slates, quartz, mica-schistos, and quartzites. Limestones and dolomites are also present, giving rise to numerous rock-shelters, many of which were after occupied since the Middle Palaeolithic. Flint may be found forming inter-stratified nodules in the Sierra Espuña, Santa María, Lorca, and other places near the coast. The Quaternary alluvial deposits composed of materials that have been carried by the strong runoff are deposited in the river valleys such as the Segura basin or in the beds of the rambles, becoming excellent places to procure a variety of raw materials, without the need for long journeys (Martínez 1991, Zilhão & Villaverde 2008).

Alicante: this corresponds to the zone called Prebetic, located on the outermost northern rim of the Betics. It comprises a set of Cenozoic and Mesozoic terrains, essentially derived from marine facies. The siliceous formations are usually located in sedimentary rocks from a marine environment, integrated by limestone, marls, calcarenites, and micrites, in which the flint is normally present in nodular form and of a variable quality. Flint is also present within the detrital deposits formed by silting from the basins as a result of the erosion of the reliefs. A broad variety of flint has been documented in this region: Mariola, Serreta, Font Roja, Beniaia, Cámara, Escobella, Polop, Preventori, and Catamarruch (Molina *et al* 2014).

Other raw materials were also used in the Betic area during the Middle Palaeolithic, but to a much lesser extent. These include compact sandstone, quartzite, limestone and quartz.

Compact Sandstone: In the Campo de Gibraltar area, there is a region known as the "Aljibe", which dates to the Tertiary age (Miocene). The sandstone formation of Aljibe is

formed by sandstones of massive aspect, which are exclusively siliceous and have a whitish coloration. From these geological units, there are compact sandstone rocks that are formed by rounded small quartz grains. From the erosion of the reliefs, compact sandstone pebbles are present along the Palmones and Guadarranque rivers basins, as well as limestone and flint pebbles, though the latter are not as abundant. The archaeological record for the area shows that this local compact sandstone was the most abundant raw material used during the Palaeolithic (Mas Cornellá *et al* 1996, Gutiérrez-Mas *et al* 2016, Castañeda 2008).

Quartzite: Quartzite is relatively rare within the Betic region. In Andalucía, it is abundant in the Sierra Morena and gets transported, as a result of erosion, along the Guadalquivir River basin towards its mouth (Díaz del Olmo *et al* 1989, Vallespí & Díaz del Olmo 1996, Fernández Caro 1998).

Limestone: Limestone is abundant within the Betic region, and although this raw material was abundantly used during the Lower Palaeolithic its use as a raw material dwindled during the Middle Palaeolithic (Cortés *et al* 1996, Ramos Muñoz *et al* 2006, 2008, Castañeda 2008). There are some isolated examples of limestone exploitation, such as Anton cave (Murcia) for example, where there is documented exploitation of limestone as a raw material, sourced locally as river cobbles (Zilhão & Villaverde 2008). In general, however, the use of limestone as a viable raw material in Middle Palaeolithic sites throughout the Betic region was very scarce.

Quartz: Quartz is also used as a raw material in the production of lithic artefacts within the Betic region, but not heavily, being documented in less than 1% of all Middle Palaeolithic sites. There is only one example, in Aviones Cave (Murcia), where the lithic assemblage is composed mostly of quartz pieces, although these are often used as blanks for flakes, and never for retouched tools, with Neanderthals using non-local flint for type of tool, which were made from flint (Zilhão & Villaverde 2008).

From a total of 32 Middle Palaeolithic sites (Figure 5.57), there are 27 (85%) in which flint is the predominant raw material used in the production of lithic artefacts (Figure 5.58 and Table 5.102.). The archaeological sites include Higueral, Santiesteban, Higueral Guardia, Ibex, Gorham, Palomas, Bajondillo, Complejo del Humo, Tajo de Doña Ana, Zafarraya, Belda, Cholones, Mármoles, Murciélagos, Colomera, Puntal, Horá, Carihuela, Bedmar,

Zájara I, Sima de las Palomas, El Salt, Pastor, Beneito, Cochino, Cova Patxina, and Cova Negra.

Sites in which other raw materials predominate include: compact sandstone: Devil´s Tower, Vanguard Cave; quartzite: El Niño; quartz: Aviones; limestone: Anton. However, these are rare exceptions, establishing that flint was the predominant raw material exploited by Neanderthals within the Betic mountain system.

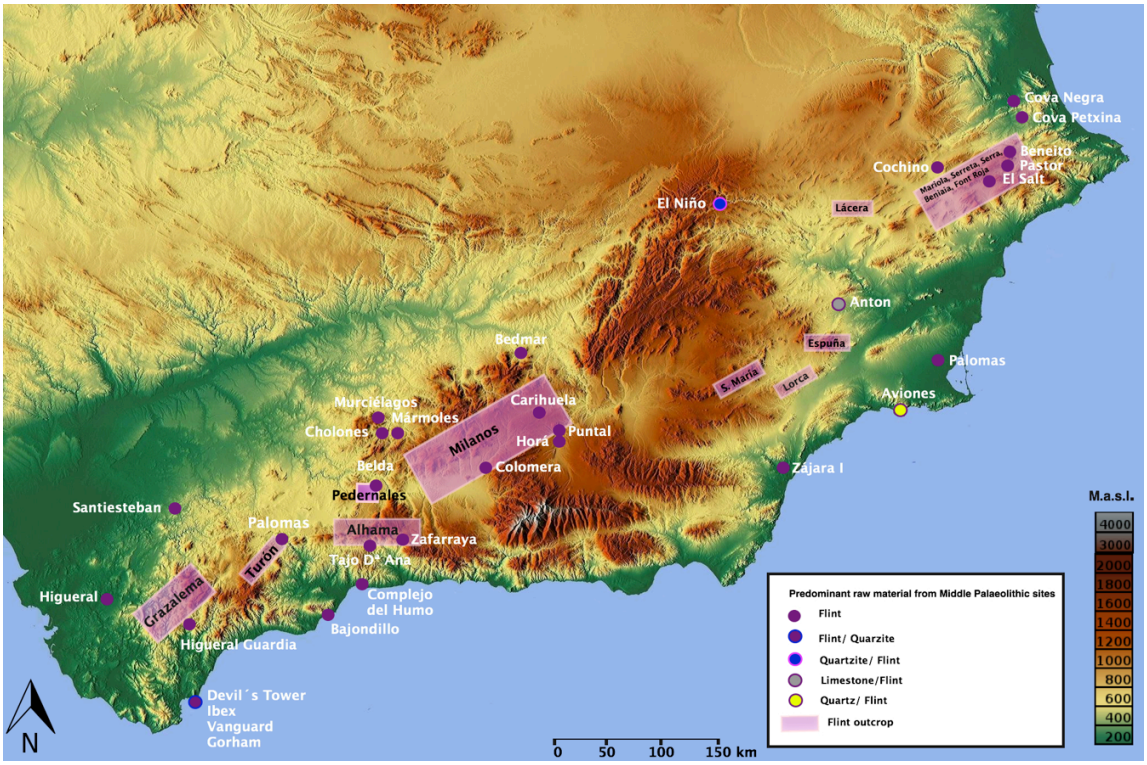
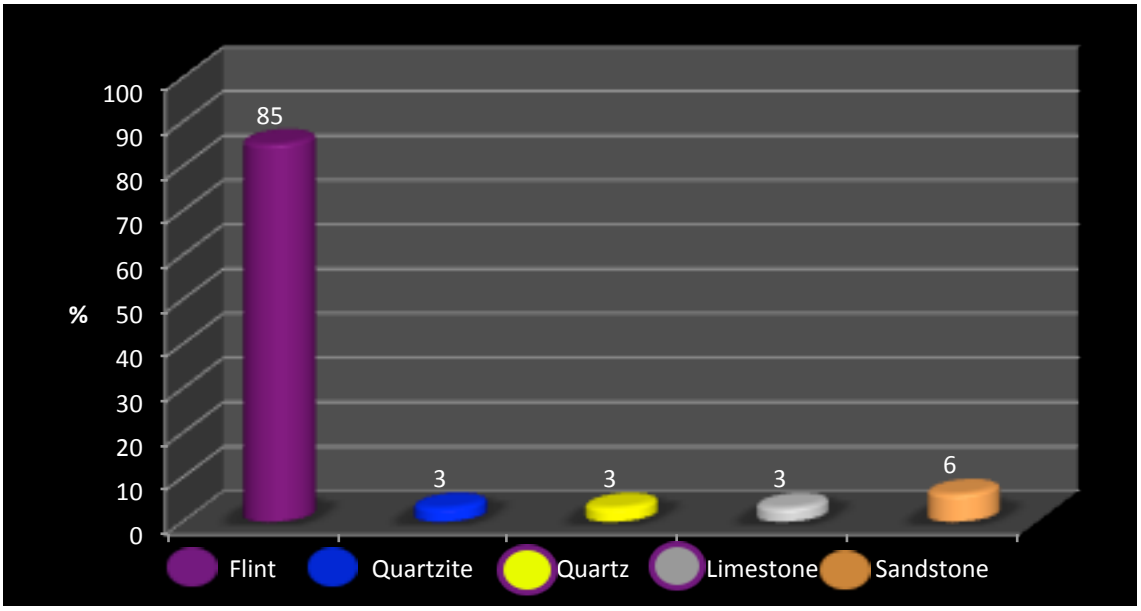


Figure 5.57. Map of principal raw materials sources in the Betic Region.



Predominant raw material	Flint	Quartzite	Quartz	Limestone	Sandstone	Total
Middle Palaeolithic Sites	27	1	1	1	2	32
%	85	3	3	3	6	100

Figure 5.58 and Table 5.102. Predominant raw material in the Middle Palaeolithic sites of the Betic region.

When comparing the eight Middle Palaeolithic sites detailed above (Figure 5.59), we see a distinct difference between both regions of study. The Cantabrian region offers a high variety of raw materials (mudstone, ferruginous, sandstone, and quartz), which were used frequently. Another significant pattern within this region is the west/east divide with a predominant use of quartzite in the western sites (Esquilleu, El Castillo) and a predominant use of flint in the eastern sites (Axlor). Within the Betic region, however, flint dominates the archaeological record, with other raw materials such as sandstones, quartzite, quartz and limestones used much more sporadically. The abundance of flint as raw material is documented for the sites analysed here, such as Abrigo 3, Carihuela, and Zafarraya, with Gorham´s Cave also documenting use of a large proportion of sandstone being used.

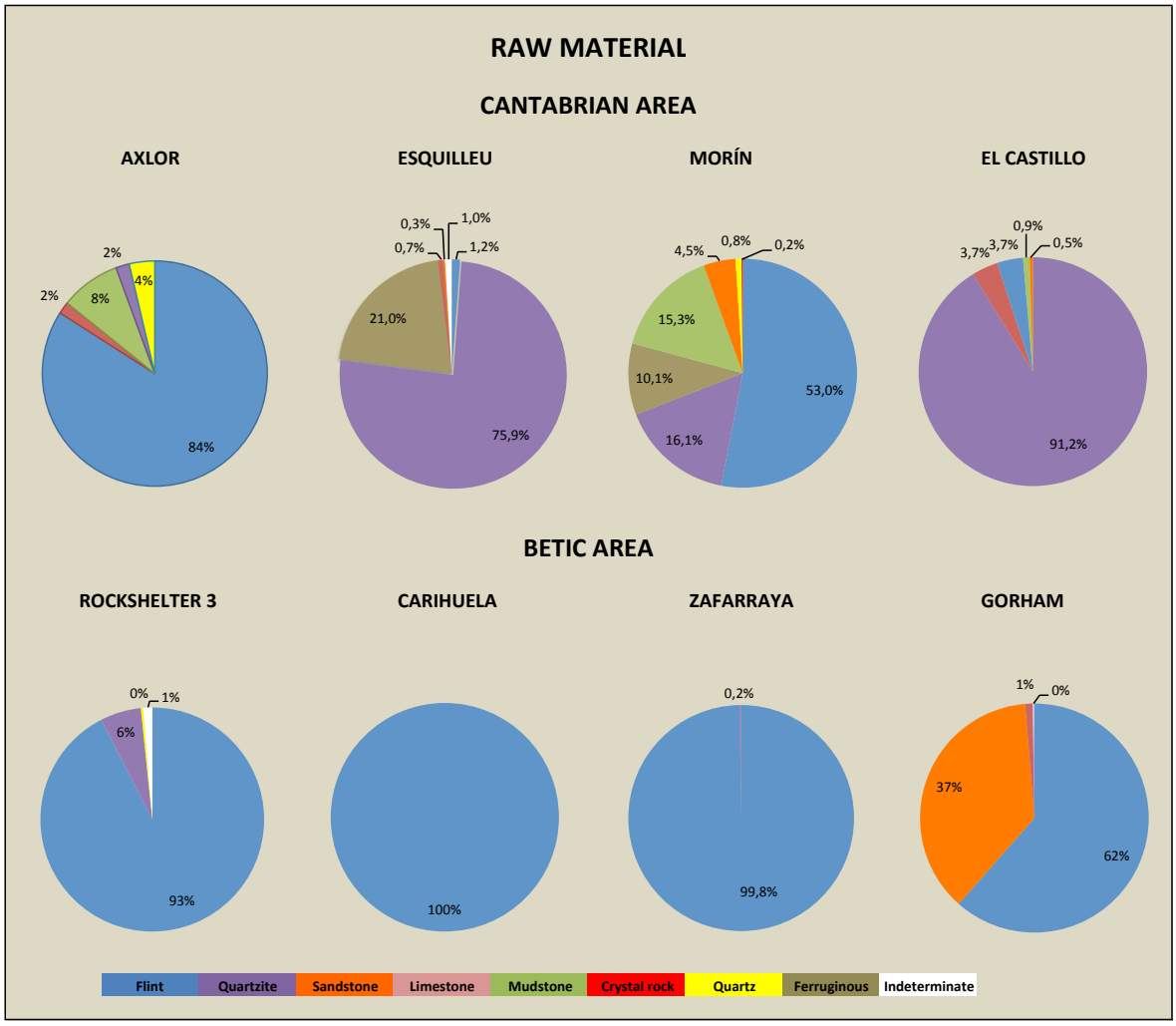


Figure 5.59. Pie chart of raw material from the Middle Palaeolithic sites studied from the Cantabrian and Betic regions.

The Neanderthals within the two regions of study exploited a variety of raw materials in their production of lithic artefacts, but this variety in exploitation depended on various interrelated factors. First, the geological and mineralogical composition of the local territory. This factor was imperative, as it dictated the presence or absence of raw material, its abundance or scarcity, its quality and the type of raw material available. All these factors conditioned which raw material was exploited by Neanderthals in the surrounding area. Second, the mobility of the group, which plays a significant role in the procurement of raw materials. Most researchers suggest that the majority of the raw material, exploited at the sites being analysed here, was procured from outcrops within a 20 km radius, corresponding to a maximum of a day´s walk. Another significant factor, is knowledge of the territory. Neanderthals had a great knowledge of potential raw material sources located

within fluvial deposits and of outcrops around the territory. They would also possess knowledge of optimal catchment areas around their campsites.
The accessibility of these outcrops around the territory was another significant factor in their procurement. Finally, their individual preferences, in the type of raw material best suited for the type of tool they wanted to produce, or the application of a particular knapping method, would all have played a significant role in choosing a particular raw material.

All these factors are important for understanding Neanderthal strategies and their choice of lithic resources.

Similarities

The data obtained from the two study regions indicate that the Neanderthals generally employed an opportunistic strategy, exploiting locally available raw materials. One notable exception is sites such as Axlor in the Basque Country, where raw material was procured from distant sources.

On the catchment of raw materials, by the Neanderthals within both regions, they were mainly obtained from secondary or derived positions, from gravel areas and alluvial deposits, and from outcrops of siliceous materials with the presence of pebbles of different raw materials, which appear on the surface.

Where flint is sparse, we see within both regions a use of local, less preferred raw materials (quartzite, limestone, quartz). The same discoidal or Levallois methods were used, but with very low indices of retouched tools, mostly made up of denticulates and notches. In some sites, such as Axlor (Cantabrian region), or Aviones (Betic region), the Neanderthals brought in high quality flint in the form of tools. In the case of Axlor, the flint was introduced into the site in the form of retouched tools (sidescrapers with scalariform retouched, Quina retouched). In Aviones the absence of flint cores and the high values of the sidescrapers index replicate the situation at Axlor. This may reflect cultural preference, economizing behaviour or technological constraints.

I can conclude that within both regions there was a predilection for selecting the highest quality raw material best suited for its final purpose of curation and reduction, which explains the predominant use of flint and quartzite, despite the great variety of raw materials available within both regions.

Differences

There are no significant behavioural differences between the Neanderthals from both regions as they follow the same strategies of selection and procurement of raw materials. The only notable difference is the presence or absence, abundance or scarcity of different raw materials, as dictated by the geological and mineralogical conditions of the territories. These study regions differ due to their different origins, formation, and geological and mineralogical composition, despite both being within the same peninsula.

In conclusion, it should also be noted that the raw material used is the key factor in interpreting many technical aspects of a lithic assemblage. Its availability, quality, and size influences the method of knapping applied at the moment of the reduction of cores and in the final configurations of the tools of the lithic assemblages, both between the regions, and within the regions themselves.

5.4.2. Technical categories from cores, flakes and retouched tools

5.4.2.1. Descriptive Statistical Analysis

A descriptive statistical analysis was run on the assemblages studied in the Cantabrian and Betic regions in order to compare the late Mousterian lithic assemblages from Cantabrian and Betic regions, and quantify patterns of variability, similarities and differences within and between them. This analysis was carried out on three structural categories: cores, flakes, and retouched tools.

5.4.2.1.1.Cores

The study of the cores is a key part of understanding the reduction processes, with the caveat that cores only reveal the last phase of reduction. The reconstruction of knapping methods is therefore based on a combined assessment of the cores and the products from the debitage.

From a quantitative point of view (Figure 5.60) the metric measurements and the analysis of the area of the cores show a very similar average between the sites from both regions, (Cantabrian: length (mean: 51 mm; st.dev.: 18), width (mean: 41 mm; st.dev.: 15), thickness (mean: 27 mm; st.dev.: 11), area (mean: 2604 mm^2; st.dev.: 1758); Betic: length (mean: 55 mm; st.dev.: 16), width (mean: 46 mm; st.dev.: 10), thickness (mean: 29 mm; st.dev.: 9), area (mean: 2151 mm^2; st.dev.: 1336)). Only one site from each area (El Castillo and Zafarraya), shows a size significantly higher than the others. In general, the data suggest that the cores from both areas are of small size at the moment of their final usage.

In both regions the majority of the cores still retained some of their cortex at the point of abandonment (Figure 5.60) (Cantabrian: 0% (mean: 42%; st.dev.: 17), ≤25% (mean: 28%; st.dev.: 8), >25 to ≤50% (mean: 25%; st.dev.: 22), >50% to ≤ 75% (mean: 5%; st.dev.: 6); Betic: 0% (mean: 31%; st.dev.: 23), ≤25% (mean: 46 %; st.dev.: 30), >25 to ≤50% (mean: 23 %; st.dev.: 31)). In addition, in both areas the cores produced from local raw materials correspond with the pieces retaining the most amount of cortex.



MEASUREMENTS		Length	Width	Thickness
Cantabrian	Mean	51	41	27
	St. deviation	18	15	11
Betic	Mean	55	46	29
	St. deviation	16	10	9

AREA		Area
Cantabrian	Mean	2604
	St. deviation	1758
Betic	Mean	2151
	St. deviation	1336

AMOUNT OF CORTEX		0%	≤ 25%	>25 ≤50%	≤ 75%
Cantabrian	Mean	42	28	25	5
	St. deviation	17	8	22	6
Betic	Mean	31	46	23	0
	St. deviation	23	30	31	0

Figure 5.60. Bar charts of mean values for cores: measurements, area, amount of cortex.

From a qualitative point of view, I now turn to a comparison of the attributes of the cores in the lithic assemblages from both regions.

Regarding the stages of the knapping sequence (Figure 5.61), we observe that most of the cores from the both regions are in the terminal stage (Cantabrian: Terminal (mean: 77%; st.dev.: 33), Exploitation (mean: 21%; st.dev.: 27), Initial (mean: 3%; st.dev.: 6); Betic : Terminal (mean:62 %; st.dev.: 22), Exploitation (mean: 30%; st.dev.: 21), Initial (mean: 8%; st.dev.: 8)), with the exception of the two sites mentioned above, El Castillo (61%)(Cantabrian area) and Zafarraya (54%)(Betic area), which show a high percentage of

cores in the exploitation stage. This indicates that the Neanderthal groups exploited them to the maximum to obtain the greatest possible number of flakes from each core.

When looking at how the cores were reduced (Figure 5.61), we observe that bifacial reduction is predominant in both regions (Cantabrian: Bifacial (mean: 88%; st.dev.: 7), Unifacial (mean: 10%; st.dev.: 9), Trifacial (mean: 1%; st.dev.: 2) Globular (mean: 1%; st.dev.: 2); Betic : Bifacial (mean: 67%; st.dev.: 14), Unifacial (mean: 25%; st.dev.: 20), Trifacial (mean: 6%; st.dev.: 11) Globular (mean: 1%; st.dev.: 2)). We find that the knapping strategies employed were varied, but the most common strategy in both areas is the centripetal method (Cantabrian: Centripetal (mean: 74%; st.dev.: 18), Multidirectional (mean: 15%; st.dev.: 13), Unidirectional (mean: 5%; st.dev.: 5) Bidirectional (mean: 6%; st.dev.: 5); Betic: Centripetal (mean: 61%; st.dev.: 22), Multidirectional (mean: 12%; st.dev.: 10), Unidirectional (mean: 3%; st.dev.: 5), Ortogonal (mean: 3%; st.dev.: 5), Bidirectional (mean: 1%; st.dev.: 2)).

The method of knapping also varies in both regions (Figure 5.61). In the Cantabrian region the dominant method of knapping is discoidal, however there is one site that adopts the Quina method (Cantabrian: Discoidal (mean: 61%; st.dev.: 42), Quina (mean: 16%; st.dev.: 32), Levallois (mean: 3%; st.dev.: 6) Globular (mean: 1%; st.dev.: 2)). In the Betic region centripetal recurrent Levallois and discoidal are the predominant methods (Betic: Levallois (mean: 60%; st.dev.: 39), Discoidal (mean: 19%; st.dev.: 21), Quina (mean: 1%; st.dev.: 2), Globular (mean: 1%; st.dev.: 2)).



Figure 5.61. Bar charts of the attributes of cores.

A broader perspective on the methods of knapping in the study regions can be obtained by consulting the literature, despite the obvious caveats concerned with the application of a non-homogeneous methodology being applied at each of the sites. I have examined data from 16 Middle Palaeolithic sites from the Cantabrian region (Figure 5.62) including El Conde (Freeman 1977, Arzibu *et al* 2005), La Viña (Fortea 1999, Santamaría 2012, 2014), El Sidrón (Fortea *et al* 2003, De la Rasilla *et al* 2011), La Güelga (Menéndez & Martínez 1992, Menéndez *et al* 2005, 2009, 2014), Sopeña (Pinto *et al* 2006, 2012, 2014), El Esquilleu (Baena *et al* 2005, 2006, 2012, 2014), Hornos de la Peña (Carrión 2003), El Castillo (Cabrera 1984, Cabrera *et al* 2005, Sánchez & Bernaldo de Quirós 2008), Morin (González Echegaray *et al* 1971, 1973, González Echegaray & Freeman 1978, Maíllo-Fernández *et al* 2014), El Pendo (Freeman 1980, Montes & Sanguino 2001), Covalejos (Martín *et al* 2006, Sanguino & Montes 2005), Prado Vargas (Navazo *et al* 2005, 2008), Arrillor (Sáenz 2014), Axlor (Barandarián 1980, Baldeón 1999, Ríos-Garaizar *et al* 2003, 2007, González-Urquijo *et al* 2004, 2005, 2006, 2014, Frías 2012), Lezetxiki (Barandarián & Altuna 1966, 1970, Baldeón 1993, Arrizabalaga *et al* 2004, 2006, Lauzén & Altuna

2012) and Amalda (Ríos-Garaizar 2008). The data from these 16 sites are summarised in Figure 5.63. In 63% of them the discoidal method of knapping prevails as the most method used, followed by the Levallois method with 31% and the Quina method with 19%.

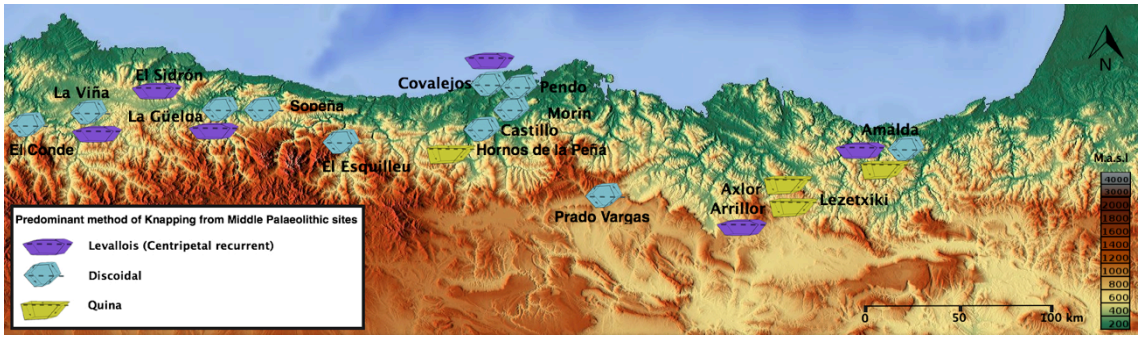


Figure 5.62. Map of the most common method of knapping of the Middle Palaeolithic sites in the Cantabrian region.

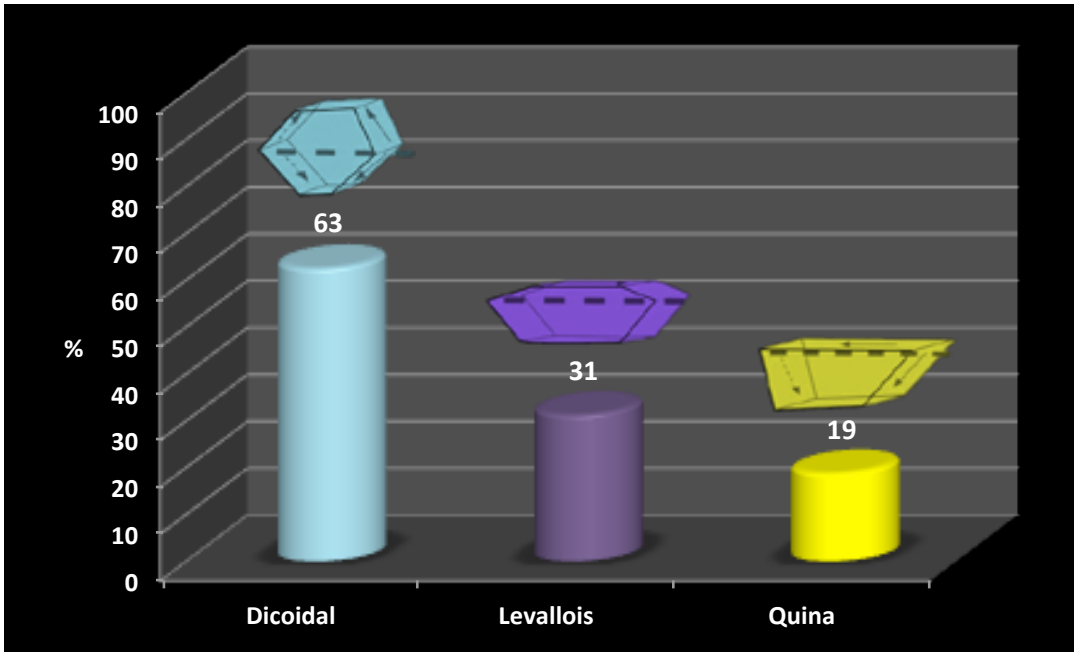


Figure 5.63. Bar chart of the most common type of cores in the Cantabrian region

I undertook a similar analysis from 26 Middle Palaeolithic sites in the Betic region (Figure 5.64). The sites include: Higueral de Valleja (Jennings *et al* 2009), Santiesteban (Fernández 2003), Higueral Guardia (Baena *et al* 2012), Gorham´s Cave (Waechter

1951,1964, Barton *et al* 2012), Palomas (Medianero *et al* 2012), Bajondillo (Cortés 2007), Complejo del Humo (Ramos Fernández *et al* 2012), Tajo de Doña Ana (Ramos Muñoz *et al* 1995), Zafarraya (Barroso 2003), Belda (Ramos Fernández 1982b), Murciélagos (Vera & Gavilán 1993), Colomera (Toro & Almohalla 1981), Puntal (Vega Toscano 1988), Horá (Botella *et al* 1983), Carihuela (Vega Toscano 1988), Bedmar (Solano pers. comm.), Zájara I (Vega Toscano 1980), Aviones (Montes 1991), Sima de las Palomas (Walker 2001), Anton (Martínez 1997), El Niño (García *et al* 2014), El Salt (Galván *et al* 2014), Pastor (Galván *et al* 2009), Beneito (Iturbe *et al* 1993), Cochino (Soler 1956) and Cova Negra (Villaverde *et al* 2014). The data are summarised in Figure 5.65 and show that 85% of the sites use the Levallois method of knapping, followed by the discoidal method with 35% and the Quina method with 4% .

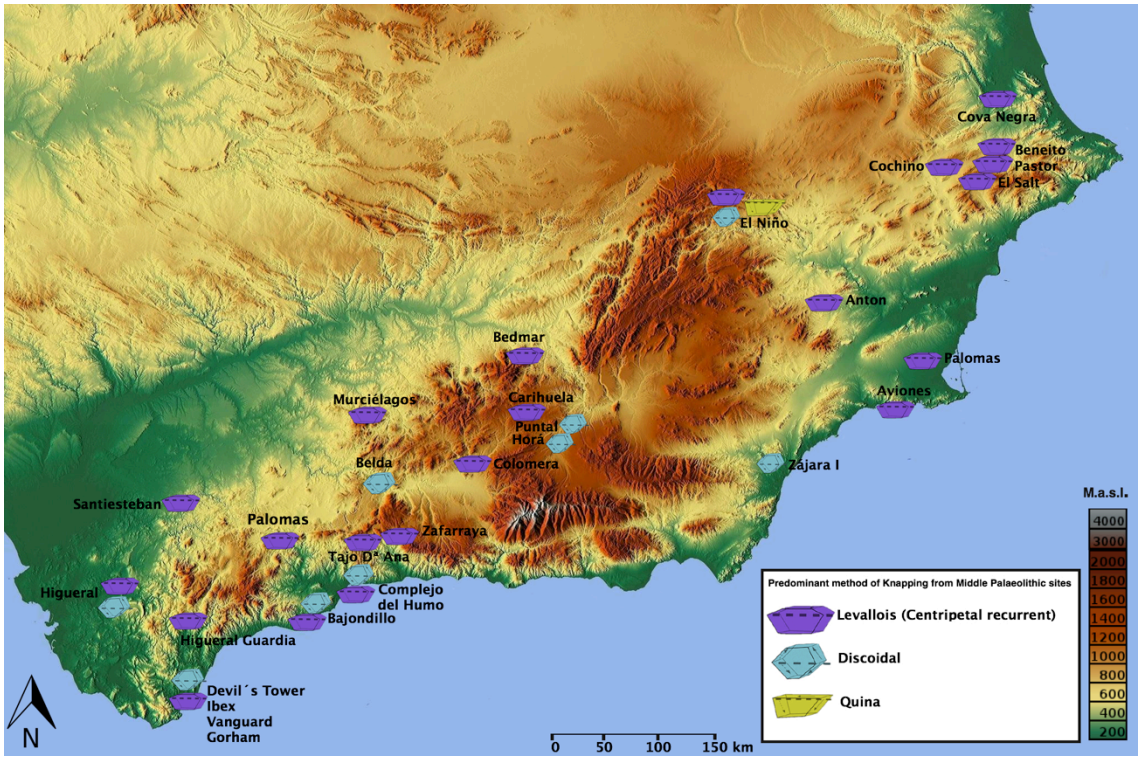


Figure 5.64. Map of the most common method of knapping of the Middle Palaeolithic sites in the Betic region.

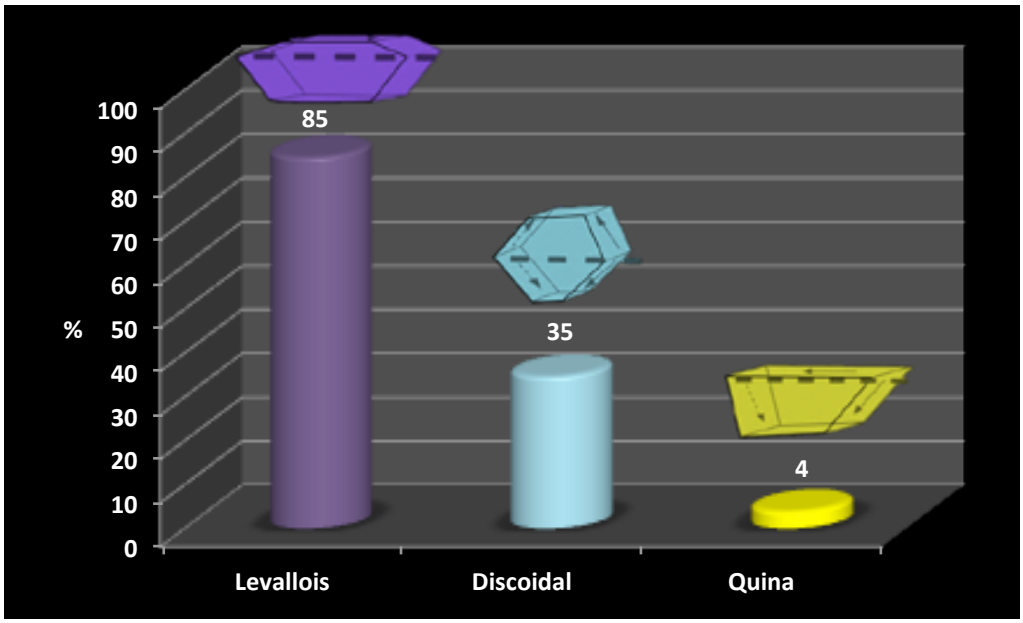


Figure 5.65. Bar chart of the most common type of cores in the Betic region

A comparison of the prevailing methods in both regions shows that in the Cantabrian region the discoidal predominates and in the Betic region the Levallois centripetal recurrent is dominant. In addition, in the Cantabrian area the Quina method is more represented than in the Betic area during the Late Middle Palaeolithic (Figure 5.66).

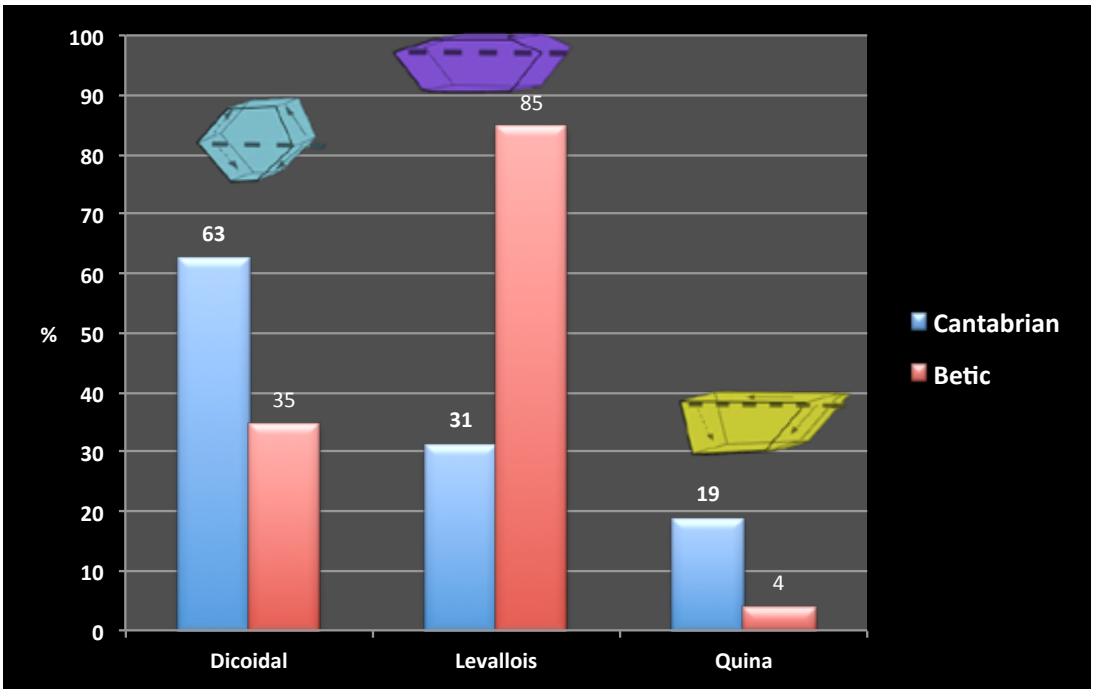


Figure 5.66. Comparison of the most common type of cores in both regions.

5.4.2.1.2. Flakes

From a quantitative point of view, in the metric measurements and area of the flakes (Figure 5.67), we can observe only a small difference, between the sites from both areas (Cantabrian: length (mean: 35 mm; st.dev.: 16), width (mean: 33 mm; st.dev.: 14), thickness (mean: 11 mm; st.dev.: 5), area (mean: 1442 mm^2; st.dev.: 1363); Betic: length (mean: 40 mm; st.dev.: 6), width (mean: 32 mm; st.dev.: 4), thickness (mean: 9 mm; st.dev.: 1), area (mean: 1380 mm^2; st.dev.: 346)).

Regarding the amount of cortex (Figure 5.67), the most common finding in both regions is that the flakes do not retain any cortex and a low percentage of flakes retain cortex (Cantabrian: 0% (mean: 73%; st.dev.: 14), ≤50% (mean: 18%; st.dev.: 9), >50% (mean: 8%; st.dev.: 5), 100% (mean: 2%; st.dev.: 1); Betic: 0% (mean: 77%; st.dev.: 19), ≤50% (mean: 16%; st.dev.: 11), >50% (mean: 6%; st.dev.: 5), 100% (mean: 2%; st.dev.: 3)).



LENGHT, WIDTH, THICNESS		Length	Width	Thickness
Cantabrian	Mean	35	33	11
	St. deviation	16	14	5
Betic	Mean	40	32	9
	St. deviation	6	4	1

AREA		Area
Cantabrian	Mean	1442
	St. deviation	1363
Betic	Mean	1380
	St. deviation	346

AMOUNT OF CORTEX		0	≤50%	>50%	100%
Cantabrian	Mean	73	18	8	2
	St. deviation	14	9	5	1
Betic	Mean	77	16	6	2
	St. deviation	19	11	5	3

Figure 5.67 .Bar charts of mean values for flakes: measurements, area, amount of cortex.

Regarding the bulb of percussion on the flakes (Figure 5.68), we can see in the bar chart that the flakes from the assemblages of the Betic region are dominated by a pronounced bulb, although the assemblages of the Cantabrian region are dominated by diffuse bulbs (Cantabrian: Diffuse (mean: 66%; st.dev.: 10), Marked (mean: 35%; st.dev.: 10); Betic: Marked (mean: 60%; st.dev.: 9), Diffuse (mean: 41%; st.dev.: 9)). This could be caused by the raw material, because in the Betic region flint is the predominant raw material and in the Cantabrian region there is more variety of raw material with a high presence of quartzite and other materials such as mudstone, ferruginuous and lutite. Additionally, the conchoidal fracture on the flint blank is normally more pronounced than in other raw

materials. Another reason for the difference may be the different use of hammers, strike intensity or the method of knapping applied.

The delineation of the ventral face (Figure 5.68) is diverse in the assemblages studied from the two regions (Cantabrian: Sinuous (mean: 47%; st.dev.: 10), Straight (mean: 27%; st.dev.: 7), Convex (mean: 19%; st.dev.: 6) Concave (mean: 9%; st.dev.: 4); Betic: Sinuous (mean: 48%; st.dev.: 2), Concave (mean: 23%; st.dev.: 15), Straight (mean: 21%; st.dev.: 12), Convex (mean: 9%; st.dev.: 3)). However the sinuous delineation is predominant in the majority of the sites with the exception of Gorham´s Cave.

Regarding the retention of cortex in the butt of the flakes (Figure 5.68), the majority of assemblages do not present cortex in both regions (Cantabrian: No cortical (mean: 93%; st.dev.: 3), Cortical (mean: 7%; st.dev.: 3); Betic: No cortical (mean: 94%; st.dev.: 6), Cortical (mean: 7%; st.dev.: 6)).

The predominant type of butt is the platform type across all of the assemblages (Cantabrian: Platform (mean: 83%; st.dev.: 9), Linear (mean: 7%; st.dev.: 9), Cortical (mean: 6%; st.dev.: 4), Puntiform (mean: 3%; st.dev.: 3); Betic: Platform (mean: 87%; st.dev.: 9), Linear (mean: 6%; st.dev.: 2), Cortical (mean: 6%; st.dev.: 6), Puntiform (mean: 3%; st.dev.: 3)) (Figure 5.68).



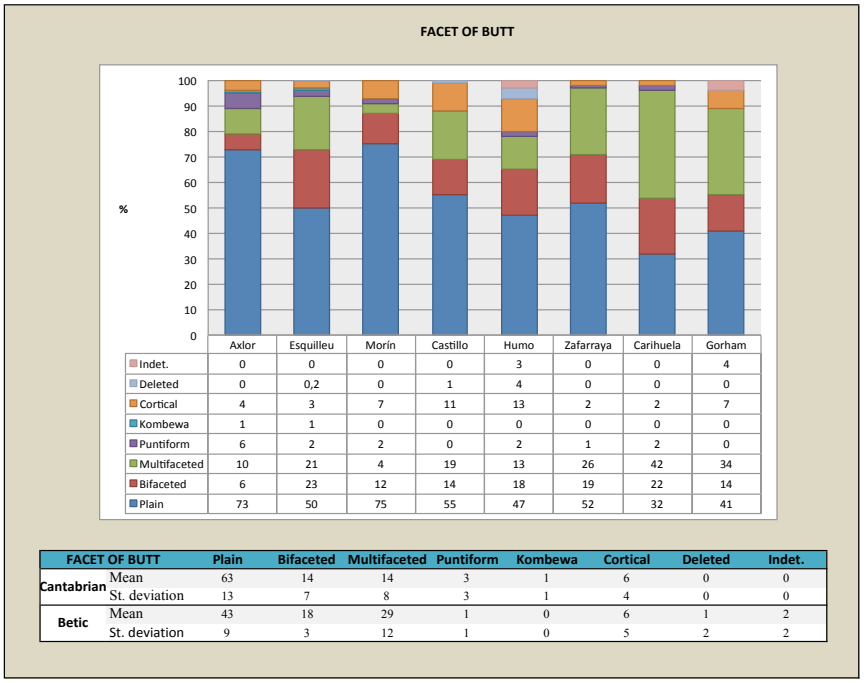
Figure 5.68. Bar charts of the attributes of ventral face and butt.

With regard to the facet of butt (Figure 5.69), the plain butt is dominant in all assemblages except for Carihuela (Betic region) where the multifaceted butt is the most common (Cantabrian: Plain (mean: 63%; st.dev.: 13), Multifaceted (mean: 14%; st.dev.: 8), Bifaceted (mean: 14%; st.dev.: 7), Puntiform (mean: 3%; st.dev.: 3); Betic: Plain (mean: 43%; st.dev.:9), Multifaceted (mean: 29%; st.dev.: 12), Bifaceted (mean: 18%; st.dev.: 3), Puntiform (mean: 1%; st.dev.: 1)). We can observe that in the Betic region the multifaceted butt is more present in a higher proportion than in the Cantabrian assamblages. The cause of this may be due to the predominance of the Levallois Centripetal recurrent method of knapping in the Betic region. In addition it may be related to the raw material, where there is a dominance in the use of flint.

There is a clear difference between assemblages in both areas regarding the delineation of the butt (Figure 5.70) (Cantabrian: Straight (mean: 53%; st.dev.: 12), Sinuous (mean: 24%;

st.dev.: 6), Uniangular (mean: 13%; st.dev.: 7), Convex (mean: 2%; st.dev.: 1), Concave (mean: 2%; st.dev.: 1), Biangular (mean: 1%; st.dev.: 1); Betic: Sinuous (mean: 41%; st.dev.: 12), Straight (mean: 34%; st.dev.: 8), Uniangular (mean: 12%; st.dev.: 6), Convex (mean: 4%; st.dev.: 2), Concave (mean: 2%; st.dev.: 1). In the Cantabrian region the straight delineation is most common, however in the Betic region there is a majority of straight delineation in two places - Abrigo 3 and Zafarraya - but in the other two sites, - Carihuela and Gorham - the sinuous delineation prevails.

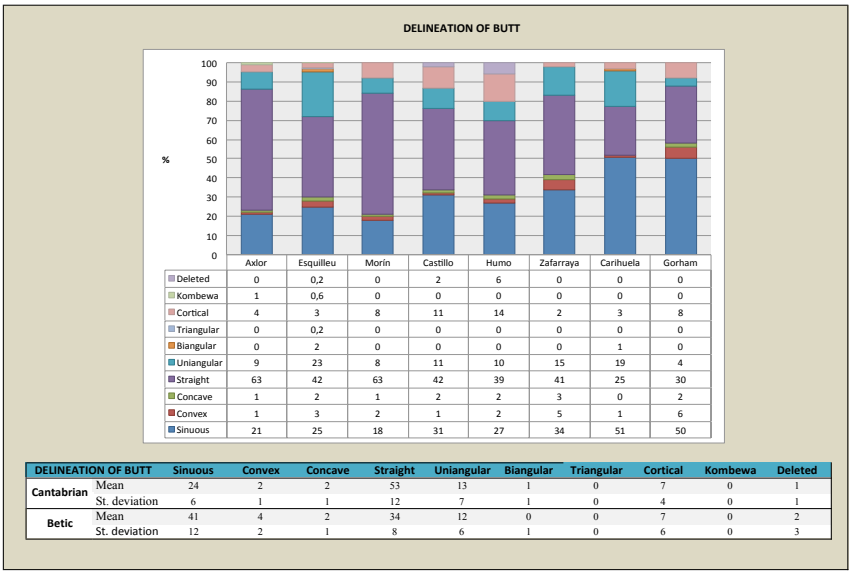
There is a variety of directions of scarring in all assemblages (Figure 5.71) (Cantabrian: Multidirectional (mean: 41%; st.dev.: 11), Unidirectional (mean: 31%; st.dev.: 7), Centripetal (mean: 21%; st.dev.: 4), Bidirectional (mean: 5%; st.dev.: 3); Betic: Multidirectional (mean: 38%; st.dev.: 20), Centripetal (mean: 27%; st.dev.: 22), Unidirectional (mean: 24%; st.dev.: 10), Bidirectional (mean: 9%; st.dev.: 6)), in both regions there is a predominance of multidirectional attributes, followed by unidirectional and centripetal directions. Bidirectional approaches are less represented in all assemblages.



	Axlor	Esquilleu	Morín	Castillo	Humo	Zafarraya	Carihuela	Gorham
Indet.	0	0	0	0	3	0	0	4
Deleted	0	0,2	0	1	4	0	0	0
Cortical	4	3	7	11	13	2	2	7
Kombewa	1	1	0	0	0	0	0	0
Puntiform	6	2	2	0	2	1	2	0
Multifaceted	10	21	4	19	13	26	42	34
Bifaceted	6	23	12	14	18	19	22	14
Plain	73	50	75	55	47	52	32	41

FACET OF BUTT		Plain	Bifaceted	Multifaceted	Puntiform	Kombewa	Cortical	Deleted	Indet.
Cantabrian	Mean	63	14	14	3	1	6	0	0
	St. deviation	13	7	8	3	1	4	0	0
Betic	Mean	43	18	29	1	0	6	1	2
	St. deviation	9	3	12	1	0	5	2	2

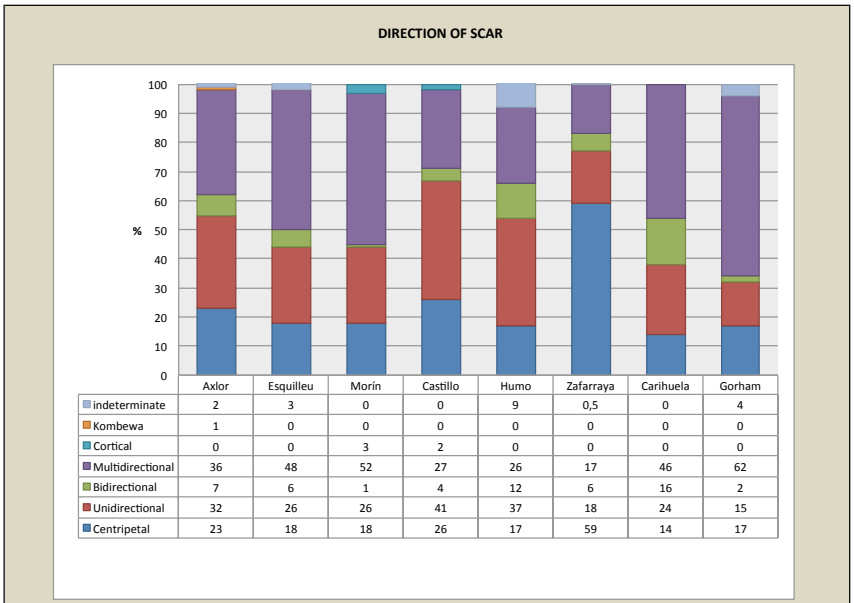
Figure 5.69. Bar chart of the face of butt.



	Axlor	Esquilleu	Morín	Castillo	Humo	Zafarraya	Carihuela	Gorham
Deleted	0	0,2	0	2	6	0	0	0
Kombewa	1	0,6	0	0	0	0	0	0
Cortical	4	3	8	11	14	2	3	8
Triangular	0	0,2	0	0	0	0	0	0
Biangular	0	2	0	0	0	0	1	0
Uniangular	9	23	8	11	10	15	19	4
Straight	63	42	63	42	39	41	25	30
Concave	1	2	1	2	2	3	0	2
Convex	1	3	2	1	2	5	1	6
Sinuous	21	25	18	31	27	34	51	50

DELINEATION OF BUTT		Sinuous	Convex	Concave	Straight	Uniangular	Biangular	Triangular	Cortical	Kombewa	Deleted
Cantabrian	Mean	24	2	2	53	13	1	0	7	0	1
	St. deviation	6	1	1	12	7	1	0	4	0	1
Betic	Mean	41	4	2	34	12	0	0	7	0	2
	St. deviation	12	2	1	8	6	1	0	6	0	3

Figure 5.70. Bar chart of the delineation of butt.



	Axlor	Esquilleu	Morín	Castillo	Humo	Zafarraya	Carihuela	Gorham
indeterminate	2	3	0	0	9	0,5	0	4
Kombewa	1	0	0	0	0	0	0	0
Cortical	0	0	3	2	0	0	0	0
Multidirectional	36	48	52	27	26	17	46	62
Bidirectional	7	6	1	4	12	6	16	2
Unidirectional	32	26	26	41	37	18	24	15
Centripetal	23	18	18	26	17	59	14	17

DELINEATION OF SCAR		Centripetal	Unidirectional	Bidirectional	Multidirectional	Cortical	Kombewa	indeterminate
Cantabrian	Mean	21	31	5	41	1	0	1
	St. deviation	4	7	3	11	2	1	2
Betic	Mean	27	24	9	38	0	0	3
	St. deviation	22	10	6	20	0	0	4

Figure 5.71. Bar chart of the direction of scar.

5.4.2.1.3. Retouched Tools

Metric measurements and area analysis of the retouched tools (Figure 5.72) yield similar quantitative data as the flake results; there is a small difference on average between the sites from both regions (Cantabrian: length (mean: 36 mm; st.dev.: 11), width (mean: 31 mm; st.dev.: 8), thickness (mean: 14 mm; st.dev.: 6), area (mean: 1266 mm^2; st.dev.: 780); Betic: length (mean: 44 mm; st.dev.: 3), width (mean: 34 mm; st.dev.: 3), thickness (mean: 10 mm; st.dev.: 1), area (mean: 1567 mm^2; st.dev.: 219)).

Regarding the extent of retouch (Figure 5.72) along the edge of the flakes (Cantabrian: ≤25% (mean: 12%; st.dev.: 3), >25 to ≤50% (mean: 44%; st.dev.: 7), >50% to ≤ 75% (mean: 26%; st.dev.: 11), >75% to ≤100% (mean: 2%; st.dev.: 2); Betic: ≤25% (mean: 29%; st.dev.: 19), >25 to ≤50% (mean: 34%; st.dev.: 11), >50% ≤ 75% (mean: 31%; st.dev.18:), >75% to ≤100% (mean: 7%; st.dev.: 3)), in both regions the pieces with a >25 to ≤50% extent of retouch are the most common in the tool assemblages, so retouch on the pieces was not very extensive in either region.



Figure 5.72 .Bar charts of mean values for retouched tools: measurements, area, extension of retouch.

The kind of blanks (Figure 5.73) that were selected for retouching are flakes in all assemblages from both regions (Cantabrian: flakes (mean: 64%; st.dev.: 16), fragmented flakes (mean: 24%; st.dev.: 13), fragments of flake (mean: 10%; st.dev.: 4), chunk (mean: 1%; st.dev.: 2), debris (mean: 1%; st.dev.: 2), fragments of core (mean: 0,25%; st.dev.: 1); Betic: flakes (mean: 68%; st.dev.: 12), fragmented flake (mean: 18%; st.dev.: 11), fragments of flake (mean: 13%; st.dev.: 4), chunks (mean: 1%; st.dev.: 2)).

The majority of the retouched tools from all assemblages have unifacial retouch (Cantabrian: Unifacial (mean: 76%; st.dev.: 12), Bifacial (mean: 24%; st.dev.: 12); Betic: Unifacial (mean: 86%; st.dev.: 9), Bifacial (mean: 14%; st.dev.: 9)). There is a lower percentage of bifacial retouch in all the assemblages. However, we can observe that in

assemblages from the Cantabrian region the percentage of bifacial retouch is more elevated than in the assemblages from the Betic region (Figure 5.73).

Regarding the localization of the retouch (Figure 5.73), there is a homogeneous proportion in all assemblages in both regions (Cantabrian: Left (mean: 41%; st.dev.: 3), Right (mean: 38%; st.dev.: 4), Distal (mean: 14%; st.dev.: 2), Proximal (mean: 3%; st.dev.: 2); Betic: Left (mean: 43%; st.dev.: 3), Right (mean: 41%; st.dev.: 5), Distal (mean: 13%; st.dev.: 8), Proximal (mean: 2%; st.dev.: 2)). The left side is the predominant side with extensive retouch in all assemblages, followed by the right side, distal and proximal respectively.

Regarding the angle of retouch in both regions (Figure 5.73), the semi-abrupt angle is most common in all assemblages (Cantabrian: Semi-abrupt (mean: 63%; st.dev.: 7), Abrupt (mean: 25%; st.dev.: 2), Simple (mean: 13%; st.dev.: 7); Betic: Semi-abrupt (mean: 47%; st.dev.: 6), Simple (mean: 39%; st.dev.: 6), Abrupt (mean: 15%; st.dev.: 7)). However, there is a very clear difference between the assemblages of both regions regarding the angle of retouch. In the Betic region, simple angle retouch is more representative than in the Cantabrian region. In the Cantabrian region the semi-abrupt and abrupt angle retouch have higher percentages than in the Betic region.



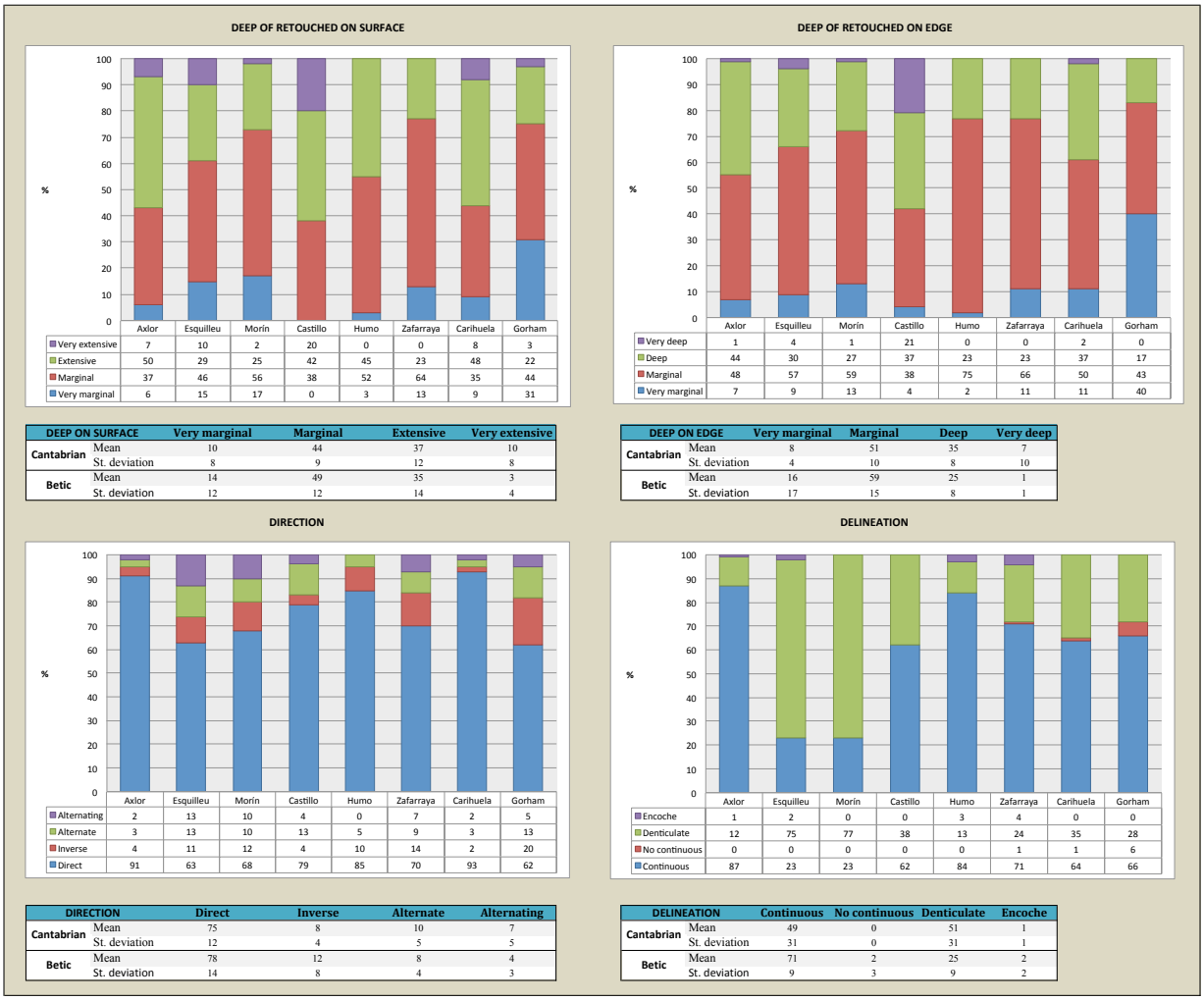
Figure 5.73. Bar chart of the attributes of retouched tools.

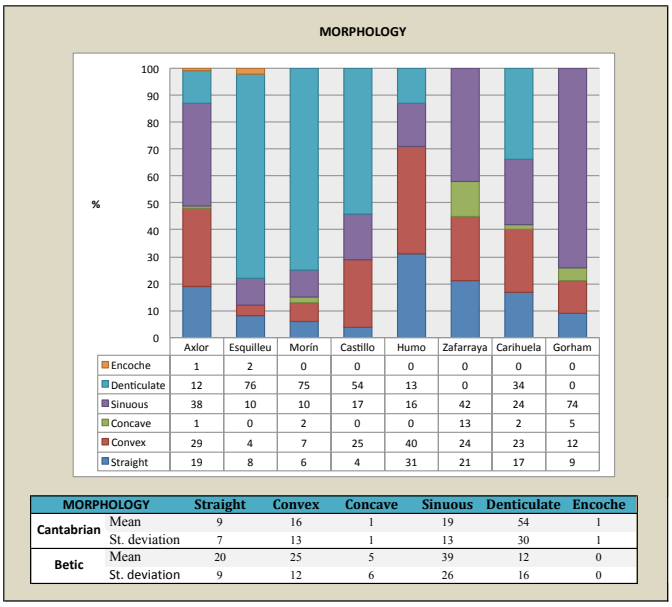
With regard to the extent of retouch on the dorsal/ventral surfaces (Figure 5.74), we can observe that the marginal and extensive amounts of retouch are the most represented in the assemblages of both regions (Cantabrian: Marginal (mean: 44%; st.dev.: 9), Extensive (mean: 37%; st.dev.: 12), Very Marginal (mean: 10%; st.dev.: 8), Very Extensive (mean: 10%; st.dev.: 8); Betic: Marginal (mean: 49%; st.dev.: 12), Extensive (mean: 35%; st.dev.: 14), Very Marginal (mean: 14%; st.dev.: 12), Very Extensive (mean: 3%; st.dev.: 4)). In regard to the depth of retouch category both attributes (marginal and deep) are most common in all lithic assemblages (Cantabrian: Marginal (mean: 44%; st.dev.: 9), Deep (mean: 35%; st.dev.: 8), Very Marginal (mean: 8%; st.dev.: 4), Very Deep (mean: 7%; st.dev.: 10); Betic: Marginal (mean: 59%; st.dev.: 15), Deep (mean: 25%; st.dev.: 8), Very Marginal (mean: 16%; st.dev.: 17), Very Deep (mean: 1%; st.dev.: 1). Most of the pieces in the majority of assemblages do not therefore have an intense configuration on the edges.

The dominant direction of retouch is direct in all assemblages in both regions (Cantabrian: Direct (mean: 75%; st.dev.: 12), Alternate (mean: 10%; st.dev.:5), Inverse (mean: 8%;

st.dev.:4), Alternating (mean: 7%; st.dev.: 5); Betic: Direct (mean: 78%; st.dev.: 14), Inverse (mean: 12%; st.dev.: 8), Alternate (mean: 8%; st.dev.: 4), Alternating (mean: 4%; st.dev.: 3)) (Figure 5.74). With regard to the delineation of the retouched edge (Figure 5.74), in the Betic region continuous is most common and in the Cantabrian region in two sites continuous is predominant (Axlor and El Castillo) and in the other two denticulate delineation (Cantabrian: Denticulate (mean: 51%; st.dev.:31), Continuous (mean: 49%; st.dev.: 31), Encoche (mean: 1%; st.dev.: 1); Betic: Continuous (mean: 71%; st.dev.:9), Denticulate (mean: 25%; st.dev.:9), Encoche (mean: 2%; st.dev.: 2), No continuous (mean: 2%; st.dev.:3)). This seems to be related to the raw material; where flint is predominant there is higher percentage of continuous retouch. In addition, it may relationed to the functionality to which the lithic assemblage is oriented, where one or other type of tool (denticulate or scraper) may dominate.

Regarding the morphology of the retouched edges (Figure 5.75), there is high variability in the Cantabrian region where the denticulate morphology is the most common, however in the Betic region sinuous, convex and straight morphology are the most common (Cantabrian: Denticulate (mean: 54%; st.dev.:30), Sinuous (mean: 19%; st.dev.: 13), Convex (mean: 16%; st.dev.: 13), Straight (mean: 9%; st.dev.: 7), Encoche (mean: 1%; st.dev.: 1), Concave (mean: 1%; st.dev.: 1); Betic: Sinuous (mean: 39%; st.dev.: 26), Convex (mean: 25%; st.dev.: 12), Straight (mean: 20%; st.dev.: 9), Denticulate (mean: 12%; st.dev.: 16), Concave (mean: 5%; st.dev.: 6). The high frequency of these types of retouch morphologies is probably influenced by the type of raw material selected (Betic: Flint; Cantabrian: Quartzite and flint) and the functionality to which the lithic assemblage is oriented.





Figures 5.74 and 5.75. Bar charts of the attributes of retouched tools.

From a typological point of view, the retouched tools can be grouped into two; scrapers and denticulates (Figure 5.76). By each group, following the Laplace Typology (Laplace,

1972), we have distinguished different types of scrapers and denticulates. Amongst the former, two types of side scrapers are most common in all assemblages, R1 (with marginal retouching) and R21 (with retouching a little more deep). The rest of the scraper types (R22, R23, R3, R2) are present in all assemblages but in lower proportions. (Cantabrian: R1 (mean: 15%; st.dev.: 12), R21 (mean: 14%; st.dev.: 14), R22 (mean: 6%; st.dev.: 5), R3 (mean: 4 %; st.dev.: 5), R23 (mean: 2%; st.dev.: 3); Betic: R1 (mean: 27%; st.dev.: 10), R21 (mean: 22%; st.dev.: 13), R23 (mean: 7%; st.dev.: 5), R22 (mean: 3%; st.dev.: 1).

Amongst the denticulates, the marginal denticulate retouch D1 is most common in all assemblages, with the exception of one site, Abrigo 3. The rest of the denticulate types (D25, D24, D23, D21, D3) are also present in the lithic assemblages of both regions but in lower proportions (Cantabrian: D1 (mean: 30%; st.dev.: 22), D23 (mean: 15%; st.dev.: 10), D21 (mean: 5%; st.dev.: 4), D24 (mean: 3%; st.dev.: 3), D3 (mean: 2%; st.dev.: 3) D25(mean: 1%; st.dev.: 1), D22 (mean: 1%; st.dev.: 2); Betic: D1 (mean: 15%; st.dev.: 11), D22 (mean: 4%; st.dev.: 3), D23 (mean: 4%; st.dev.: 4), D21 (mean: 3%; st.dev.: 4), D25 (mean: 3%; st.dev.: 5) D3 (mean: 1%; st.dev.: 1), D24 (mean: 1%; st.dev.: 2)).

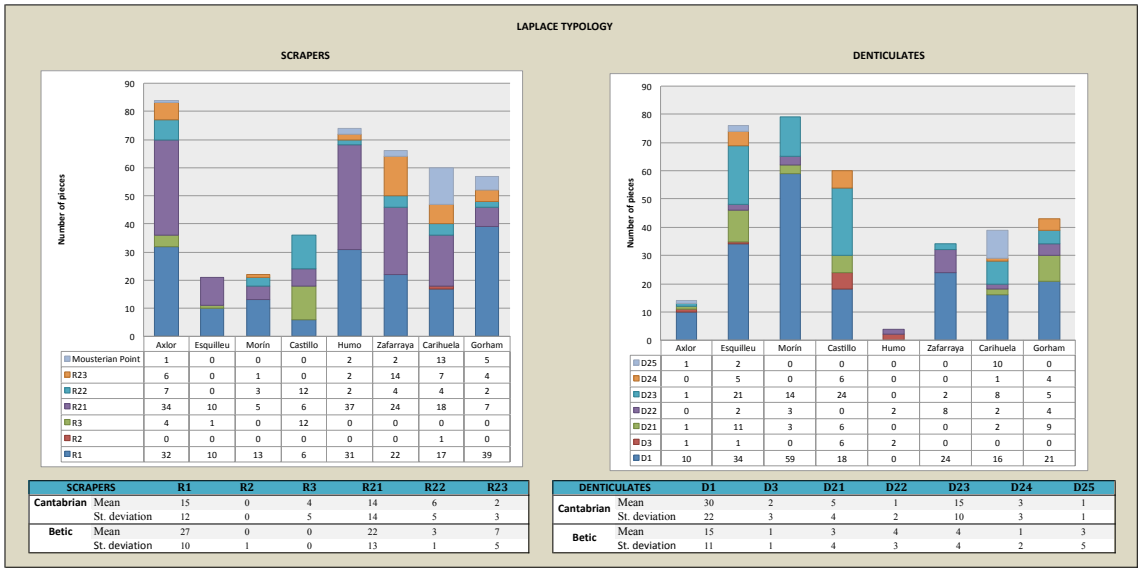


Figure 5.76. Bar charts of typology of retouched tools according to Laplace 1972.

Turning now to the most dominant retouched tools, I have obtained data from 16 Middle Palaeolithic sites from the Cantabrian region (Figure 5.77). The sites are: El Conde (Freeman 1977, Arzibu *et al* 2005), La Viña (Fortea 1999, Santamaría 2012, 2014), El

Sidrón (Fortea *et al* 2003, De la Rasilla *et al* 2011), La Güelga (Menéndez & Martínez 1992, Menéndez *et al* 2005, 2009, 2014), Sopeña (Pinto *et al* 2006, 2012, 2014), El Esquilleu (Baena *et al* 2005, 2006, 2012, 2014), Morin (González Echegaray *et al* 1971, 1973, González Echegaray & Freeman 1978, Maíllo-Fernández *et al* 2014), El Pendo (Freeman 1980, Montes & Sanguino 2001), Covalejos (Martín *et al* 2006, Sanguino & Montes 2005), El Castillo (Cabrera, 1984, Cabrera *et al* 2005, Sánchez & Bernaldo de Quirós 2008), Mirón (Straus *et al* 2001), Prado Vargas (Navazo *et al* 2005, 2008), Arrillor (Sáenz 2014), Axlor (Barandarián 1980, Baldeón 1999, Ríos-Garaizar *et al* 2003, 2007, González-Urquijo *et al* 2004, 2005, 2006, 2014, Frías 2012), Lezetxiki (Barandarián & Altuna 1966, 1970, Baldeón 1993, Arrizabalaga *et al* 2004, 2006, Lauzén & Altuna 2012), Kurtzia (Barandarián *et al* 1960, Muñoz *et al* 1990) and Abauntz (Mazo *et al* 2012). The results show that, 56% of the tools are retouched denticulates, followed by scrapers with 28% and Quina scrapers with 28 % (Figure 5.78). From these sites four (22%) stand out for the presence of Mousterian points. In addition, flake cleaver tools has been documented in 11 sites (61%).

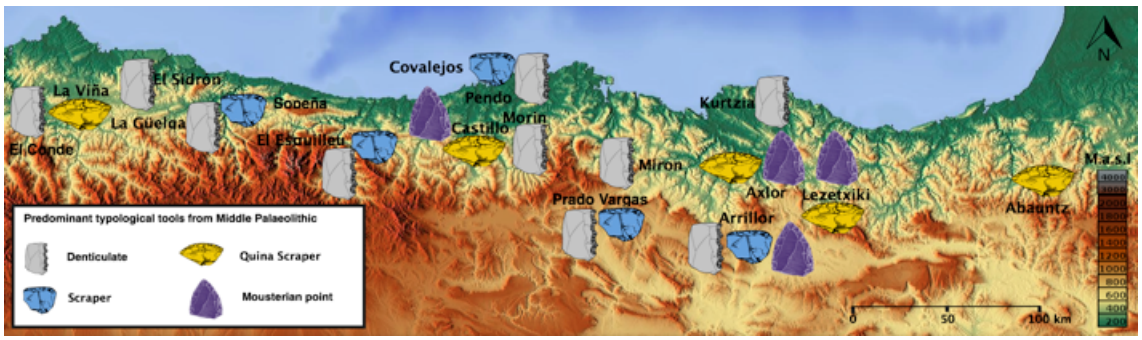


Figure 5.77. Map of the most common retouched tools of the Middle Palaeolithic sites in the Cantabrian region.

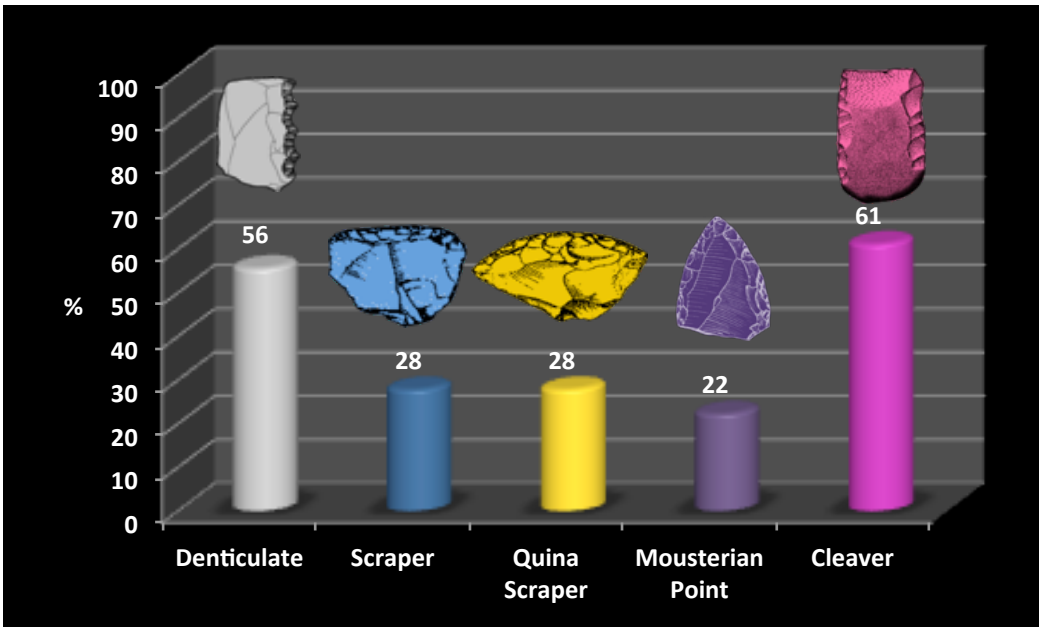


Figure 5.78. Bar chart of the most common retouched tools in the Cantabrian region.

From the Middle Palaeolithic in Cantabrian region 11 sites (Figure 5.79) have cleaver tools. These sites are: El Conde, La Viña, Hornos de la Peña, El Castillo, Morín, El Pendo, Arrillor, Axlor, Lezetxiki, Amalda and Abauntz. In this region there are more sites with flake cleavers, but these are isolated discoveries at sites such as Alcedo, Juyo, Rostrío, Altu la Maya, Bañugues, Irikaitz, and Zerratu (Mazo *et al* 2012).

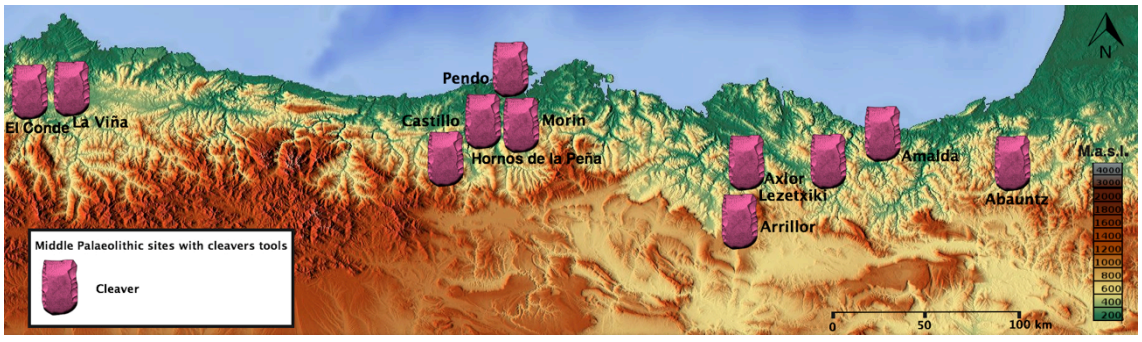


Figure 5.79. Map of the Middle Palaeolithic sites with cleaver tools in the Cantabrian region.

In this thesis these artifacts have not been studied, but I have collected the information from the scientific literature (Bordes 1953, Benito del Rey 1976, Cabrera 1984, Cabrera *et al* 1992, Mazo *et al* 2012, Deschamps 2010, Deschamps & Moure 2012, Claud *et al* 2015).

The presence of flake cleavers at the end of the Middle Palaeolithic in the Cantabrian region is one element in the variability of lithics in the Mousterian. They are not present in the Betic region at all. François Bordes defined the Mousterian facies with flake cleavers as the Vasconian, thus giving it a cultural attribution reflecting an African influence (Bordes 1953). The reasons why the flake cleavers were manufactured is unresolved. Since their discovery there has been an intense debate about their origin, meaning and functionality (Vega del Sella 1921, Obermaier 1924, Bordes 1953, Utrilla & Mazo 1996, Claud *et al* 2015). Utrilla & Mazo (1996) and Claud *et al* (2015) applied use-wear analyses to experimental tools and consider that the cleavers were used to work and in butchery.

Freeman (1966, 1969, 1994) was one of the first researchers to consider the flake cleavers not to be distinctive elements of a facies. Subsequently, several authors including Cabrera (1984), Cabrera & Bernaldo (1992), Carrión (2003), and Ríos-Garaizar (2012) have concluded that flake cleavers are not a type fossil of the Mousterian. The cleavers in question are technologically similar, and were always manufactured on ophite, quartzites or sandstone, never on flint. They were usually manufactured on quadrangular blanks of large dimensions (these vary in size between 15 cm and 6 cm) with long transverse edges and medium angles that have a robust grip surface created by a cortical dorsum and thick butt.

The hypothesis that the production of flake cleavers dates back to Acheulean times has been discarded by several authors. Currently, most authors consider that these tools could be valuable in microregional cultural terms, like a cultural marker of a group in the Cantabrian Mousterian (Cabrera & Bernaldo 1992, Deschamps 2010).

A general overview of the most dominant retouched tools has been taken from 26 Middle Palaeolithic sites from the Betic region (Figure 5.80). The sites include: Higueral de Valleja (Jennings *et al* 2009), Santiesteban (Fernández 2003), Higueral Guardia (Baena *et al* 2012), Gorham (Waechter 1951,1964, Barton *et al* 2012), Palomas (Medianero *et al* 2012), Bajondillo (Cortés 2007), Complejo del Humo (Ramos Fernández *et al* 2011), Tajo de Doña Ana (Ramos Muñoz *et al* 1995), Zafarraya (Barroso 2003), Belda (Ramos Fernández 1982), Murciélagos (Vera & Gavilán 1993), Colomera (Toro & Almohalla 1981), Puntal (Vega Toscano 1988), Horá (Botella *et al* 1983), Carihuela (Vega Toscano 1988), Bedmar (Solano pers. comm.), Zájara I (Vega Toscano 1980), Aviones (Montes 1991), Sima de las Palomas (Walker 2001), Anton (Martínez 1997), El Niño (García *et al*

2014), El Salt (Galván *et al* 2014), Pastor (Galván *et al* 2009), Beneito (Iturbe *et al* 1993), Cochino (Soler 1956) and Cova Negra (Villaverde *et al* 2014).

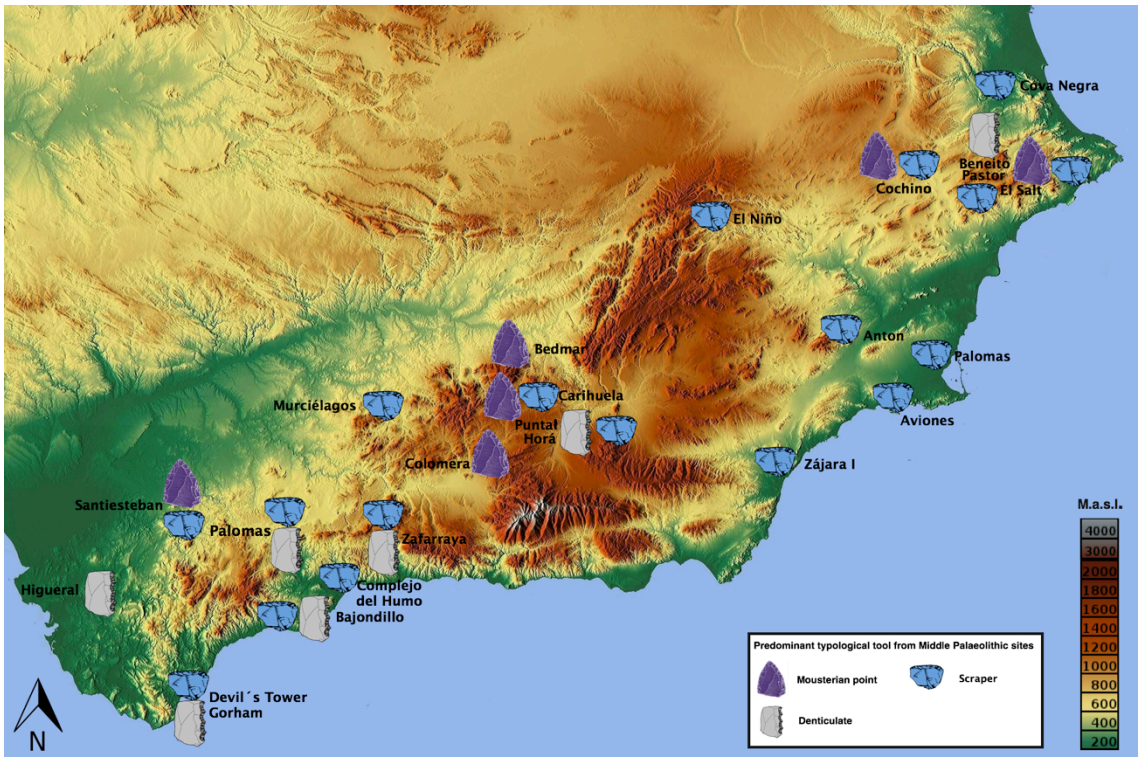


Figure 5.80. Map of the most common retouched tools of the Middle Palaeolithic sites in the Betic region.

Of the retouched tools from these 26 Middle Palaeolithic sites (Figure 5.81), scrapers dominate, making up 79% of the assemblage, with 38% being denticulates. In six sites (25%) there is a high presence of Mousterian points in comparison with the rest.

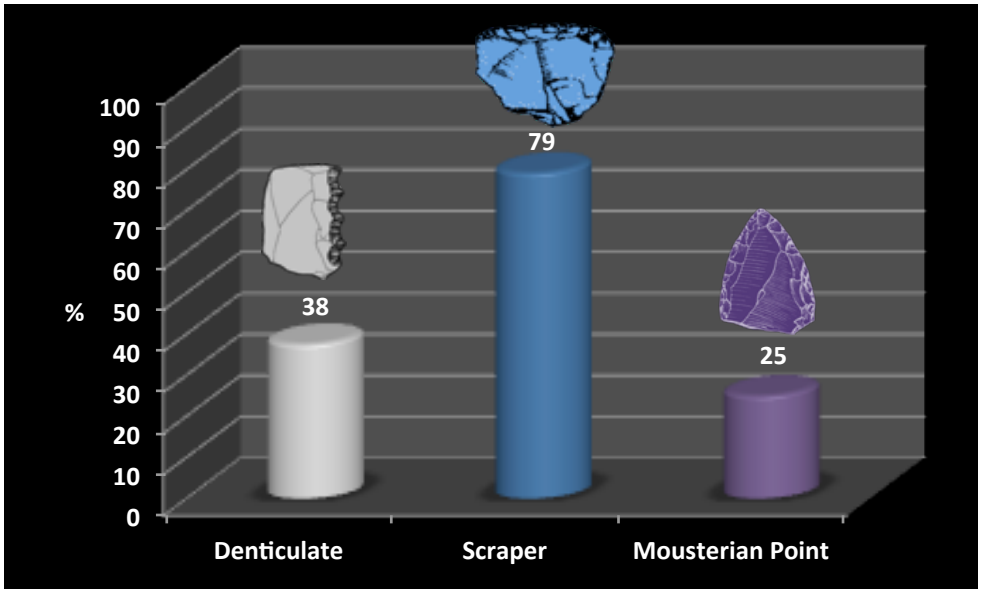


Figure 5.81. Bar chart of the most common retouched tools in the Betic region.

Regarding the comparison of the typological retouched tools between both regions, we can observe (Figure 5.82) that in the Cantabrian area during the Late Middle Palaeolithic the denticulates dominate and in the Betic region the scrapers do. In both regions there are few sites with a high presence of Mousterian points and in the Cantabrian region there are two types of tools absent in the Betic during the Late Middle Palaeolithic, namely Quina scrapers and flake cleavers.

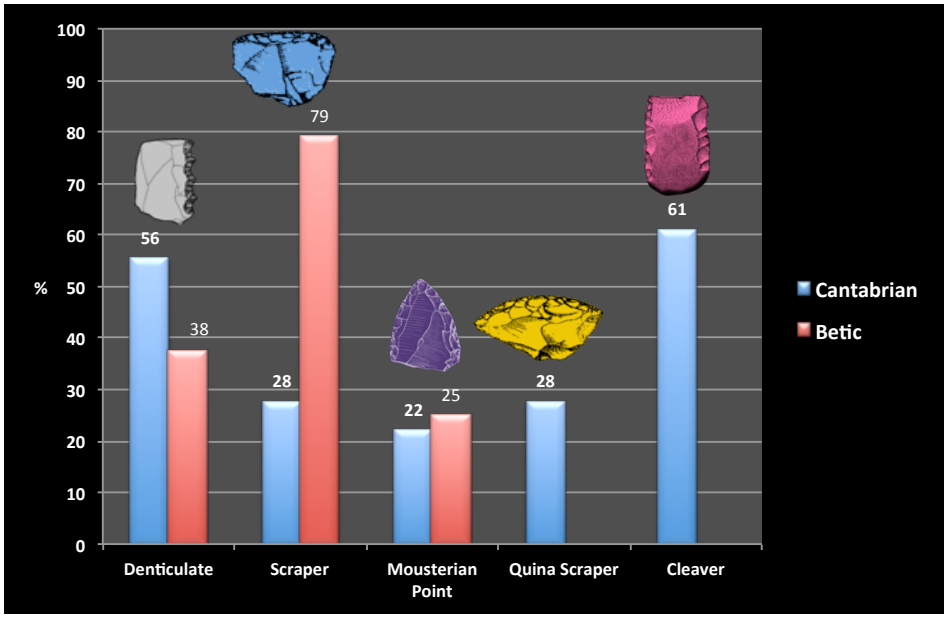


Figure 5.82. Comparison of the most common type of retouched tools in both regions.

5.4.2.2. Principal Component Analysis

A multivariate analysis through Principal Components Analysis (using PAST software) was run on quantitative and qualitative variables from the assemblages studied of both regions of study (Cantabrian and Betic). In order to compare the Cantabrian and Betic last Mousterian lithic assemblages to quantify patterns of variability (similarities and differences) within and between them this analysis was carried out in two phases according to the two types of variables (quantitative and qualitative) on three structural categories: cores, flakes, and retouched tools.

Quantitative variables analysis

A quantitative variable is expressed by a number, and is a mathematical variable, so one can perform arithmetic operations with it. Here, these variables include length, width, thickness, area, number of scars and percentage of cortex (0%, ≤ 25%, >25 ≤50%, ≤ 75%) (described in Chapter 4). All measurements were recorded in millimetres using a Mitutoyo Absolute AOS digimatic digital calliper nº 500-158-30 connected to a computer by USB and inputed into Microsoft Excel.

Qualitative variables analysis

The qualitative variables refer to characteristics or qualities that cannot be measured with numbers. Each modality or characteristic presented is called an attribute or category, and the measurement consists of the classification of these attributes. These categories analysed have been described in Chapter 4. For my comparative study I have focused on three structural categories: cores, flakes, and retouched tools.

The Principal Component Analysis (PCA) is a descriptive analysis whose function is to reduce the number of existing variables, excluding those that have less influence when establishing differences between individuals. The result graphically summarizes the entire main component analysis, and its correct interpretation, supported by numerical data, check working for sense is basic in reaching conclusions.

5.4.2.2.1. Cores

Quantitative variables analysis

From a total of 136 analysed cores of eight assemblages studied, for each piece nine attributes were analysed: length, width, thickness, area, number of scars, percentage of cortex (0%, ≤ 25%, >25 ≤50%, ≤ 75%).

PCA Summary		
PC	Eigenvalue	% Variance
1	5.48024	60.892
2	1.46288	16.254
3	1.31648	14.628
4	0.634974	7.0553
5	0.0869745	0.96638
6	0.0184613	0.20513

Table 5.103. Correlation Matrix from quantitative variables values of the cores.

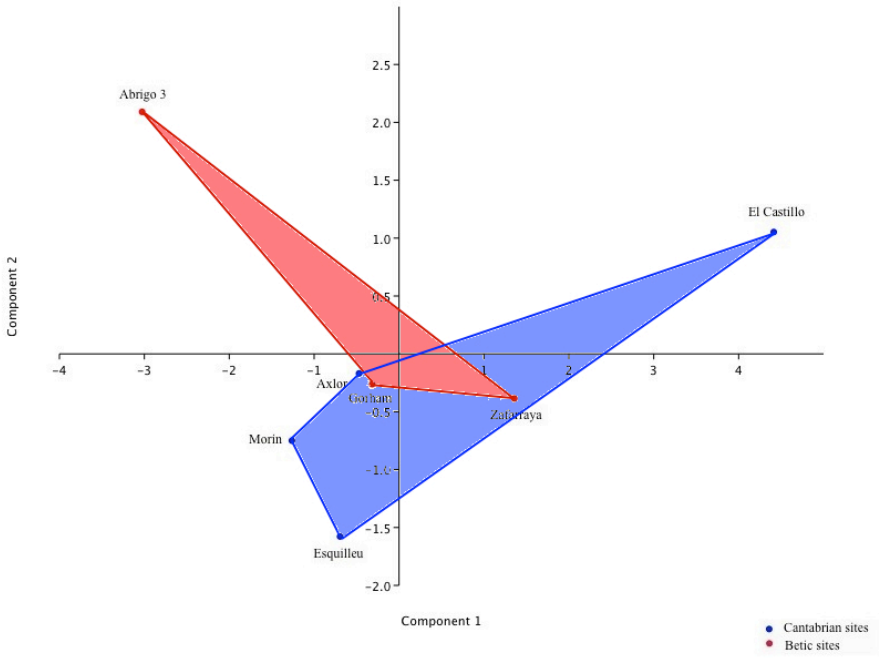
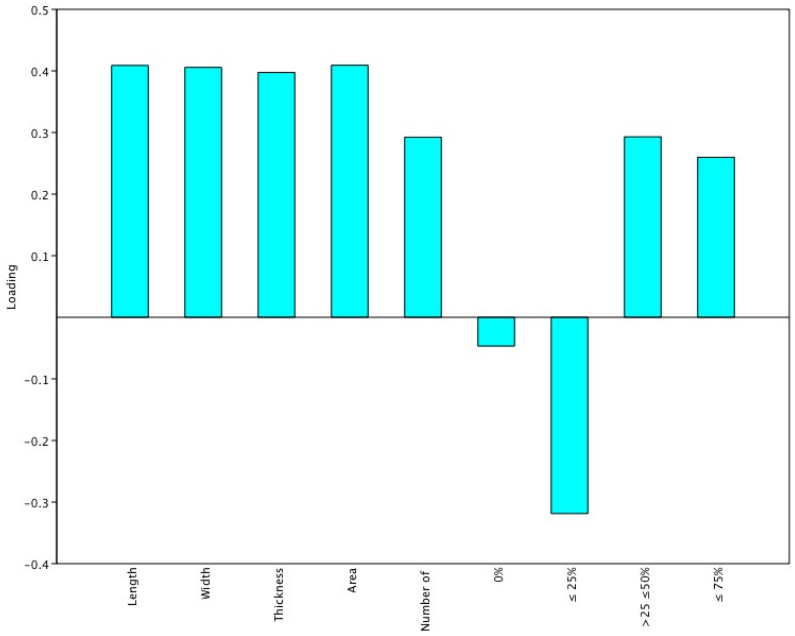


Figure 5.83. Scatter plot from quantitative variables values of the cores.



Loadings	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6
Length	0.40893	0.097531	0.13644	0.26548	-0.067176	-0.0044479
Width	0.40576	0.19034	0.081181	0.18863	-0.22189	0.7043
Thickness	0.39759	0.17274	0.20595	0.19438	0.25081	-0.50701
Area	0.40924	0.16039	0.15079	0.14679	-0.010749	-0.22315
Number of scars	0.2924	-0.54721	-0.19038	0.025382	0.71195	0.25467
0%	-0.046705	-0.55446	0.62838	0.12911	-0.29803	0.10265
≤ 25%	-0.31868	0.48961	0.11429	0.31049	0.3787	0.31911
>25 ≤50%	0.29301	-0.06257	-0.62368	-0.014952	-0.36448	0.01562
≤ 75%	0.25977	0.21957	0.2766	-0.84892	0.10614	0.14009

Figure 5.84 and Table 5.104. Loadings plot from quantitative variables values of the cores.

We can observe that the first three components comprise 91.8% of the variation (Table 5.103). The highest positive values of their coefficients in PC1 (Figure 5.84 and Table 5.104) are the variables Length, Width, Thickness, and Area. It seems that positive correlations exist between the variables of measurements, also in PC2 and PC3. The negative values are represented in the percentage of cortex, although varying according to PC1, PC2 and PC3. The other components (PC4-PC6) are more diffuse to interpret; they are not necessary to perform a correct analysis of the main components.

There is an interesting convergence of the sites, which depend on the higher coefficient variables (Length, Width, Thickness, Area), however three sites are widely separated:

Abrigo 3 and Zafarraya (Betic area) and El Castillo (Cantabrian Area). The differences are due to the state of final reduction of the cores. The Abrigo 3 site contains cores of a very reduced size, which are almost exhausted. While the majority of cores of the assemblages are exhausted, those from El Castillo and Zafarraya, have the largest dimensions.

Although certain assemblages show different states of reduction, a close relationship between the measurement variables suggests a volumetric relationship in the assemblages of both areas. In general the cores from both areas were of small size at the moment of their final abandonment.

In both areas the majority of cores still retain some their cortex at the point they were abandoned. In the PCA results on cortex remains on the cores, the highest absolute values of their coefficients are in PC2 (25% of cortex) and PC3 (0% of cortex). This shows us that the remains of cortex on the cores of the assemblages are low.

Qualitative variables analysis

From a total of 136 analysed cores in eight assemblages studied, each piece was analysed using a total of 16 attributes: Stage of knapping sequence (Initial, Exploitation, Terminal); facial attribute (Bifacial, unifacial, trifacial, globular); strategies of knapping (Centripetal, Unidirectional, Bidirectional, Multidirectional, Ortogonal, Indeterminate); Method of knapping (Discoidal, Quina, Levallois, Globular, Indeterminate).

PCA Summary		
PC	Eigenvalue	% Variance
1	4.75105	29.694
2	3.86888	24.181
3	3.21728	20.108
4	1.97945	12.372
5	1.45967	9.1229
6	0.723667	4.5229

Table 5.105. Correlation Matrix from qualitative variables values of the cores.

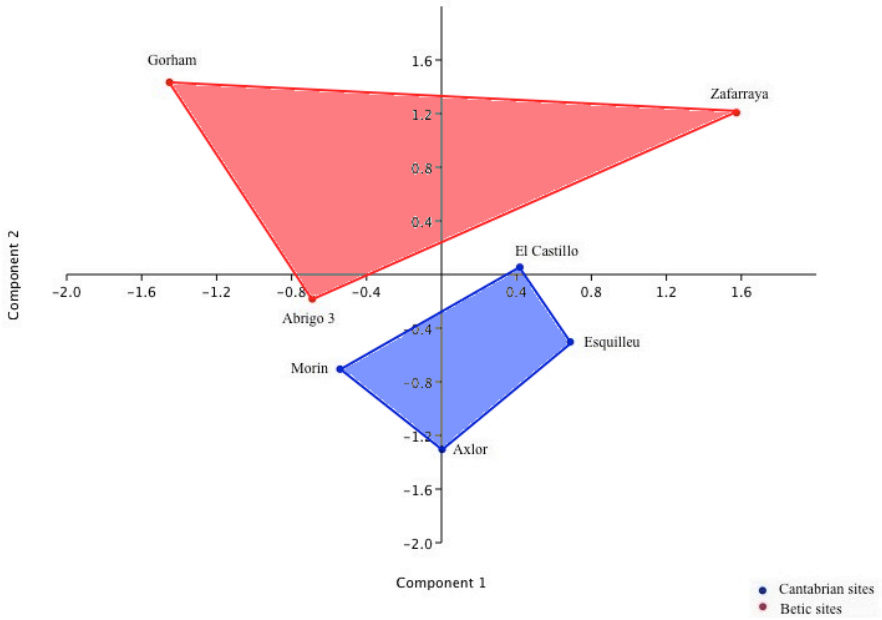
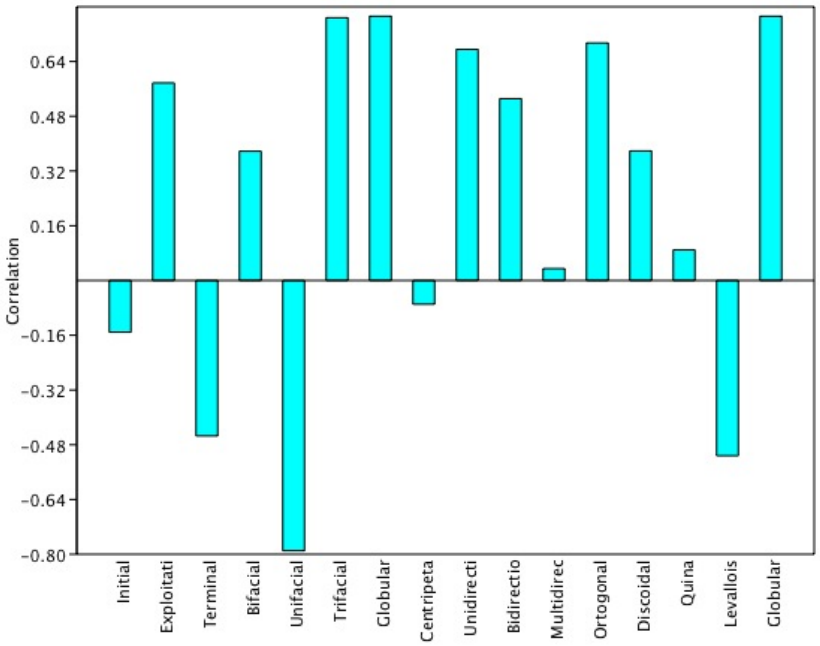


Figure 5.85. Scatter plot from qualitative variables values of the cores.



Loadings	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6
Initial	-0.15103	0.83077	0.043073	0.50583	0.15705	0.067997
Exploitation	0.5773	0.49278	-0.059548	0.53226	-0.36827	0.037793
Terminal	-0.45413	-0.61964	0.040196	-0.57464	0.27502	-0.048557
Bifacial	0.37778	-0.70568	-0.5593	0.18205	-0.10549	0.047112
Unifacial	-0.78969	0.40762	0.44868	0.023688	0.075356	0.051783
Trifacial	0.76789	0.49199	0.19111	-0.30765	-0.010313	-0.19242
Globular	0.77231	0.24061	-0.1117	-0.46844	0.26657	0.20658
Centripetal	-0.069337	0.221	-0.61617	0.27639	0.7002	-0.0046177
Unidirectional	0.67546	-0.24081	0.59348	0.33558	0.088514	0.11448
Bidirectional	0.53132	-0.49482	0.40211	0.32374	0.24704	0.38121
Multidirectional	0.034755	-0.15525	0.78547	0.11999	0.41666	-0.41198
Ortogonal	0.69412	0.53224	0.27738	-0.22335	-0.10466	-0.31167
Discoidal	0.37866	-0.28459	-0.57452	0.40004	0.41123	-0.34119
Quina	0.089398	-0.51539	0.83105	0.14992	0.10273	0.052106
Levallois	-0.51196	0.72406	0.16269	-0.047583	0.37597	0.20868
Globular	0.77231	0.24061	-0.1117	-0.46844	0.26657	0.20658

Figure 5.86 and Table 5.106. Loadings plot from qualitative variables values of the cores.

The first three components comprise 73.9% of the variation (Table 5.105). The positive absolute values in PC1 (Figure 5.86 and Table 5.106) with their highest coefficients are from Stage of knapping sequence (Exploitation), facial attribute (Bifacial, Trifacial, Globular), strategies of knapping (Unidirectional, Bidirectional, Multidirectional, Ortogonal) and method of knapping (Discoidal, Globular, Quina). The negative values are from stage of knapping sequence (Initial, Terminal), facial attribute (Unifacial), from strategies of knapping (Centripetal), and method of knapping (Levallois). In PC2 the positive values are from stage of knapping sequence (Initial, Exploitation), facial attribute (Unifacial, Trifacial, Globular), and strategies of knapping (Centripetal, Ortogonal), and also from method of knapping (Levallois and Globular). The negative values come from stage of knapping sequence (Terminal), facial attribute (Bifacial), from strategies of knapping (Unidirectional, Bidirectional, Multidirectional), and method of knapping (Discoidal, Quina). In both PC1 and PC2 the positive values are mainly focused on facial attribute, strategies of knapping, and method of knapping. The negative values are mainly from strategies of knapping. The strategies of knapping show where there is more heterogeity in the different assemblages.

In the scatter plot (Figure 5.85), PC1 and PC2, we can observe the separation of sites by areas due to the differences in the correlation of their values, with a concentration closer to those sites of the Cantabria area and a greater dispersion of the Betic sites.

5.4.2.2.2. Flakes

Quantitative variables analysis

From a total of 2194 analysed flakes of eight assemblages studied, each piece was analysed using a total of nine quantitative attributes: length, width, thickness, area, elongation index, flattening index, angle of knapping, number of scars, percentage of cortex (0%, ≤ 50%, >50%, 100%).

PCA Summary		
PC	Eigenvalue	% Variance
1	6.02475	50.206
2	3.06447	25.537
3	1.18199	9.8499
4	0.964785	8.0399
5	0.487322	4.061
6	0.245063	2.0422
7	0.031619	0.26349

Table 5.107. Correlation Matrix from quantitative variables values of the flakes.

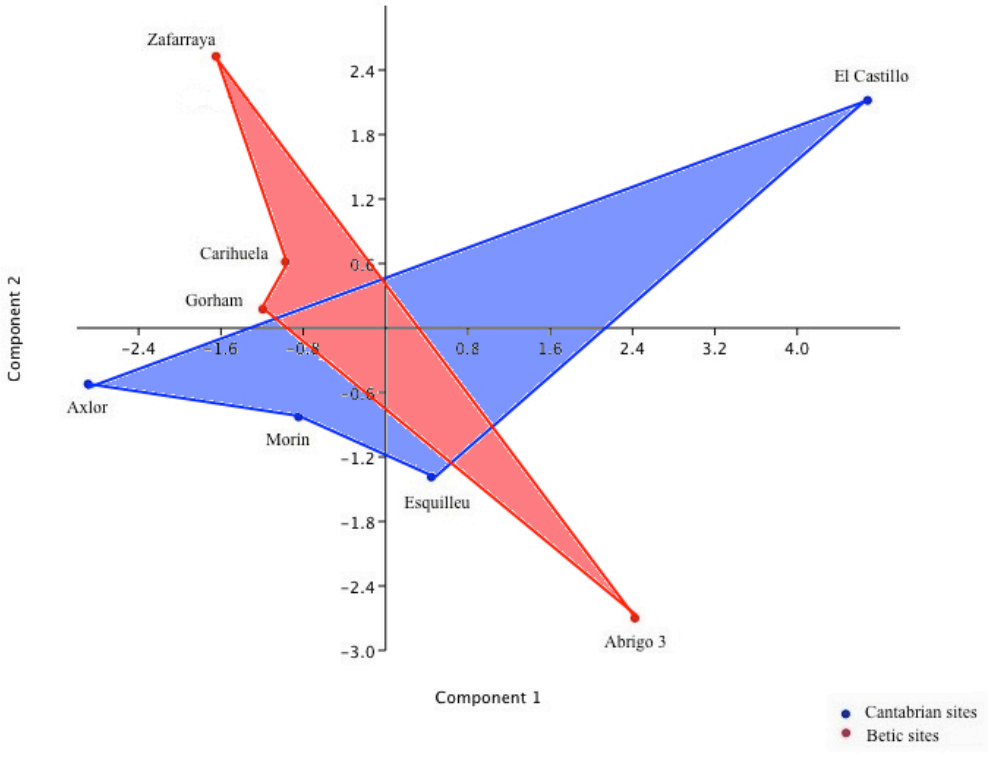
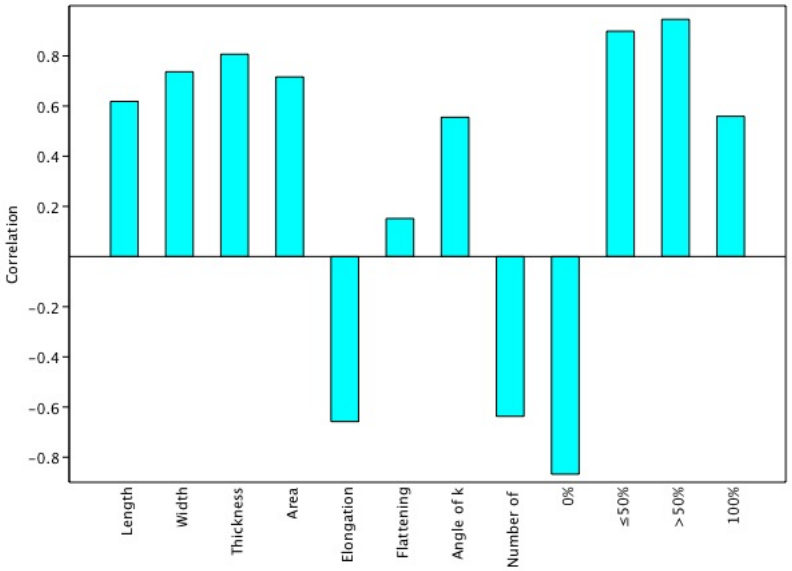


Figure 5.87. Scatter plot from quantitative variables values of the flakes.



Loadings	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
Length	0.61853	0.72418	-0.28961	-0.0010922	0.084453	0.038275	-0.022393
Width	0.73659	0.66441	-0.025515	0.076717	0.081283	0.05304	-0.0057942
Thickness	0.80658	0.51164	0.27022	-0.081791	0.028063	0.054809	0.064366
Area	0.71599	0.68809	-0.025736	0.097995	0.020188	0.041261	0.038966
Elongation Index	-0.65789	0.015794	-0.051687	0.67775	-0.1462	0.28755	0.029046
Flattening index	0.15158	-0.094263	0.96493	0.17208	0.075895	-0.039775	0.0098633
Angle of knapping	0.55525	-0.64775	0.0027471	-0.12467	0.41337	0.29	-0.039877
Number of scars	-0.63708	0.40471	-0.052355	0.45866	0.41856	-0.20079	-0.041479
0%	-0.86762	0.32864	0.10182	-0.29309	0.18624	0.091005	0.0016497
≤50%	0.8983	-0.26725	-0.0087122	0.31775	-0.12195	-0.029695	-0.069601
>50%	0.94557	-0.29398	0.035061	0.082922	-0.0706	-0.060343	-0.052413
100%	0.55911	-0.71063	-0.27496	0.18436	0.21128	-0.12079	0.11652

Figure 5.88 and Table 5.108. Loadings plot from quantitative variables values of the flakes.

The first two components comprise 75.7% of the variation (Table 5.107). The positive absolute values in PC1 (Figure 5.88 and Table 5.108) with their highest coefficients derive from measurements (Length, Width, Thickness, Area), angle of knapping, and percentage of cortex. The negative values are present in Elongation index, Number of scars, and 0% of cortex. In PC2 the positive values are the measurement variables again, and the percentage of cortex results now have negative values. It seems that positive correlations exist between the variables of measurement in PC1 and PC2. The negative values are represented in the percentage of cortex in PC2. The El Castillo and Abrigo 3 are very

separated in the scatter plot (Figure 5.87) for the measurement values and the percentage of cortex and are very different in comparison with the other sites.

Qualitative variables analysis

From the flakes a total of 36 qualitative attributes have been analysed. These includes: Type of butt (marked, difuse); delineation of ventral face (sinuous, convex, concave, straight); cortex of butt (cortical, non cortical); tipe of butt (platform, linear, cortical, puntiform); face of butt (plain, bifaceted, multifaceted, puntiform); delineation of butt (sinuous, convex, concave, straight, uniangular, biangular, triangular); direction of scars (centripetal, unidirectional, bidirectional, multidirectional…).

PCA Summary		
PC	Eigenvalue	% Variance
1	10.134	28.15
2	7.20091	20.003
3	5.61035	15.584
4	4.64952	12.915
5	4.15417	11.539
6	2.99838	8.3288
7	1.25265	3.4796

Table 5.109. Correlation Matrix from qualitative variables values of the flakes.

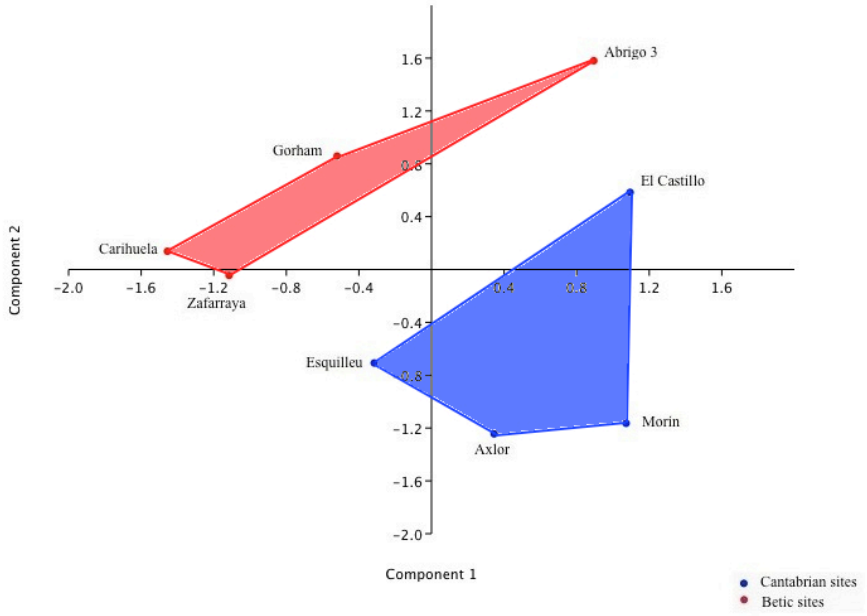
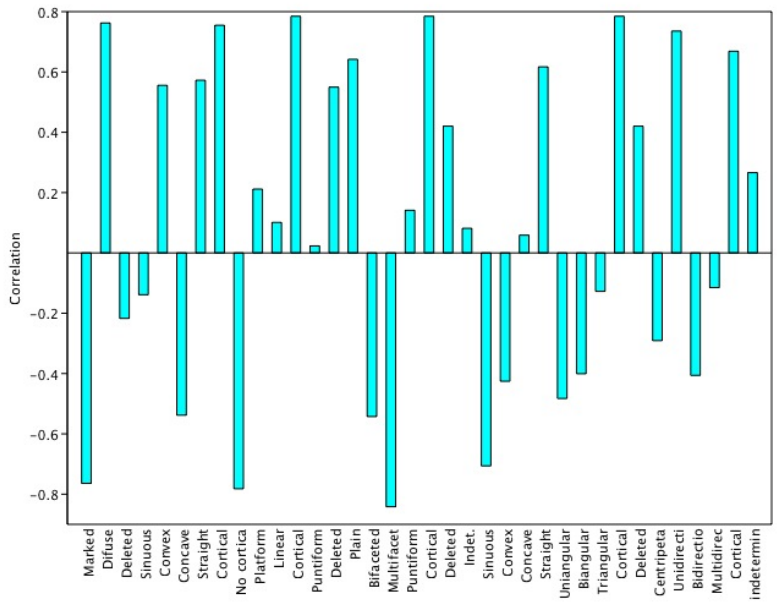


Figure 5.89. Scatter plot from qualitative variables values of the flakes.



Loadings	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
Marked	**-0.76401**	**0.52101**	**0.019439**	**-0.17153**	**0.16445**	**-0.28846**	**0.069194**
Difuse	**0.76243**	**-0.51574**	**-0.027082**	**0.19203**	**-0.17875**	**0.2809**	**-0.065116**
Deleted	**-0.21715**	**0.357**	**0.10503**	**-0.80291**	**0.18013**	**0.31199**	**-0.19981**
Sinuous	**-0.13862**	**0.030842**	**0.87618**	**-0.21984**	**0.34042**	**-0.21473**	**-0.042501**
Convex	**0.55571**	**-0.77245**	**-0.052641**	**-0.12014**	**-0.13865**	**0.12916**	**-0.20344**
Concave	**-0.53811**	**0.29624**	**-0.71868**	**-0.13594**	**-0.25507**	**-0.0142**	**0.14982**
Straight	**0.57256**	**0.13889**	**-0.40892**	**0.62428**	**-0.17429**	**0.25443**	**-0.028751**
Cortical	**0.7549**	**0.64633**	**-0.011377**	**-0.0029508**	**0.08177**	**0.045187**	**-0.059253**
No cortical	**-0.78199**	**-0.60679**	**0.0030334**	**-0.004488**	**-0.10906**	**-0.091427**	**-0.0020112**
Platform	**0.21164**	**0.011624**	**0.2518**	**0.89062**	**0.27684**	**-0.13992**	**-0.0474**
Linear	**0.1012**	**-0.27495**	**-0.25833**	**-0.23179**	**0.68108**	**-0.074007**	**0.56952**
Cortical	**0.78469**	**0.61583**	**-0.027752**	**0.036438**	**0.029978**	**-0.030782**	**-0.032867**
Puntiform	**0.023256**	**-0.23379**	**-0.75384**	**0.24151**	**0.53476**	**-0.11059**	**0.14142**
Deleted	**0.54971**	**0.7023**	**0.30052**	**-0.15313**	**0.10766**	**0.28144**	**0.0050688**
Plain	**0.64194**	**-0.67731**	**-0.19406**	**-0.29991**	**-0.027728**	**-0.026044**	**-0.010568**
Bifaceted	**-0.54263**	**0.33267**	**0.43708**	**0.26983**	**-0.28933**	**0.44271**	**-0.22657**
Multifaceted	**-0.84157**	**0.37954**	**0.083602**	**0.26322**	**-0.019328**	**-0.25413**	**0.080483**
Puntiform	**0.14136**	**-0.57802**	**0.093686**	**-0.24637**	**0.71544**	**0.15144**	**0.20408**
Cortical	**0.78469**	**0.61583**	**-0.027752**	**0.036438**	**0.029978**	**-0.030782**	**-0.032867**
Deleted	**0.42036**	**0.18022**	**0.45056**	**0.15102**	**-0.50613**	**-0.37694**	**0.40837**
Indet.	**0.081566**	**0.7326**	**-0.57633**	**0.15507**	**0.26792**	**0.16866**	**0.014718**
Sinuous	**-0.70609**	**0.51084**	**-0.086147**	**0.27124**	**0.064135**	**-0.39411**	**0.0070008**
Convex	**-0.42556**	**0.23138**	**-0.74526**	**0.0040592**	**-0.41132**	**0.20004**	**0.02693**
Concave	**0.058872**	**0.32551**	**-0.31152**	**-0.36453**	**-0.67368**	**0.3671**	**0.26839**
Straight	**0.61697**	**-0.70791**	**-0.15151**	**-0.29734**	**0.059081**	**0.054122**	**-0.020657**
Uniangular	**-0.4826**	**-0.21031**	**0.699**	**0.1381**	**-0.18666**	**0.42221**	**0.045785**
Biangular	**-0.40065**	**-0.24525**	**0.44271**	**0.55618**	**-0.055468**	**0.49825**	**0.1506**
Triangular	**-0.12753**	**-0.28594**	**0.21525**	**0.47182**	**-0.25086**	**0.68809**	**0.31086**
Cortical	**0.78469**	**0.61583**	**-0.027752**	**0.036438**	**0.029978**	**-0.030782**	**-0.032867**
Deleted	**0.42036**	**0.18022**	**0.45056**	**0.15102**	**-0.50613**	**-0.37694**	**0.40837**
Centripetal	**-0.29085**	**-0.062189**	**-0.0822**	**-0.75396**	**-0.57912**	**-0.0027155**	**0.030624**
Unidirectional	**0.73558**	**0.14934**	**0.59128**	**-0.12411**	**0.15019**	**-0.036035**	**0.2185**
Bidirectional	**-0.40604**	**0.3075**	**0.61686**	**-0.1411**	**0.55824**	**0.1241**	**-0.1145**
Multidirectional	**-0.11511**	**-0.22099**	**-0.42308**	**0.83004**	**0.22849**	**-0.083362**	**-0.10392**
Cortical	**0.66875**	**-0.17914**	**0.14931**	**0.16934**	**-0.42524**	**-0.45957**	**-0.27871**
indeterminate	**0.26611**	**0.57046**	**-0.13514**	**-0.071963**	**0.39737**	**0.64559**	**0.075033**

Figure 5.90 and Table 5.110. Loadings plot from qualitative variables values of the flakes.

The first three components comprise 63.7% of the variation (Table 5.109). The first observation we can make in the scatter plot (Figure 5.89) is the separation of the sites by area, forming polygons separating each, leading us to interpret that there are technical differences by geographic region. The loadings (Figure 5.90 and Table 5.110) according to PC1 are: with regard to the type of bulb, marked bulbs have a negative value and diffuse bulbs have a positive value. The marked bulb is most common in the Betic region, and the diffuse is commonest in the Cantabrian region. With respect to the delineation of the ventral face, negative values are more represented with the concave attribute (most predominant in the Betic region) and straight attribute are more represented with positive values (most common on flakes from Cantabrian region). From the cortex of butt data, cortical attributes have positive value and no cortical attributes have negative value. With these variables the asemblages have an equal proportion and there is a positive correlation between all sites. Regarding type of butt, all variables have positive values, highlighting the platform attribute in all sites. From the face of the butt the mainly positive values are plain and puntiform, with the same percentage in both areas. Bifaceted and multifaceted attributes have negative values. Regarding the delineation of the butt, the following attributes were recorded: sinuous, convex, uniangular, biangular, triangular, have negative values, however concave and straight attributes have positive values. There is a very clear difference between both areas regarding the delineation of the butt, the sinuous delineation prevailing in the Betic region and the straight delineation in Cantabrian. Regarding the direction of scars, the attributes with positive values are: centripetal, bidirectional, multidirectional, while those with negative values comprise the unidirectional attribute. In both regions there is a predominance of multidirectional attributes, however centripetal and bidirectional directions are more represented in the Betic region and unidirectional direction in the Cantabrian region.

5.4.2.2.3. Retouched tools

Quantitative variables analysis

Out of a total of 684 retouched tools of the eight assemblages studied, each piece was analysed using a total of ten quantitative attributes: length, width, thickness, area, elongation index, flattening index, extent of retouch (≤25%, >25 to ≤50%, >50% to ≤ 75%, >75% to ≤100%).

PCA Summary		
PC	Eigenvalue	% Variance
1	4.82041	48.204
2	2.93702	29.37
3	1.37018	13.702
4	0.582104	5.821
5	0.182428	1.8243
6	0.096898	0.96898
7	0.0109609	0.10961

Table 5.111. Correlation Matrix from quantitative variables values of the retouched tools.

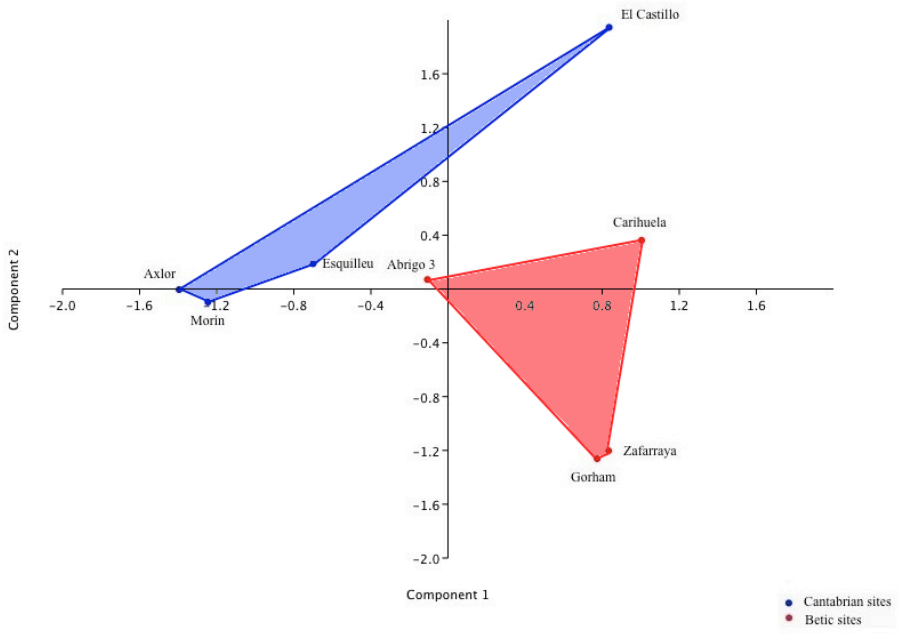
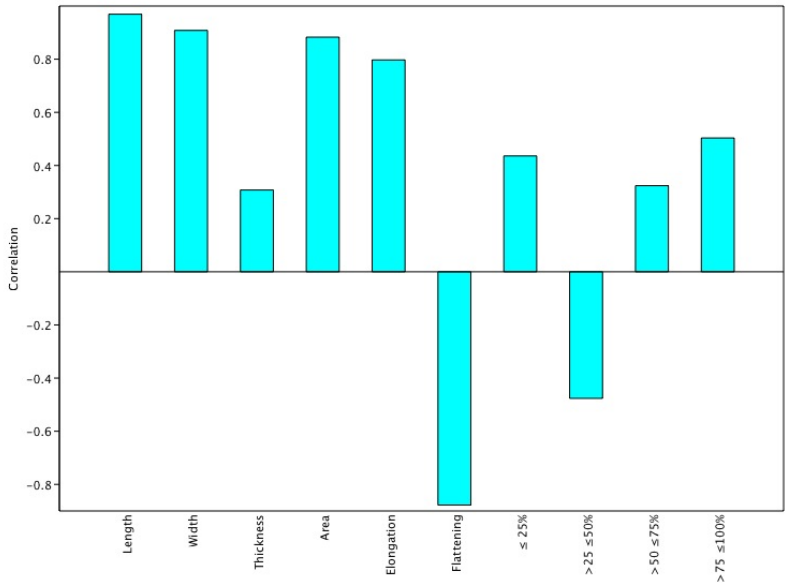


Figure 5.91. Scatter plot from quantitative variables values of the retouched tools.



Loadings	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
Length	0.96931	0.21546	0.10826	0.043137	0.019073	0.0024459	-0.0086453
Width	0.90825	0.38673	0.14545	-0.044842	0.021347	-0.037328	-0.022384
Thickness	0.30773	0.78825	0.51067	-0.09786	0.11217	-0.00062097	0.031789
Area	0.88292	0.43193	0.17785	-0.040101	-0.00026202	-0.002594	-0.025311
Elongation Index	0.79727	-0.42976	-0.11362	0.36572	0.00035193	0.17965	-0.027155
Flattening index	-0.87782	-0.055661	0.36497	-0.038727	0.28606	0.089169	-0.042929
≤ 25%	0.43597	-0.76807	0.45238	-0.042832	0.038257	0.087808	0.065901
>25 ≤50%	-0.47633	0.5926	0.13517	0.63358	0.011901	-0.038584	0.024566
>50 ≤75%	0.32406	0.40238	-0.822	-0.06141	0.22283	0.052878	0.034267
>75 ≤100%	0.50348	-0.80145	-0.013312	0.15737	0.18957	-0.20802	-0.0057454

Figure 5.92 and Table 5.112. Loadings plot from quantitative variables values of the retouched tools.

The first two components comprise 77.5% of the variation (Table 5.111). In the table one can see that the positive absolute values in PC1 (Figure 5.92 and Table 5.112) with the highest coefficients are from measurements Length, Width, Thickness, Area, Elongation index, and the extent of retouch (≤25%, >50% ≤ 75%, >75% to ≤100%). The negative values are present in Flattening index and >25 to ≤50% of extent of retouch. In PC2 the positive values are the measurement variables again, and the extent of retouch now has negative values in ≤25% and >75% to ≤100%. Both the Flattening and Elongation indices have negative values. Positive correlations exist between the variables of measurements, in PC1 and PC2. Regarding the thickness, in the Cantabrian region the retouched tools are thicker than in the Betic Area. Regarding the extent of retouch in the Cantabrian region

>25% to ≤50% extent of retouch dominates all assemblages, but in the Betic region >25% have a higher percentage. For these differences the scatter plot (Figure 5.91) shows the separation of the sites by area, forming polygons separating each area.

Qualitative variables analysis

A total of 38 qualitative attributes have been analysed by piece: types of blank (flakes, fragmented flake, fragment of flake, fragment of core, chunk, debris); facial attribute (unifacial, bifacial); localisation of retouch (left, distal, right, proximal); angle (abrupt, semi abrupt, simple); depth of retouch on surface (very marginal, marginal, extensive, very extensive); depth of retouch on edge (very marginal, marginal, deep, very deep); direction (direct, inverse, alternate, alternating); delineation (continuous, no continuous, denticulate, encoche); morphology (straight, convex, concave, sinuous, denticulate, encoche).

PCA Summary		
PC	Eigenvalue	% Variance
1	11.2484	29.601
2	9.70235	25.532
3	5.93204	15.611
4	3.84759	10.125
5	3.34554	8.8041
6	2.28156	6.0041
7	1.64253	4.3224

Table 5.113. Correlation Matrix from qualitative variables values of the retouched tools.

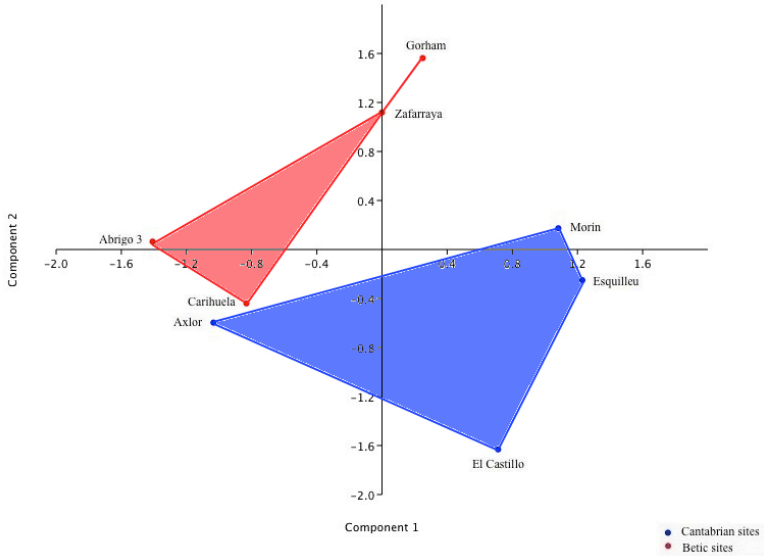
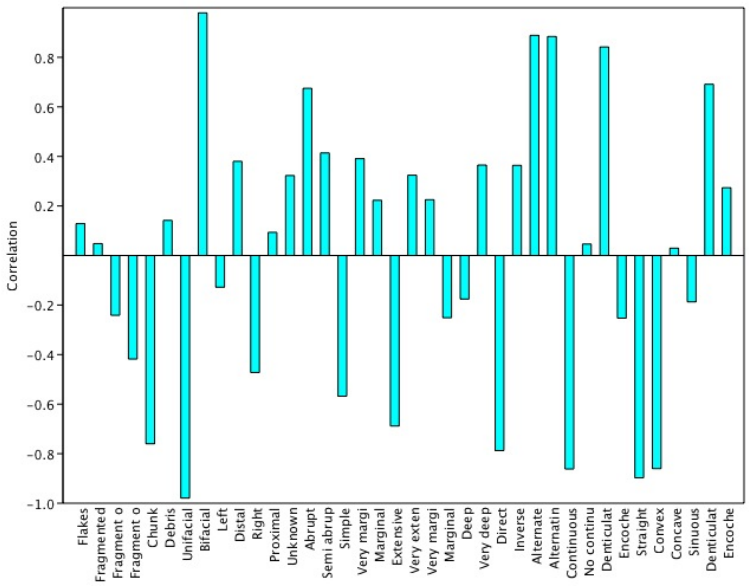


Figure 5.93. Scatter plot from qualitative variables values of the retouched tools.



Loadings	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
Flakes	0.12871	-0.31491	-0.74199	-0.50565	-0.15203	0.23	0.044994
Fragmented flake	0.048123	0.18567	0.81971	0.36493	0.05727	-0.38577	-0.077584
Fragment of flake	-0.24141	0.68282	-0.069584	0.36203	0.39081	0.428	-0.060388
Fragment of core	-0.41793	-0.24119	0.0085629	0.81147	0.15029	0.19315	0.22071
Chunk	-0.76002	-0.13339	0.43333	0.15745	-0.068023	-0.18099	0.39323
Debris	0.14172	-0.081146	0.41815	0.78427	-0.059286	-0.24283	-0.34775
Unifacial	-0.97934	0.0071912	0.010427	0.11987	-0.11454	-0.057932	-0.099494
Bifacial	0.97934	-0.0071912	-0.010427	-0.11987	0.11454	0.057932	0.099494
Left	-0.12798	0.54016	0.62499	-0.4564	-0.18357	0.04897	0.23841
Distal	0.38007	0.023278	-0.36282	0.22789	0.70813	0.31977	-0.26026
Right	-0.47227	0.09538	-0.013635	-0.071011	-0.84867	0.20389	-0.028603
Proximal	0.09343	0.32536	-0.026445	0.8287	-0.29899	-0.22249	0.24302
Unknown	0.32276	-0.60522	0.12881	-0.2105	0.20577	-0.65291	-0.002537
Abrupt	0.67493	-0.13966	0.36872	0.38564	0.42789	-0.028899	0.23742
Semi abrupt	0.41395	-0.85784	0.21447	0.037778	-0.037382	0.0375	0.20624
Simple	-0.56811	0.66244	-0.29507	-0.20169	-0.20421	-0.0031049	-0.26262
Very marginal	0.39087	0.80314	-0.27648	0.20408	-0.28948	-0.014635	0.0085071
Marginal	0.22282	0.57639	0.67567	-0.13765	0.35345	-0.041353	-0.12658
Extensive	-0.68834	-0.70224	-0.065588	0.12377	-0.10242	0.049958	0.021044
Very extensive	0.32413	-0.82866	-0.40923	-0.087929	0.099997	0.027773	0.14931
Very marginal	0.22521	0.70751	-0.57652	0.20155	-0.19238	-0.19288	0.038796
Marginal	-0.25121	0.34097	0.84709	-0.29834	-0.030796	0.069039	-0.091399
Deep	-0.17576	-0.83763	-0.13491	0.3841	0.075305	0.28343	-0.12546
Very deep	0.36506	-0.73051	-0.31176	-0.24578	0.30455	-0.24777	0.14606
Direct	-0.78752	-0.53804	-0.076748	0.11419	0.02201	0.011822	-0.26604
Inverse	0.36384	0.87074	0.079492	-0.029848	-0.016375	-0.22159	0.22991
Alternate	0.88863	0.16098	-0.12187	-0.17554	0.077226	-0.21993	0.29056
Alternating	0.88396	0.17799	0.28836	0.086161	-0.10573	0.28864	-0.043242
Continuous	-0.86184	0.011365	-0.24846	0.017765	0.36969	-0.132	0.2024
No continuous	0.046177	0.69379	-0.65101	0.03155	-0.14022	-0.21792	0.15672
Denticulate	0.84176	-0.10097	0.2593	0.01319	-0.37917	0.096243	-0.2466
Encoche	-0.253	0.32245	0.55872	-0.36048	0.40995	0.38482	0.27157
Straight	-0.89734	0.14039	0.35645	-0.17791	-0.027592	0.073251	0.10112
Convex	-0.8603	-0.27643	0.082815	-0.18765	0.26949	-0.22872	0.12831
Concave	0.02954	0.73681	-0.13832	-0.063642	0.57628	0.19226	-0.25295
Sinuous	-0.18722	0.63506	-0.64028	0.26966	0.12396	-0.1084	0.22769
Denticulate	0.69122	-0.50516	0.29297	-0.0086046	-0.37027	0.025213	-0.2083
Encoche	0.27358	-0.21081	0.19746	0.25473	-0.29416	0.66148	0.50275

Figure 5.94 and Table 5.114. Loadings plot from qualitative variables values of the retouched tools.

The first three components comprise 70.7% of the variation (Table 5.113). The scatter plot (Figure 5.93) show the separation of the sites by area, forming polygons separating each, where the sites are very dispersed due to their heterogeneity and variability.

The positive values with the highest coefficients in PC1 (Figure 5.94 and Table 5.114) are: from facial attribute (bifacial); from localisation of retouch (distal); type of angle (abrupt, semi abrupt); from the depth of retouch on surface (very marginal, marginal, extensive, very extensive); from the depth of retouch on edge (very marginal, marginal); from the direction (inverse, alternate, alternating); type of delineation (denticulate); from morphology (denticulate).

The positive values in PC2 are from types of blank (fragment of flake); from localisation of retouch (left); type of angle (simple); from depth of retouch on surface (very marginal, marginal); from depth of retouch on edge (very marginal, marginal); direction (inverse); type of delineation (no continuous, denticulate, encoche) and from morphology (concave, sinuous).

The positive values in PC3 are from types of blank (fragmented flake, chunk, debris); from facial attribute (unifacial, bifacial); from localisation of retouch (left); from depth of retouch on the surface (marginal); from depth of retouch on the edge (marginal); type of delineation (encoche) and from morphology (straight).

Although some sites show a closer correlation, the loadings show a lot of heterogeneity in the values of the PCs and scatter plots show a separation of sites by area and within each area.

5.5. SUMMARY

In summary, after the comparison of the characteristics observed, I now want to point out the differences and similarities in the lithic technological aspects by Neanderthals in both regions of study.

Similarities

Cores

In both regions the methods of knapping most commonly used were the discoidal and recurrent centripetal Levallois methods. However, in the Cantabrian region there is a great presence of discoidal methods and a low representation of the Levallois method by comparison to the Betic region. The Levallois method that is dominant in both areas is the centripetal recurrent Levallois with very few examples of the preferential Levallois method, although exhaustion of cores in many cases can mask the method of knapping employed.

The blanks obtained by the method of reduction are mainly flakes with thick butts and peripheral cutting edges. There is a high degree of core exhaustion in both regions because the cores from both areas were of small size at the moment of their final abandonment. In both areas the majority of cores still retained some of their cortex at the point they were abandoned. In addition, in both areas the cores produced from local raw materials correspond with the pieces retaining the most amount of cortex, although in the Betic region the cores retained more cortex than in the Cantabrian region.

Regarding the stages of the knapping sequence, we observe that most of the cores from both regions are in the terminal stage, which indicates that the Neanderthals groups exploited them to the maximum to obtain the greatest possible number of flakes from each core.

When looking at how the cores were reduced, we observe that bifacial reduction is the dominant method in both regions.

Regarding the knapping strategies employed, there was much variation, but the most common strategy in both regions is the centripetal.

Flakes

Metric measurements and area analysis of the flakes yields very similar quantitative data; there is a small difference on average between the sites from both regions.

Regarding the amount of cortex, the dominant finding in both areas is that the flakes do not retain any cortex and a low percentage of flakes retain cortex.

With respect to the delineation of ventral face, in both regions the sinuous delineation is the most represented in all assemblages.

With regard to the retention of cortex in the butt of the flakes, the majority of assemblages do not show cortex in both areas.

With respect to the type of butt, the platform butt is the most common in all assemblages.

With respect to the facet of butt, the plain butt is dominant in both areas.

There is a variety of directions of scarring in all assemblages in both regions. However, in both the multidirectional pattern is most common, followed by unidirectional and centripetal direction of scarring. Less represented is the bidirectional direction in all assemblages.

Retouched tools

Metric measurements and area analysis of the retouched tools yields very similar quantitative data; there is a small difference on average between the sites from both regions.

The kind of blanks that were selected for retouching are flakes in all the assemblages from both areas.

The majority of the retouched tools from all assemblages have unifacial retouch.

Regarding the localization of the retouch, the sides of the blank (left and right) are where most retouch is located in all assemblages, followed by the distal and proximal sides respectively.

Regarding the angle of retouch, the semi-abrupt angle is most common in the all assemblages in both regions.

With regard to the extent of retouch on the dorsal/ventral surfaces, we can observe that the marginal and extensive extent of retouch are the most represented in the assemblages from both regions. In regard to the depth of retouch, both attributes (marginal and deep) are most common in all lithic assemblages. Most of the pieces in the majority of assemblages do not have an intense configuration on the edges.

The predominant direction of retouch is direct in all assemblages in both regions.

Among the retouched tools, scrapers and denticulates make up the biggest group.

Differences

Cores

There is a high use of the discoidal method in the Cantabrian region and a lower use of the Levallois method in comparison with Betic region.

The Quina method is used in the late Mousterian levels in the Cantabrian region, in the sites of the Basque Country, whereas in the Betic region this method is practically absent (with the exception of the El Niño site).

Flakes

Regarding the bulb of percussion on the flakes, the flakes from the assemblages of the Betic region are dominated by pronounced bulbs, although the assemblages of the Cantabrian region are dominated by diffuse bulbs.

With regard to the delineation of the ventral face, concave delineation is more represented in the Betic region and straight delineation in the assemblages of Cantabrian region.

The line butt is emphasized in the Axlor site (Cantabrian region) when compared to all other sites. The reason for this is the methods of knapping used, both the Quina method and the Quina retouch.

From the face of butt there are several differences. In the Cantabrian region the percentage of plain butts is bigger than in the Betic region. In the Betic region the bifaceted and multifaceted butt are more represented.

There are very clear differences between both areas regarding the delineation of the butt, with the sinuous delineation prevailing in the Betic region and straight delineation in Cantabrian region.

With regard to the direction of scar attributes, in the Betic region centripetal and bidirectional directions are more represented than in the Cantabrian. In the Cantabrian region, unidirectional direction is more strongly represented than in the Betic region.

Retouched tools

The retouched tools pieces in the Cantabrian region are thicker than in the Betic region.

Regarding the extent of retouch in the Cantabrian region >25% to ≤50% extent of retouching predominate in the all assemblages, but in the Betic region >25% have a higher percentage. So in the Cantabrian region the edges of the blanks are more retouched than in the Betic region.

In the Betic region simple angle retouch is more representative than in the Cantabrian region, and in the Cantabrian region semi-abrupt and abrupt angle retouch have higher percentage than in the Betic region.

With regard to the delineation of the retouched edge, in the Betic region continuous delineation is dominant. In the Cantabrian region, two sites have dominant continuous (Axlor and El Castillo) and in the other two (Morín and Esquilleu) denticulate delineation.

Regarding the morphology of the retouched edge, there is a high variety in the Cantabrian region with the denticulate morphology being the most common. However, in the Betic region sinuous, convex and straight morphologies are the most common.

From a typological point of view in the Cantabrian region in the Late Middle Palaeolithic the denticulate is most represented and in the Betic region it is the scrapers.

In the Cantabrian region there is a type of retouched tool that is absent in the Betic during the Late Middle Palaeolithic, namely: the Quina scraper.

The flake cleavers are present in the Cantabrian region, but are non-existent in the Betic region during the Late Middle Palaeolihic.

CHAPTER 6

NEANDERTHAL SUBSISTENCE

6.1. INTRODUCTION

Faunal evidence forms the second data set for this comparative study between the Cantabrian and Betic regions. A database of the faunal remains from 39 Middle Palaeolithic sites from each region (11 from the Betic and 24 from the Cantabrian) was constructed from the literature in order to address the following questions:

Was Neanderthal diet diverse?

What species of animals did Neanderthals consume most abundantly or frequently in both regions?

Which of the two regions had a richer diversity of species?

Faunal remains are the principal source of information regarding Neanderthal subsistence. Data were obtained from a variety of published sources: Altuna (1972), Straus (1992), Castaños (2005), and Yravedra (2001), and supplemented by the various publications regarding the faunal evidence from each archaeological site (Breuil 1922; Garrod *et al* 1928; Fuentes & Mejide 1975; Díez *et al* 1989; Villaverde & Martínez Valle 1992; Martínez Valle 1996; Baldeón 1999; Baena *et al* 2001, 2005; Barroso 2003; Jennings *et al* 2009; Utrilla *et al* 2010; Ríos-Garaizar 2003, 2012; Yravedra 2007, 2010a,b,c,d,e, *et al* 2013a,b, 2015; Barton *et al* 2012; Pérez 2014). Subsistence and diet are central for our understanding of hominin evolution, behaviour, adaptation, and environmental exploitation. Within the last decade, an abundance of studies focusing on Neanderthal subsistence and hunting strategies has been providing a new perspective about their behaviour and cognitive ability (Patou-Mathis 2000, Dusseldorp 2009, Blasco & Fernández 2012a,b, *et al* 2010, 2014, Hardy & Moncel 2011; Salazar-García *et al* 2013, Yravedra *et al* 2014).

Data derived from different geographical areas, and multidisciplinary research methods are providing new interpretations about Neanderthal diets. The Neanderthals occupied a large territory, spanning from the Iberian Peninsula to Siberia, encompassing a great diversity of environments as well as resources. It has been established, that Neanderthal diet was as diverse as their territories, adapting to local resources, and incorporating diverse strategies whilst exploiting differing environments such as coastal, inland, river valley, plateau or

mountain settings.

The Iberian Peninsula is a mosaic of environments, encompassing a highly heterogeneous collection of habitats. It is almost entirely surrounded by the sea and is topographically and ecologically diverse. Iberia also served as a refuge for temperate species during the Quaternary glacial cycles (O´Regan 2008) and zooarchaeological studies show that the Neanderthals carried out a wide and varied faunal exploitation (Salazar-García *et al* 2013). In addition, cold-adapted taxa such as reindeer, woolly rhinoceros, and giant deer, crossed the corridor between the Basque Country coastline and the Pyrenees as well as through the Pyrenees Mountains themselves and lived in the northern region of the Iberia, further adding to this area´s diversity of species.

Many of the Middle Palaeolithic sites in the regions under study did not have any faunal information available as they have yet to be studied. Of the studies that were published, the NISP (number of identified specimens) was used in our comparisons, as some studies did not publish their MNI (minimum number of individuals) data. For this analysis, I used the faunal assemblages recovered from archaeological levels with recorded anthropic activity. Due to a lack of taphonomic studies, it was not possible to confirm whether the faunal assemblage was accumulated in the sites by human inhabitants, by carnivores, or a combination of both.

Archaeological interpretation is further complicated by the fact that during the Middle Palaeolithic, both Neanderthals and carnivores often occupied the same sites alternately, with each predator group generating significant palimpsests (Binford 1981, Stiner 1994, Yravedra 2011, Talamo *et al* 2016). Additionally, some of the sites have not been extensively excavated over the total area of occupation, further biasing the faunal assemblage.

It is also crucial to consider the various theories and debates regarding the ecological interpretation of the faunal assemblages. Among them we can highlight:

The hunting vs. scavenging debate

Binford proposed that hominin involvement with animal carcases did not necessarily mean that the animal was hunted but most likely was scavenged, speculating that the hunting of

animals, such as ungulates, did not occur until very recently (Binford 1981, 1984). This theory posed significant repercussions for the interpretation of Neanderthal archaeology. Similarly, Stiner (1994) analysed several Italian Middle Palaeolithic sites and proposed a largely scavenging mode of subsistence before 50 ka. Recent research, however, has shown that Neanderthals were neither passive scavengers nor inferior hunters.

The discovery of different archaeological sites with pointed artefacts, clearly intended to be used for hunting, has intensified this debate. Examples of these sites are: Schöningen (Germany), where an assemblage of eight wooden spears associated with animal bones was recovered and dated to between 380,000 and 400,000 BP. This site was considered to be a "kill site" by pre-Neanderthals (Thieme & Veil 1985, Veil & Plisson 1990, Thieme 1997, 2000, Weber 2000, Roebroeks 2001); Lehringen site (Germany), dated to 125,000 BP, where an elephant carcass was recovered in association with stone tools and a wooden spear (Thieme & Veil 1985, Gaudzinski 2004); and Umm-el-Tlel (Syria) where a fragment of a Levallois flake was found embedded in a wild donkey vertebra, recovered from a Mousterian level dated to 50,000 BP (Boëda *et al* 1999).

Other evidence of stone artefacts designed for hunting found within the Middle Palaeolithic of Middle East have been recorded (Shea 1988, 1998, 2001), for instance, at Skhul, Qafzeh XV (Hovers 2009), Kebara (Meigmen & Bar-Yosef, 1992), Tabun (Garrod & Bate 1937, Jelinek 1982), Amud (Hovers 1998), Yabroud (Solecki & Solecki, 1995), and Tor Faraj (Groucutt 2014). Sites with similar operational chains oriented towards the production of hunting points have also been documented within the Iberian Peninsula (El Pastor (Galván *et al* 2007); Carihuela; Zafarraya; El Castillo; Amalda (Ríos-Garaizar 2012a,b); Axlor (Ríos-Garaizar 2012a,b). Some authors have argued that some of the Middle Palaeolithic points could have been used for melee, or as long distance projectiles (Boëda *et al* 1999, Shea 1998, 2001, Plisson & Beyries 1998). In addition, some of these points show impact scars on their surface where they have been impacted (Villa *et al* 2009, Ríos-Garaizar 2012a,b), as well as intentional thinning of the bulbs and butt platforms to facilitate hafting (Wendorf & Schild 1993).

Such examples help further support the thesis that Palaeolithic humans actively hunted. Recent analyses of the lithic, zooarchaeological and palaeo-diet data from Neanderthal sites suggest that they were more prolific at hunting than at scavenging, as was previously thought.

Specialised or opportunistic hunting

The question of "specialization" in the exploitation of faunal resources has been heavily debated. The hunting patterns documented in Middle Palaeolithic sites suggest a great variability in subsistence strategies. Some authors propose that the Neanderthals were opportunistic hunters because they had no organisational abilities when compared to anatomically modern humans (Mellars 1973,1989, Gamble 1986, Stiner 1994). Others, in turn, suggest that Neanderthals were in fact selective hunters (Gardeisen 1999, Hoffecker & Cleghron 2000), preferential hunters (Farizi *et al* 1994, Jaubert *et al* 1990, Maroto *et al* 2001, Blasco 1997, Moncel *et al* 1998, Boyle, 2000, Ríos-Garaizar 2005, Bourguignon 2002, Yravedra *et al* 2014), or systematic hunters (Chase 1989, Grayson & Delpech 2003, Hockett & Haws, 2005, Conard *et al* 2012, Rendu *et al* 2012).

In our area of study there is evidence of specialised hunting within Neanderthal groups, at sites such as Axlor (Castaños 2005), Esquilleu (Baena *et al* 2001, Yravedra *et al* 2014), and Amalda (Altuna 1990) in the Cantabrian region and Zafarraya (Barroso 2003) and Horá (Fuentes & Mejide 1975) in the Betic region. Furthermore, generalised hunting is often interpreted as opportunistic, and it is this "opportunistic behaviour" that has led many to believe that Neanderthals were incapable of being organised in terms of their hunting strategies. In reality, however, we are seeing evidence of extensive planning by Neanderthal groups, in terms of the preparation of their tool kits, the knowledge of their surrounding environment, the species that inhabited the different biotopes, the techniques of hunting or capture, the consumption of their prey using fire, the treatment of the carcass, which suggest all of complex behaviors and a high organizational capacity, similar to that found in the Upper Palaeolithic record.

The key is to know the environments which Neanderthal groups occupied. Whilst exploiting the resources available in a specific biotope, there is the possibility that they also selected specific resources more convenient for them. The Neanderthals took the place of predators in the food chain, but without staying in a pre-determined environment they were able to choose to hunt one species or an other depending on circumstances. Therefore, we must consider both possibilities and not think of then as exclusive. The first factor is climatic and the other economic. In the past, however, these factors have usually been dealt with as exclusive factors.

It is necessary to differentiate between monospecific and multispecific sites. In monospecific sites, hunting was oriented towards one or two species. These present an apparent specialization, but the specific animals were determined by the abundance of the taxon in the environment, seasonal movements and climate, among others. It is necessary to consider the ecological conditions of the sites to understand cases of hyperspecialization. The multispecies sites show a more general presence of prey, and will depend on the environmental biodiversity of the site. Therefore specialization will often depend on purely on climatic factors, and on the availability and presence of monospecies in a specific context, whereas generalised hunting may be indicative of a richer abundance of species in the environment, rather than either strategy being a reflection of behavioural or cognitive abilities. In addition, it is necessary to consider other factors, such as the functionality of the site, the time of occupation and the Neanderthal occupants and their individual choices, often selecting prey according to their age sex or ethology, or hunting seasonally (Patou-Mathis 2000).

Optimal foraging model

This model focuses on foraging strategies, derived from behavioural ecology and economics (Raport & Turner 1977), which assumes that the most economically advantageous foraging pattern will be selected for in a species through natural selection. This model was originally designed for ecological analyses and rarely applied outside this field, despite the fact that it has significant application for archaeological sites as well (Dusseldorp 2009).

Broad Spectrum Revolution

This model was proposed by Kent Flannery (1969) and revolved around the shift from the hunting of large game to a focus on the use of birds, reptiles, fish, invertebrates and plant resources. Since Flannery proposed it, researchers have found support for his hypothesis in faunal assemblages from Upper Pleistocene sites. According to Stiner *et al* (1999, 2000, 2001), the exploitation of small animals rises in importance only in the late Middle Palaeolithic ca 50,000 cal BP and especially in the Upper Palaeolithic. The central idea of her thesis is that anatomically modern humans were able to replace Neanderthals because of their ability to hunt small game in high proportions, therefore enabling modern humans to maintain higher population densities. However, faunal evidence from some Middle

Palaeolithic sites suggests that Neanderthals comonly exploited small prey, as I discuss in further detail below.

The emergence of new scientific methodologies has further enabled new approaches to the investigation and interpretation of Neanderthal subsistence. Stable isotope analyses on Neanderthal remains have shown that most of their food came from animal protein (Richard *et al* 2000, Bocherens *et al* 1991, 2001). Additionally, recent microscopic residue analysis has also suggested that plant consumption was a significant part of the Neanderthal diet (El Zaatari *et al* 2011, Hardy *et al* 2012, 2017, Weyrich *et al* 2017).

The variability of the subsistence behaviour, as recorded by the faunal evidence recovered from the Middle Palaeolithic sites analysed as part of this thesis, will be considered in greater detail below, focusing on:

- Large game (including horses; bovids, goats; chamois; deers; reindeers; roe deers; wild boars; woolly rhinoceros; megaloceros; and mammoths)

- Cannibalism

- Small game (including rabbits; tortoise; marine resources; fishes; and birds)

- Plants

6.2. LARGE GAME:

All of the Middle Palaeolithic sites from both study regions show an abundance of large herbivore remains within their faunal assemblage. Such a high proportion suggests that these assemblages could not have been accumulated solely from scavenging by Neanderthals, therefore showing Neanderthals as more than capable of systematically hunting medium to large prey. This is further substantiated by isotope analyses of Neanderthal remains, which show meat from ungulates as the main source of sustenance (Bocherens *et al* 2001, 2005, 2014, Richards & Trinkaus 2009). Figures 6.1 and 6.2 below present the zooarchaeological data from the Middle Palaeolithic assemblages recovered from the 24 sites within the Cantabrian region and 11 sites within the Betic region featured in this thesis. Figure 6.1 shows the total sum of Number of Identified Specimens (NISP)

for each species identified for all Middle Palaeolithic Levels within each study region. Figure 6.2 shows the presence of each identified species, as a percentage, from each site within the study regions. Most of the faunal assemblages have not undergone significant taphonomic analyses, therefore not providing any quantitative evidence for how the assemblage was accumulated, if by human or carnivorous action, which in turn masks the NISP data. For this reason, the percentage of presence/absence of species from each study site will be compared.

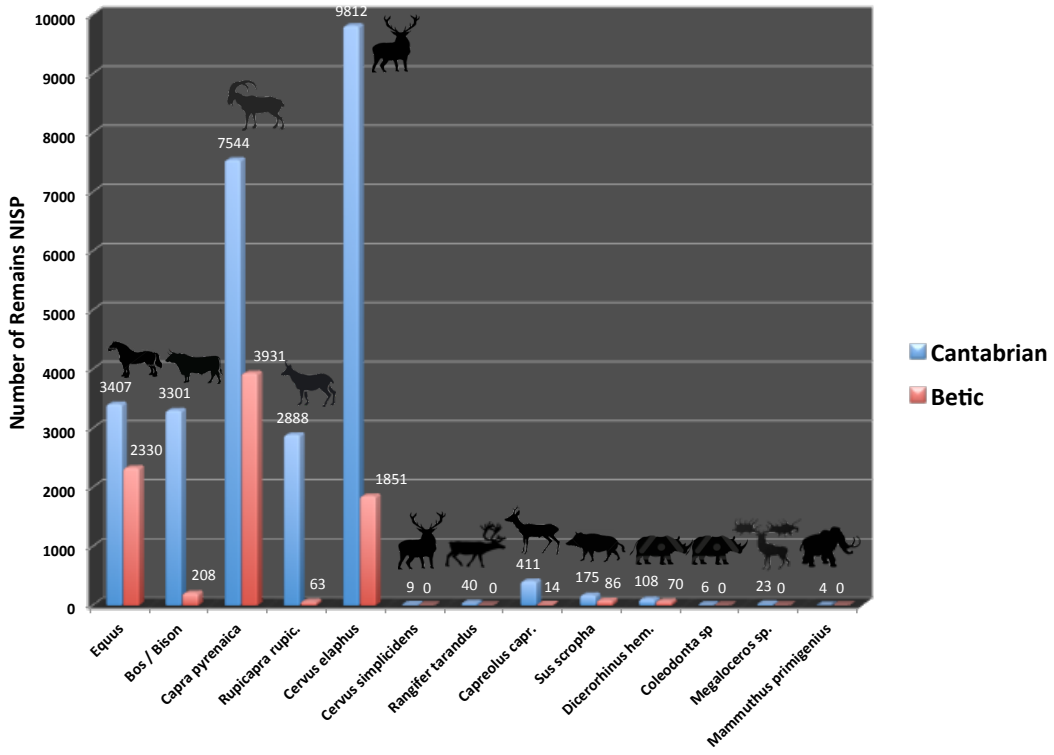


Figure 6.1. Bar chart of NISP total sum of each species from both regions.

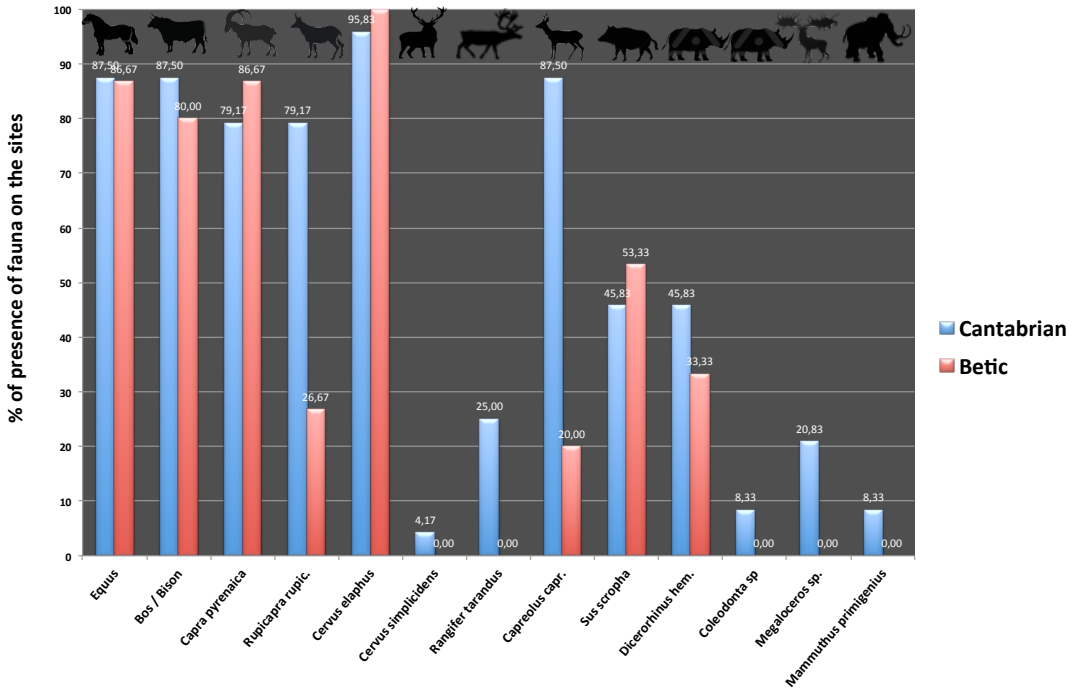


Figure 6.2. Bar chart of the percentage of presence of each species in the sites of both regions.

6.2.1. Faunal assemblages from Cantabrian region:

In the Cantabrian region during the Late Middle Palaeolithic, red deer (*Cervus elaphus*), ibex (*Capra pyrenaica*), horse (*Equus*), bovid (*Bos/Bison*) and chamois (*Rupicapra rupicapra*) constituted the bulk of the ungulate fauna in most assemblages indicating a selectived preference for medium sized prey. Others large herbivore species such as wild boar (*Sus scrofa*), roe deer (*Capreolus capreolus*), reindeer (*Rangifer tarandus*) rhinoceroes (*Dicerohinus hemitoechus*, Coleodonta sp), giant deer (Megaloceros sp.), and elephants/mammoths constitute a very small percentage (figure 6.1 and 6.2).

ZONE	SITE	LAYER	Equus	Bos / Bison	Capra pyrenaica	Rupicapra rupic.	Cervus elaphus	Cervus simplicidens	Rangifer tarandus	Capreolus capr.	Sus scropha	Dicerorhinus hem.	Cf. Rhinocerotidae	Coleodonta sp	Megaloceros sp.	Mammuthus primigenius	UNGULATES	ROCKY	WOODED	PLAIN
			NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	14	total	total	total
Cantabrian	El Conde	D	2	0	0	2	0	0	0	0	0	0	0	0	0	0	4	2	0	2
		E	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
	El Esquilleu	3	0	0	118	28	5	0	0	2	0	0	0	0	0	0	153	146	7	0
		4	0	0	35	14	6	0	0	0	0	0	0	0	0	0	55	49	6	0
		5	0	0	66	27	11	0	0	0	0	0	0	0	0	0	104	93	11	0
		6	0	0	139	13	34	0	0	0	0	0	0	0	0	0	186	152	34	0
		6f	0	0	106	7	27	0	0	0	0	0	0	0	0	0	140	113	27	0
		7	0	0	46	19	34	0	0	0	0	0	0	0	0	0	99	65	34	0
		8	0	2	32	3	23	0	0	0	0	0	0	0	0	0	60	35	23	2
		9	0	0	9	12	14	0	0	0	0	0	0	0	0	0	35	21	14	0
		10	0	0	5	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0
		11	0	1	35	9	15	0	0	0	0	0	0	0	0	0	60	44	15	1
		11f	0	15	888	127	407	0	0	0	0	0	0	0	0	0	1437	1015	407	15
		12	0	0	35	1	14	0	0	0	0	0	0	0	0	0	50	36	14	0
		13	0	27	197	34	103	0	0	0	0	0	0	0	0	0	361	231	103	27
		14	0	0	38	0	11	0	0	0	0	0	0	0	0	0	49	38	11	0
		15	0	0	30	2	0	0	0	0	0	0	0	0	0	0	32	32	0	0
		16	0	0	38	0	0	0	0	0	0	0	0	0	0	0	38	38	0	0
		17	0	0	10	0	1	0	0	0	0	0	0	0	0	0	11	10	1	0
		18	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0
		19	0	0	11	0	0	0	0	0	0	0	0	0	0	0	11	11	0	0
		20	0	0	76	4	9	0	0	0	0	0	0	0	0	0	89	80	9	0
		21	0	0	450	0	2	0	0	0	0	0	0	0	0	0	452	450	2	0
		22	0	0	42	0	3	0	0	0	0	0	0	0	0	0	45	42	3	0
		23	0	0	81	0	4	0	0	0	0	0	0	0	0	0	85	81	4	0
		24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		26	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
		27	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
		28	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
		29	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
		30	0	0	1	3	1	0	0	0	0	0	0	0	0	0	5	4	1	0
	Hornos de la Pena	F	29	7	4	77	27	0	0	8	0	0	0	0	0	0	152	81	35	36
	El Castillo	20	51	39	4	12	82	0	0	9	0	23	0	0	0	0	220	16	91	113
	El Ruso	V	58	7	3	0	179	0	0	4	0	0	0	0	0	1	252	3	183	66
	El Pendo	VIIID	0	2	0	0	46	0	0	2	0	0	0	0	0	0	50	0	48	2
		IX	0	1	0	0	29	0	0	0	0	0	0	0	0	0	30	0	29	1
		XI-XIII	4	6	0	0	10	0	0	0	0	0	0	0	0	0	20	0	10	10
		XIV	6	4	0	0	9	0	0	0	0	0	0	0	0	0	19	0	9	10
		XV	1	46	0	0	3	0	0	0	0	0	0	0	0	0	50	0	3	47
		XVI	89	70	1	0	237	0	0	18	2	4	0	0	9	0	430	1	257	163
	Cueva Morin	15	1	2	0	0	6	0	0	2	0	0	0	0	0	0	11	0	8	3
		16	5	8	0	0	3	0	0	0	0	0	0	0	0	0	16	0	3	13
		17	124	215	1	0	142	0	0	15	2	4	0	0	0	0	503	1	159	343
	Covalejos	D	2	10	20	0	252	0	0	5	2	0	0	0	0	0	291	20	259	12
		E	2	12	2	0	178	0	0	2	0	1	0	0	0	0	197	2	180	14
		H	10	20	0	1	131	0	0	7	1	0	0	0	0	0	170	1	139	30
		I	32	60	8	2	517	0	2	41	4	0	0	0	0	0	666	10	562	94
		J	160	120	28	1	1198	0	1	43	1	5	0	0	0	0	1557	29	1242	281
		K	54	33	32	0	776	0	1	37	7	0	0	0	1	0	941	32	820	88
	Otero	9	12	2	0	0	6	0	0	0	1	0	0	0	0	0	21	0	7	14
	Atxagakoa	Almk (Alak) ;Amk-i;Amck	12	20	0	1	72	0	0	21	0	4	0	0	0	0	130	1	93	36
	Amalda	VII	48	58	61	536	150	0	0	3	0	0	0	0	0	0	856	597	153	106
	Axlor	I	7	28	81	15	45	0	1	2	0	0	0	0	0	0	179	96	47	36
		II	8	9	19	1	13	0	0	0	0	0	0	0	0	0	50	20	13	17
		III	36	89	75	8	80	0	0	1	0	0	0	0	0	0	289	83	81	125
		IV	282	797	934	97	652	0	9	0	0	0	0	0	0	0	2771	1031	652	1088
		V	94	295	450	28	297	0	3	0	0	0	0	0	0	0	1167	478	297	392
		VI	16	55	173	71	276	0	0	0	1	0	0	0	0	0	592	244	277	71
		VII	0	1	18	7	30	0	0	0	0	0	0	0	0	0	56	25	30	1
		VIII	4	3	47	15	90	0	0	0	2	0	0	0	0	0	161	62	92	7
		B-C	31	41	41	1	32	0	0	3	0	0	0	0	0	0	149	42	35	72
		D	42	258	204	7	279	0	0	0	1	4	0	0	0	0	795	211	280	304
	Lezetxiki	IV	1	29	13	33	90	0	1	3	0	2	0	0	0	0	172	46	93	33
		V	0	23	2	9	59	0	0	14	0	0	0	0	0	0	107	11	73	23
		VI	12	196	2	15	26	0	0	8	2	3	0	0	4	0	268	17	36	211
		VII	0	13	0	0	0	0	0	1	1	4	0	0	0	0	19	0	2	17
		VIII	0	28	0	0	0	0	0	0	0	1	0	0	0	0	29	0	0	29
	Arrillor	Lmc	5	45	0	91	600	0	0	11	0	13	0	0	0	0	765	91	611	63
		Smk-I	6	125	128	0	103	0	0	0	0	0	0	0	0	0	362	128	103	131
		Amk	16	146	19	0	164	0	0	5	0	3	0	0	0	0	353	19	169	165
	Abauntz	g	1	1	0	5	4	0	1	0	0	0	0	0	0	0	12	5	4	3
		h	2	10	6	37	70	0	8	0	0	2	0	0	0	0	135	43	70	20
	Askondo	11	0	7	6	1	0	0	0	1	0	0	0	0	0	0	15	7	1	7
		12	0	8	0	0	3	0	0	0	0	0	0	0	0	0	11	0	3	8
		13	0	3	3	0	3	0	0	2	0	0	0	0	0	0	11	3	5	3
	Venta Laperra		1	8	136	1	28	0	0	7	0	0	0	0	0	0	181	137	35	9
	Gatzarria	cj	8	9	0	22	332	0	2	2	0	0	0	1	1	3	380	22	334	23
		cj(moust)	2	1	0	0	2	0	0	1	0	0	0	0	0	0	6	0	3	3
		cjm	3	1	0	2	16	0	0	0	0	0	0	0	0	0	22	2	16	4
		cjr	3	1	0	2	16	0	0	0	0	0	0	0	0	0	22	2	16	4
		cjrm	3	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0	1	3
		crmo	1	2	0	4	9	0	0	0	0	0	0	0	0	0	16	4	9	3
	Cova Eiros	3	0	0	0	2	7	0	0	2	0	0	0	0	0	0	11	2	9	0
	Gabasa	a+c	206	9	265	46	66	0	0	5	9	1	0	0	0	0	607	311	80	216
		d	162	17	330	44	75	0	0	2	1	0	0	0	0	0	631	374	78	179
		e	385	26	434	83	348	0	0	7	1	1	0	0	0	0	1285	517	356	412
		f	250	15	399	48	359	0	0	15	3	5	0	0	0	0	1094	447	377	270
		g	385	13	654	40	511	0	0	22	7	6	0	0	0	0	1638	694	540	404
		h	265	17	272	4	159	0	0	0	5	1	0	0	0	0	723	276	164	283
	Unikote I	7 a 9	30	23	0	5	10	1	0	5	26	0	0	2	0	0	102	5	42	55
		10 a 12	60	38	0	6	16	8	4	4	43	0	0	0	5	0	184	6	71	102
		Niveau sup	24	95	0	1	87	0	6	36	26	0	0	3	2	0	280	1	149	128
		Niveau plan	4	5	0	0	10	0	1	1	3	0	0	0	1	0	25	0	14	10
	Cueva Corazón		109	5	72	2	14	0	0	3	2	0	0	0	0	0	207	74	19	114
	Cueva de Valdegoba		238	19	66	1200	27	0	0	27	21	21	0	0	0	0	1619	1266	75	257
	Prado Vargas		3	0	35	0	26	0	0	2	1	0	0	0	0	0	67	35	29	3
																	27728	10432	10407	6837
																	%	38	38	25

Table 6.1. Ungulates from the Cantabrian Middle Paleolithic sites. Data taken from Altuna (1972, 1989, 1990); Castaños (2005), Yravedra (2000, 2001) and Martínez-Moreno (2005).

Red deer (*Cervus elaphus*): this species is almost ubiquitous, and is found in 95.83 % of sites (Figure 6.2), being particularly abundant in Covalejos, Axlor, Arrillor, Gabasa, El Pendo, El Ruso, Esquilleu (level 11f and 13), El Castillo (Table 6.1). Therefore, in the Cantabrian region, red deer appears to be the large mammal most frequently hunted by Neanderthals.

Horse (*Equus*): is represented in 87.50% of the sites (Figure 6.2). Equids are adapted to graze in open areas and are therefore not expected to be present in forested environments during the interglacial period. There is a greater presence of horses in the corridor along the Cantabrian coast and in the Plateau of Castilla y León and in the high valley of the Ebro River, where the biotopes of these regions were open areas. This taxon is not represented in mountain areas. The sites with a significant number of horse are: Covalejos, Cueva Morín, El Castillo (Corridor of Cantabrian coast), Gabasa (Valley of Ebro river); Cueva corazón, Valdegoba (Plateu of Castilla León); Axlor (at 30 km is the Plateau of Urbasa) (Table 6.1).

Bovid (Bos/Bison): is present in 87.50% of the sites (Figure 6.2) with the following sites having a significant abundance: Cueva Morín, Covalejos, Axlor, Lezetxiki, Arrillor (Table 6.1). These animals were present in the same environment as horse.

Roe deer (*Capreolus capreolus*): is present in 87.50% of the sites (Figure 6.2). Their habitat is woodland, although they can also inhabit grasslands and sparse forests. They are particularly abundant in the following sites: Covalejos, El Pendo, Cueva Morín, Atxagakoa, Lezetxiki, Gabasa, Unikote I, Valdegoba (Table 6.1).

Ibex (*Capra pyrenaica*): is present in 79.17% of the sites (Figure 6.2). This taxon is abundant in particularly rocky areas of mountains. The sites with a greater presence of ibex are: El Esquilleu, Axlor, Gabasa, Ventalaperra (Table 6.1). Some authors propose a specialization on hunting this taxon in the following sites: El Esquilleu and Axlor (Baena *et al.* 2005).

Chamois (*Rupicapra rupicapra*): is represented in 79.17% of the sites (Figure 6.2). Their habitat is the steep areas and cold conditions may have influenced the occurrence of this taxon. The sites with an abundance of this species include: Amalda, Gabasa, Valdegoba, Esquilleu (Level 11f), Hornos de la Peña, Axlor, Arrillor (Table 6.1). Some authors propose a specialization this taxon in the following places: Amalda and Valdegoba (Ríos-

Garaizar 2012b). In the case of Almada, however, a recent taphonomic study, carried out by Yravedra (2010a), concluded that this site cannot be interpreted as a specialist chamois-hunting site, as the chamois bones were accumulated by felids.

Generally, in terms of ungulates, there does not seem to be any specialization as the main species are represented in similar percentages throught the region. There are some notable exceptions, such as the lower levels of Axlor (Baldeón 1999, Ríos-Garaizar 2003) where red deer predominates, and the El Esquilleu site (Baena *et al* 2001) where ibex and chamois predominate.

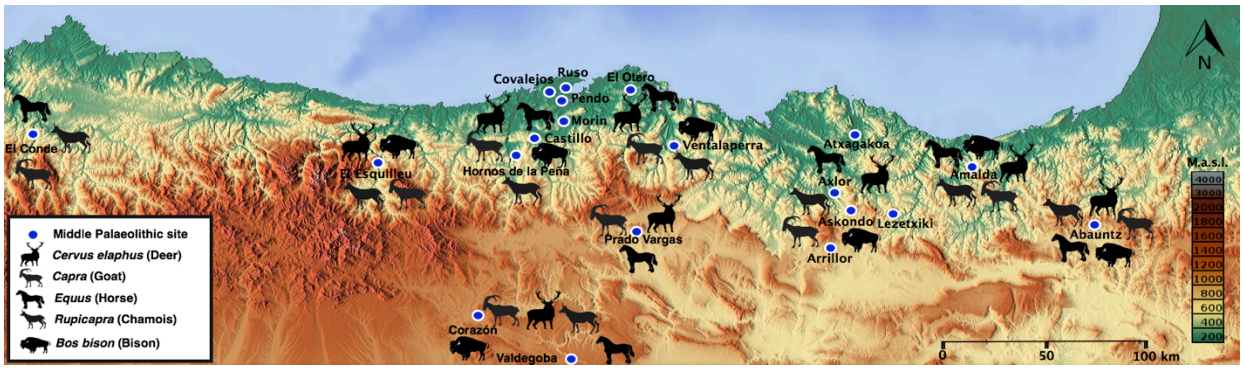


Figure 6.3. Geographical pattern of the most common ungulates in the Cantabrian region.

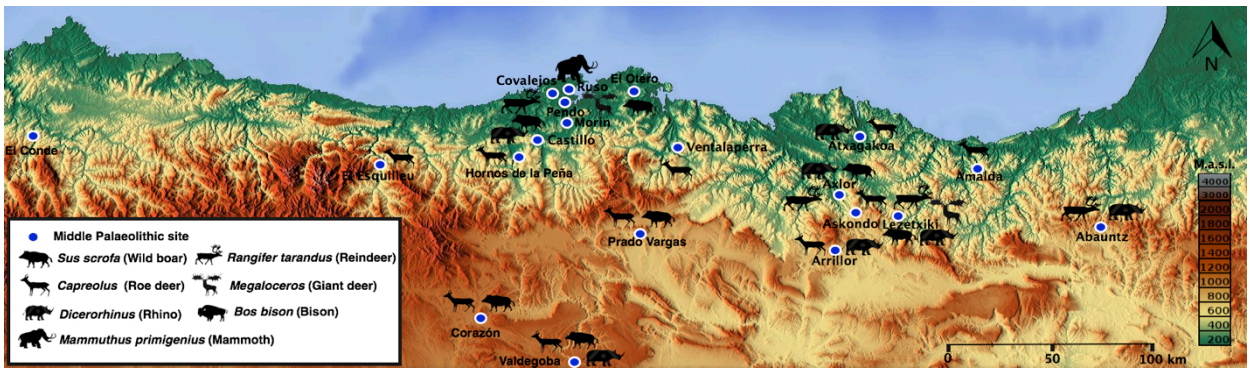


Figure 6.4. Geographical pattern of minor frequent ungulates in the Cantabrian region.

Certain species, such as wild boar (*Sus scrofa*) (45.83%) or rhinoceros (*Dicerorhinus hemitoechus*) (45.83%), are less well represented. One interpretation could be that they were considerably more dangerous prey. This could also explain the lack of megafauna (e.g. mammoth, giant deer), although, their scarcity in the archaeological record could be a direct correlate to their scarcity in the environment.

During the late Middle Palaeolithic period, cold-adapted fauna are only present in the

northern areas of the Iberian Peninsula, within the Cantabrian region and northwest of Catalonia, near the Pyrenees. The species documented include reindeer (*Rangifer tarandus*), woolly rhinoceros (*Dicerohinus hemitoechus*), giant deer (*Megaloceros sp*), and mammoth (*Mammutus primigenius*). Although the number of remains recovered is small, the species that stands out is the reindeer (Figures 6.1, 6.2, Table 6.1). The presence of this species has been linked with extreme cold and dry events. During the coldest episodes of the Late Pleistocene in France, cold-adapted large mammals moved south into the north of the Iberian Peninsula (Gómez-Olivenza *et al* 2014), perhaps because it was a continuation or a corridor with a very similar habitat (since these areas of the Peninsula, during cold periods, would become very similar habitats to those found in France) or to look for warmer temperatures.

They were not present in the rest of the Iberian Peninsula, with two exceptions: remains of woolly rhinoceros (*Coelodonta antiquitatis*) have been documented in central Iberia dating to 100ka BP; and remains of mammoth (*Mammutus primigenius*) have been found in Padul (Granada) dating to 40.4-30.6 cal ka BP (Álvarez-Lao *et al* 2009).

Reindeer (*Rangifer tarandus*): is present in 25% of the sites (Figure 6.2). This taxon indicates cold periods and open environments. The sites with reindeer include Abauntz, Axlor, Lezetxiki, Covalejos and Gatzarria (Table 6.1).

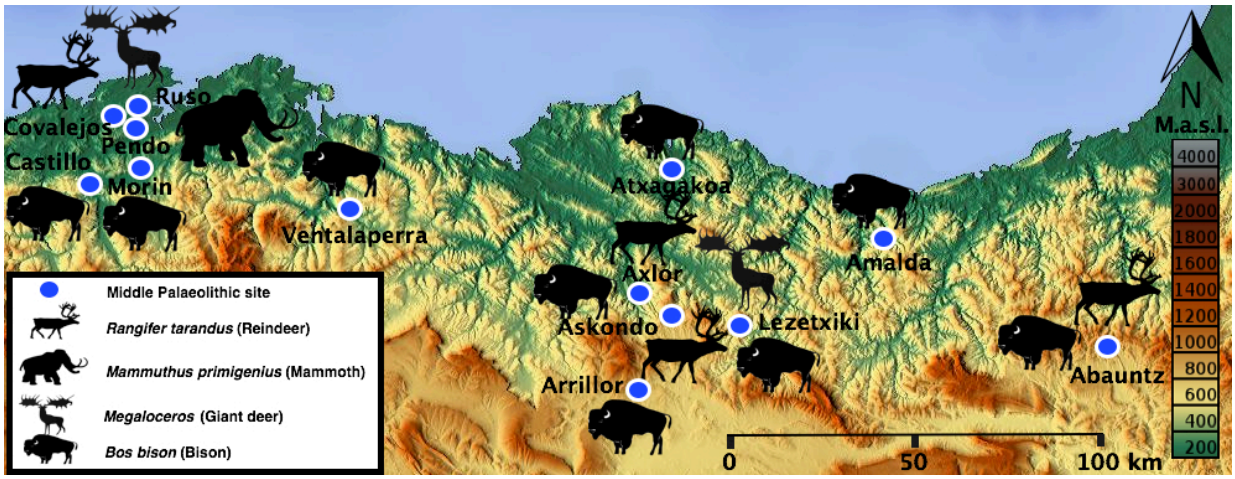


Figure 6.5. Geographical pattern of cold-adapted fauna in the Cantabrian region.

The species present have been grouped according to their corresponding habitats in order to best identify which group is most abundant during the Middle Palaeolithic: rocky areas (caprids); wooded areas (cervids and suids); open spaces species (equids and bovids). Rocky (38%) and wooded (38%) habitat-preferring species were the most abundant species

present rather than open space-preferring species (25%) (Table 6.1). Although this can be interpreted as a predilection for rocky or wooded species, the following factors must also be taken into account, which could have influenced or biased the results:

1. The faunal assemblages under consideration come from caves which are located in karst systems, that have rocky and forest environments nearby, and the sites may reflect the fauna that was most abundant in its surroundings.
2. Carnivores could have focused more on the small ungulates, such as ibex and chamois, and the faunal assemblage could have been accumulated by them (e.g.: Amalda).
3. Careful consideration of the data and sample size must be undertaken, paying particular attention to NISP and MNI data. Some animals, such as the ibex, were usually introduced into the site as a whole animal, whereas larger ungulates, such as horse and bovids, were usually introduced as smaller pre-butchered packages, and therefore are not as complete in terms of elements.

6.2.2. Faunal assemblages from Betic region:

Within the Betic region, ibex, deer and horse were the most abundant ungulate fauna amongst the majority of the sites. This would suggest a preference for medium sized prey. Other ungulate species, such as bovid (*Bos/bison*), wild boar (*Sus scrofa*), rhinoceros (*Dicerohinus hemitoechus*), chamois (*Rupicapra rupicapra*), and roe deer (*Capreolus capreolus*) were less represented. This distribution of species correlates with the types of environments in proximity to the sites analysed.

ZONE	SITE	LAYER	Equus	Bos / Bison	Capra pyrenaica	Rupicapra rupic.	Cervus elaphus	Cervus simplicidens	Rangifer tarandus	Capreolus capr.	Sus scropha	Dicerorhinus hem.	Cf. Rhinocerotidae	Coleodonta sp	Megaloceros sp.	Mammuthus primigenius	UNGULATES	ROCKY	WOODED	PLAIN
			NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	14	total	total	total
Betic	Cerro de Santiesteban		2	1	0	0	2	0	0	0	0	0	0	0	0	0	5	0	2	3
	Higueral de Valleja	V-X	2	0	1	0	4	0	0	0	0	0	0	0	0	0	7	1	4	2
	Zafarraya	UA	0	0	35	0	3	0	0	0	0	0	0	0	0	0	38	35	3	0
		UB	0	0	213	2	6	0	0	0	0	0	0	0	0	0	221	215	6	0
		UC	3	5	902	9	37	0	0	0	4	0	0	0	0	0	960	911	41	8
		UD	0	0	80	1	3	0	0	0	0	0	0	0	0	0	84	81	3	0
		UE	9	6	592	14	22	0	0	0	0	0	0	0	0	0	643	606	22	15
		UF	0	1	99	2	5	0	0	0	0	0	0	0	0	0	107	101	5	1
		UG	0	0	437	7	7	0	0	0	0	0	0	0	0	0	451	444	7	0
	Hora	1 to 61	358	5	53	0	29	0	0	0	0	3	0	0	0	0	448	53	29	366
			5	0	72	0	2	0	0	0	0	0	0	0	0	0	79	72	2	5
		XVII	4	1	1	0	0	0	0	0	0	0	0	0	0	0	6	1	0	5
		XVIII	10	1	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	11
		XXII	7	0	2	0	3	0	0	0	0	0	0	0	0	0	12	2	3	7
		XXV	7	0	1	0	0	0	0	0	0	0	0	0	0	0	8	1	0	7
		XXVII	23	0	2	0	0	0	0	0	0	0	0	0	0	0	25	2	0	23
	Cueva Anton	N.WII	5	5	0	8	55	0	0	8	0	0	0	0	0	0	81	8	63	10
	El Salt	WII	146	14	111	0	272	0	0	0	2	0	0	0	0	0	545	111	274	160
	Cova Beneito	D1	20	1	46	0	19	0	0	0	0	0	0	0	0	0	86	46	19	21
		D2	8	5	44	1	34	0	0	0	2	0	0	0	0	0	94	45	36	13
		D3	0	1	23	1	8	0	0	0	0	0	0	0	0	0	33	24	8	1
		D4	14	0	97	1	24	0	0	0	7	1	0	0	0	0	144	98	31	15
	Cova Negra	1977	300	56	260	7	501	0	0	3	11	60	0	0	0	0	1198	267	515	416
		1	52	5	78	2	117	0	0	1	7	0	0	0	0	0	262	80	125	57
		2	9	1	18	0	37	0	0	0	2	0	0	0	0	0	67	18	39	10
		3	44	5	37	2	116	0	0	2	0	0	0	0	0	0	206	39	118	49
		4	17	4	14	2	34	0	0	0	1	0	0	0	0	0	72	16	35	21
		5	26	3	13	1	38	0	0	0	1	0	0	0	0	0	82	14	39	29
		6	27	14	20	0	16	0	0	0	0	0	0	0	0	0	77	20	16	41
		7	8	3	17	0	6	0	0	0	0	0	0	0	0	0	34	17	6	11
		8	15	13	22	0	23	0	0	0	0	0	0	0	0	0	73	22	23	28
		9	10	0	13	0	37	0	0	0	0	0	0	0	0	0	60	13	37	10
		10	8	0	4	0	16	0	0	0	0	0	0	0	0	0	28	4	16	8
		11	13	0	7	1	4	0	0	0	0	0	0	0	0	0	25	8	4	13
		12	4	1	9	2	18	0	0	0	0	0	0	0	0	0	34	11	18	5
		13	13	0	4	0	11	0	0	0	0	0	0	0	0	0	28	4	11	13
		14	24	6	2	0	17	0	0	0	0	0	0	0	0	0	49	2	17	30
	Devil Tower	Breuil 1922	0	0	8	0	8	0	0	0	4	0	0	0	0	0	20	8	12	0
		Garrod et al 1928	3	14	6	0	20	0	0	0	20	0	0	0	0	0	63	6	40	17
	Vanguard Cave		0	0	121	0	40	0	0	0	11	0	0	0	0	0	172	121	51	0
	Gorham Cave	G	2	5	11	0	52	0	0	0	0	0	0	0	0	0	70	11	52	7
		H	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1
		J	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1
		K	0	5	162	0	29	0	0	0	0	2	0	0	0	0	198	162	29	7
		L	0	0	0	0	1	0	0	0	2	0	0	0	0	0	3	0	3	0
		M	8	11	132	0	53	0	0	0	0	1	0	0	0	0	205	132	53	20
		N	0	0	6	0	4	0	0	0	4	0	0	0	0	0	14	6	8	0
		P	0	1	30	0	10	0	0	0	0	0	0	0	0	0	41	30	10	1
		Q	0	1	2	0	1	0	0	0	0	0	0	0	0	0	4	2	1	1
		R	1	0	1	0	9	0	0	0	1	0	0	0	0	0	12	1	10	1
		T	0	0	1	0	3	0	0	0	1	0	0	0	0	0	5	1	4	0
		U	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	1	1	0
		IV	2	2	18	0	27	0	0	0	0	0	0	0	0	0	49	18	27	4
		CHm.2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
		UBSm.4	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	1	1	0
		UBSm.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		UBSm.7	0	0	2	0	1	0	0	0	0	0	0	0	0	0	3	2	1	0
		BeSm(Ossm).1	0	1	2	0	6	0	0	0	0	0	0	0	0	0	9	2	6	1
		BeSm(Ossm).2	0	2	3	0	2	0	0	0	1	0	0	0	0	0	8	3	3	2
		LBSmff.1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0
		LBSmff.4/LBSmcf.2	0	1	11	0	6	0	0	0	0	1	0	0	0	0	19	11	6	2
		LBSmcf.4	0	0	19	0	2	0	0	0	0	0	0	0	0	0	21	19	2	0
		LBSmcf.5/LBSmcf.5-.7	0	0	11	0	5	0	0	0	2	0	0	0	0	0	18	11	7	0
		LBSmff.8/LBSmcf.9	0	2	3	0	5	0	0	0	0	0	0	0	0	0	10	3	5	2
		LBSmcf.8	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
		LBSmff.10/LBSmcf.11	1	2	20	0	10	0	0	0	1	0	0	0	0	0	34	20	11	3
		LBSmff.11/LBSmcf.12	0	3	14	0	12	0	0	0	2	0	0	0	0	0	31	14	14	3
		LBSmcf.13	0	0	5	0	4	0	0	0	0	0	0	0	0	0	9	5	4	0
		SSLm(Usm).1	1	0	5	0	2	0	0	0	0	0	0	0	0	0	8	5	2	1
		SSLm(Usm).2	0	1	3	0	4	0	0	0	0	0	0	0	0	0	8	3	4	1
		SSLm(Usm).3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	2	0
		SSLm(Usm).4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
		SSLm(Usm).5	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1
		SSLm(Usm).6	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	3	0
																	7435	3994	1951	1490
																	%	54	26	20

Table 6.2. Ungulates from the Betic Middle Paleolithic sites. Data taken from Breuil (1922), Garrod et al (1928), Fuentes & Mejide (1975), Martínez Valle (1996); Villaverde & Martínez Valle (1992), Yravedra (2001), Barroso (2003), Jennings et al (2009), Barton et al (2012).

Red deer (*Cervus elaphus*): open woodland species. This is a ubiquitous species that has been documented in 100 % of the sites (Figure 6.2). It is significantly abundant in El Salt and Cova Negra (Table 6.2).

Ibex (*Capra pyrenaica*): is recorded in 86.67% of the sites (Figure 6.2). This taxon is abundant in mountain areas. The sites with a greater abundance of this species include: Zafarraya, El Salt, Cova Beneito, Cova Negra, Gorham´s and Vanguard Cave (Table 6.2), with some authors proposing a specialization on this taxon in the following sites: Zafarraya (Barroso *&* Lumley, 2006). This, however, has been recently dismissed by the same team (Caparrós *et al* 2012), who now propose that the majority of the ibex remains were accumulated by carnivores, especially by panthers. This has also been found to be the case in Cova Negra and Cova Benito, with the majority of ibex remains being accumulated by carnivores (Martínez Valle 1996, Villaverde & Martínez Valle 1992). These sites are usually located within rocky or mountainous terrain, either coastal or inland, and at a certain altitude, such as: Zafarraya (1022 m.a.s.l.) and Horá (1169 m.a.s.l.).

Horse (*Equus*): this taxon is represented in 86.67% of the sites (Figure 6.2) and dominates the inland sites along the Intra-Betic corridor from Málaga to Alicante and in the Guadalquivir Valley and other open prairies. Sites with the most significant presence of horse are: Carihuela, Cueva Horá, Colomera, Cueva de los Pescadores, Perneras, and Cova Negra (Table 6.2).

Aurochs (*Bos primigenius*): is represented in 80% of the sites (Figure 6.2). Like horses, aurochs lived on open prairies. The site with the highest abundance of bovids is Cova Negra (Table 6.2).

Wild boar (Sus scrofa): is present in 53.33% of the sites (Figure 6.2). It is a species found in humid and woodland environments. Sites with a significant presence of wild boar include Devil´s Tower, Vanguard, Gorham´s Cave, and Cova Negra (Table 6.2).

Rhinoceros (*Dicerohinus hemitoechus)*: is reported in 33% of the sites (Figure 6.2). The site with the greatest presence of rhinos is Cova Negra, but they are also present in the sites of Horá, Gorham´s Cave and Cueva Beneito (Table 6.2).

Chamois (*Rupicapra rupicapra*): is present in 26.67% of the sites (Figure 6.2). Its habitat comprises moderately high mountains, and it is adapted to live in rocky, cold terrains.

Their main distribution is located in the mountain areas of Alicante and Valencia and their remains are found in the sites of Antón, Beneito, and Cova Negra, in the north of the Betic region, and as far south as Zafarraya (Table 6.2). Here, this species is very rare and its presence might correspond with cold periods.

Roe deer (*Capreolus capreolus*): is present in 20% of the sites (Figure 6.2). Its distribution is located within the mountain areas of Alicante and Valencia, in the sites of Antón, and Cova Negra (Table 6.2) in the north of the Betic region.

There is possible specialization within this area in the following sites: Horá: Horses; Gorham´s and Vanguard Caves: Ibex; Cova Negra and El Salt: Red deer (Table 6.2).

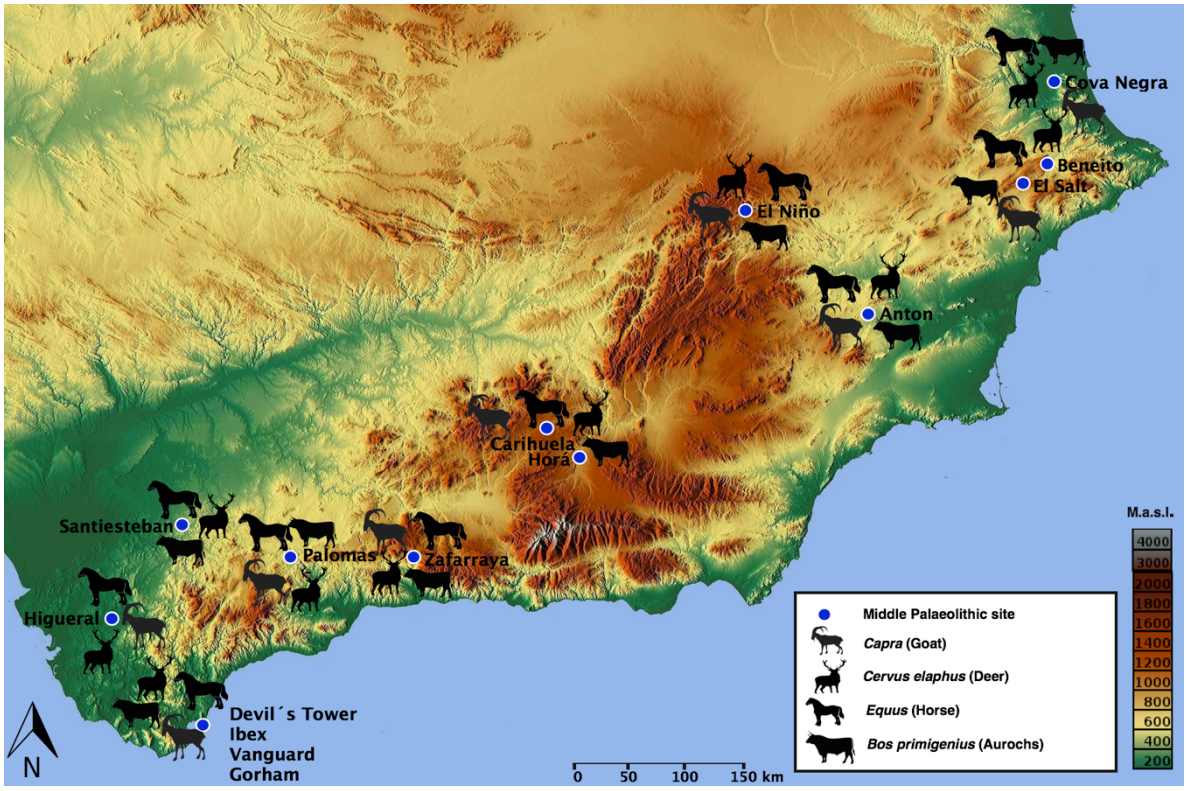


Figure 6.6. Geographical pattern of the most common ungulates in the Betic region.

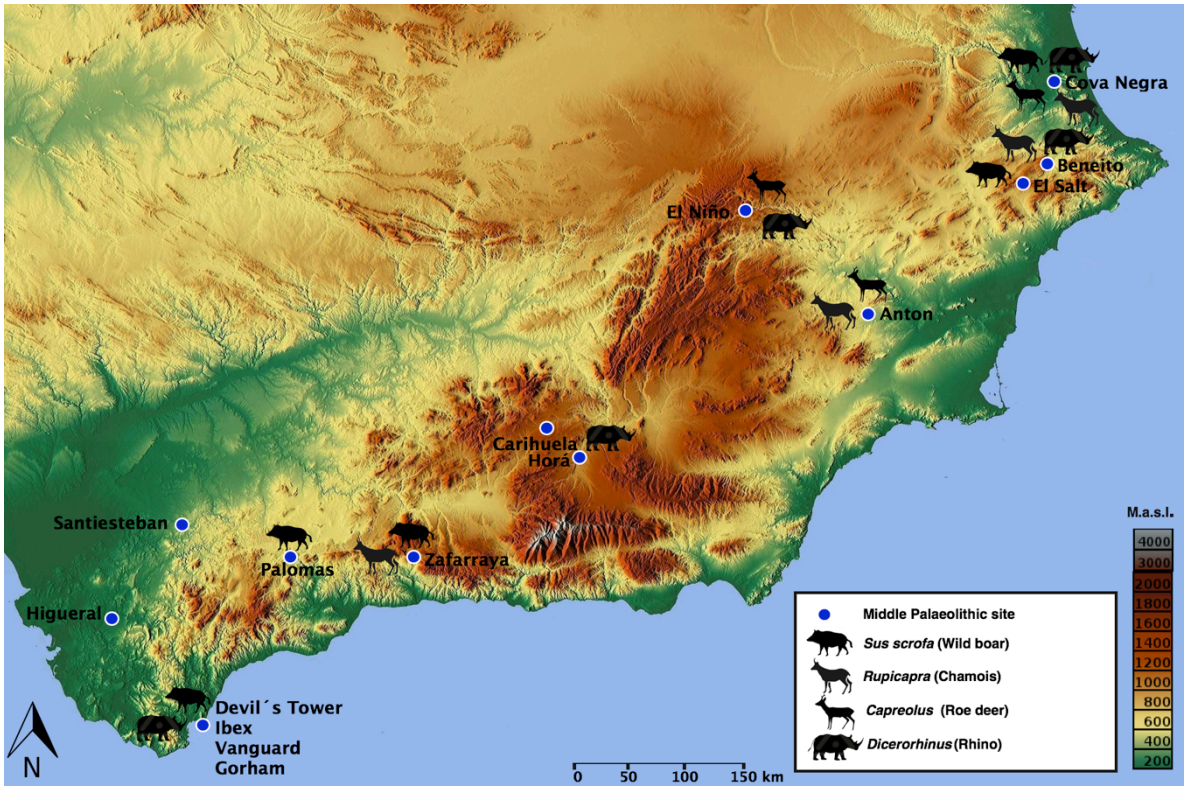


Figure 6.7. Geographical pattern of minor frequent ungulates in the Betic region.

The presence and influence of carnivores at these sites, whose activity is evident either by their remains, or from the alterations and marks left on the bones recovered, must also be considered. At Zafarraya, Cova Beneito and Cova Negra, for example, it is thought likely that carnivores accumulated the majority of the ibex bone remains that have been excavated.

With regard to climate, the presence of dhole (*Cuon alpinus*) at sites such as Zafarraya, can be indicative of cold periods, as can the presence of open space species at Cueva Horá. Sites along the Mediterranean coast, such as Cova Negra and Gorham´s Cave, show a more temperate climate, with some oscillations of cold periods (Barton 1999, Villaverde 1984). The Betic region acted as a refuge for many thermophilic species, as its proximity to the sea and its orographic conditions with its internal mountain ranges helped maintain a milder climate. Roe deer, wild boar and rhinoceros, which are documented in large number, and are temperate species, fall into this category. The lack of cold-adapted species within the Betic region, (reindeer, Irish elk and woolly rhinoceros) support this.

There is only one known example of mammoth (*Mammuthus primigenius*), found within a peat bog in Padul (Granada) and dating to 40.4-30.6 cal ka BP (Aguirre *et al* 1973,

Álvarez-Lao *et al* 2009, 2011). This is unrelated to any Neanderthal activity. Although an isolated case, this example poses important biogeographical and palaeoecological questions, as this species is commonly associated with steppe-tundra and therefore indicates that its arrival in the south would have coincided with a cold and arid episode within this area (Álvarez-Lao *et al* 2011).

When considering the species/habitat groupings, as was carried out for the Cantabrian region, the Betic region appears to have a greater abundance of rocky species (54%), followed, in smaller proportions, by wooded species (26%) and open spaces species (20%) (Table 6.2). These data would suggest that there was a predilection for rocky species as prey compared to forest or open space species, however, once again, other factors must be considered when interpreting this data. As previously mentioned, in the case of Zafarraya Cave, Cova Negra and Cova Beneito, the majority of the ibex remains, were in fact accumulated by carnivores and not by Neanderthal activity (Martínez Valle 1996, Villaverde & Martínez Valle 1992, Caparrrós *et al* 2012). An abundance of rocky species can also be attributed to a greater proportion of rocky habitats within the Betic region, particularly where the sites are located, which would also have influenced the faunal assemblage.

6.2.3. Biogeographical faunal analysis.

A cluster analysis was carried out using the NISP data of carnivores, ungulates and lagomorphs, derived from the faunal database (see Annexe 1). All NISP data for each species for all Middle Palaeolithic levels of each site were obtained along with data from all Initial Upper Palaleolithic (Aurignacian and Gravettian) and Solutrean levels. A distance matrix was calculated using the Horn-Morisite index (which is a statistical measure of the dispersion of individuals in a population, in this case different fauna) and the cluster analysis was made using Ward´s method. With regards to the stability and dissolution of the clusters, we can consider that Cluster 1 is stable (0.8748990) while Cluster 2 is not supported (0. 7070467). The number of clusters estimated by optimum average silouette width was seven.

The sites are grouped and separated into two distinct clusters, which would indicate a distinction between the fauna from the Euro-Siberian and Mediterranean bioclimatic

regions. Cluster 1 is mainly dominated by Cantabrian sites with a few Betic sites. The presence of Betic sites in this cluster could, however, be attributed to incomplete faunal assembages, which would result in insignificant NISP data and a lack of documented rabbit remains. Cluster 2 is composed of six sites from the Betic region.

The sites can be grouped according to the following factors:

1. The large proportion of lagomorph remains in the Betic sites.
2. The presence of cold-adapted fauna in the Cantabrian region and their absence in the Betic region.
3. Large NISP figures for Bovids, Ibex, Red deer, Chamois and Roe deer recovered from the Cantabrian region, in comparison to those recovered from the Betic region.

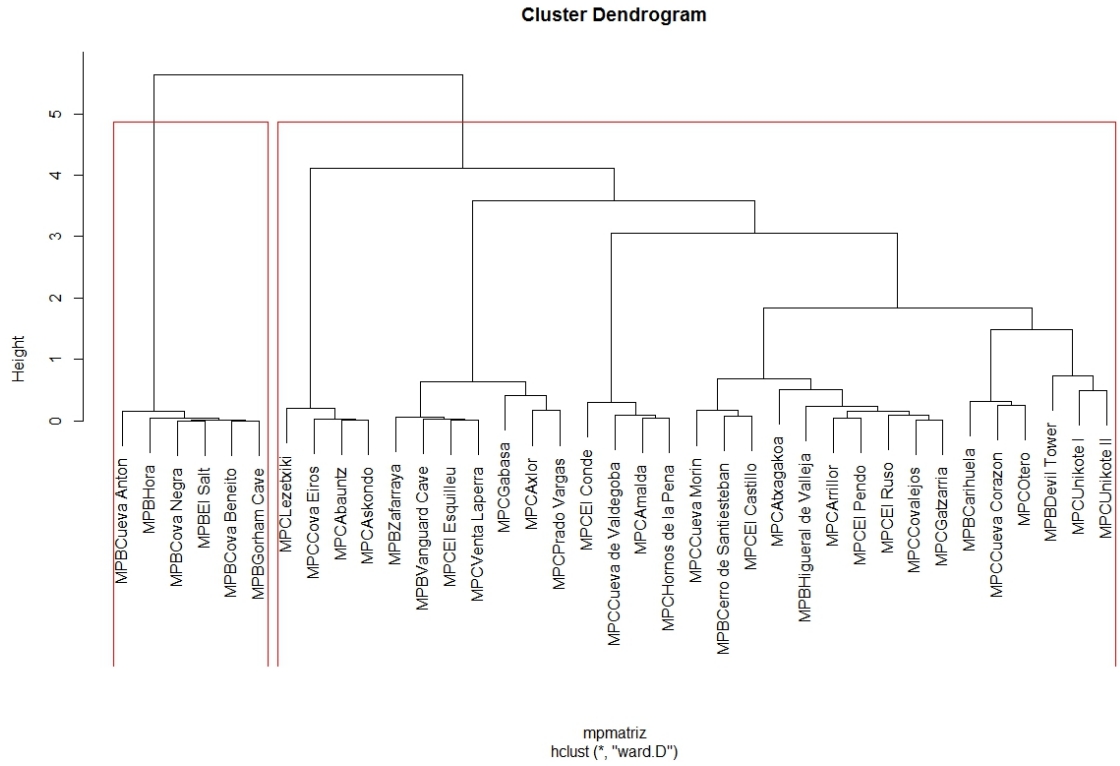


Figure 6.8. Cluster dendrogram of fauna assemblages of Middle Palaeolithic sites of both regions

The distinction between the Euro-Siberian and Mediterranean bioclimatic regions persists well into the initial Upper Palaeolithic and Solutrean periods, with Lena Jones (2015) suggesting that this pattern lasts until the Pleistocene and Holocene transition. Using the same methodogy, a database was constructed of the fauna from initial Upper Palaeolithic

(Aurignacian and Gravettian culture) and Solutrean sites. The results replicate the same pattern, with sites grouped and separated into two distinct clusters, with fauna corresponding to either the Euro-Siberian or Mediterranean bioclimatic region.

Initial Upper Palaeolithic:

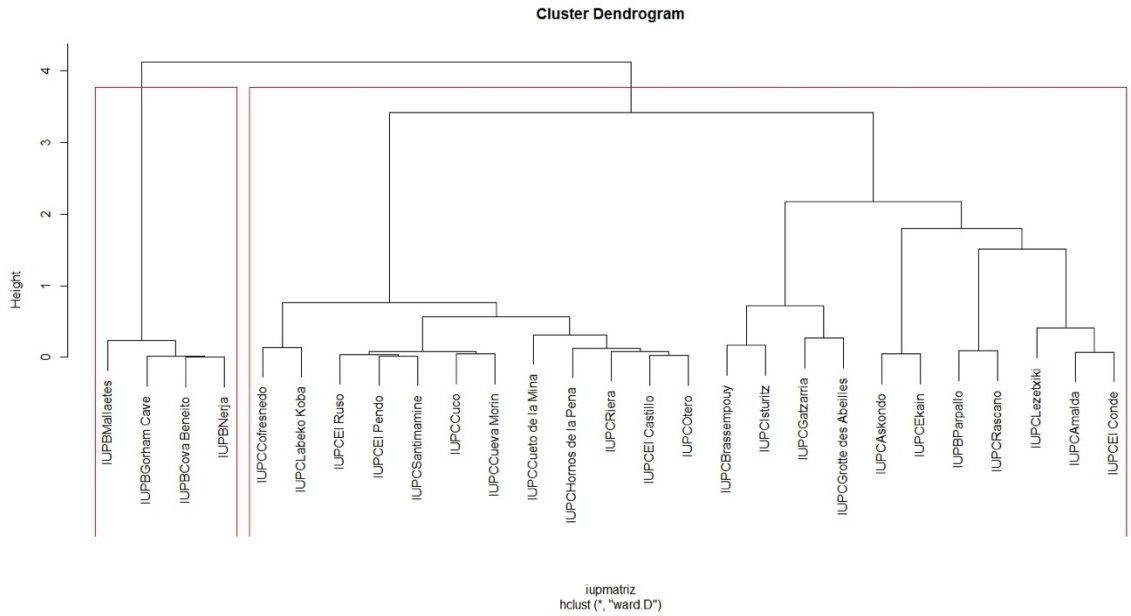


Figure 6.9. Cluster dendrogram of fauna assemblages of Initial Upper Palaeolithic sites of both regions.

Solutrean:

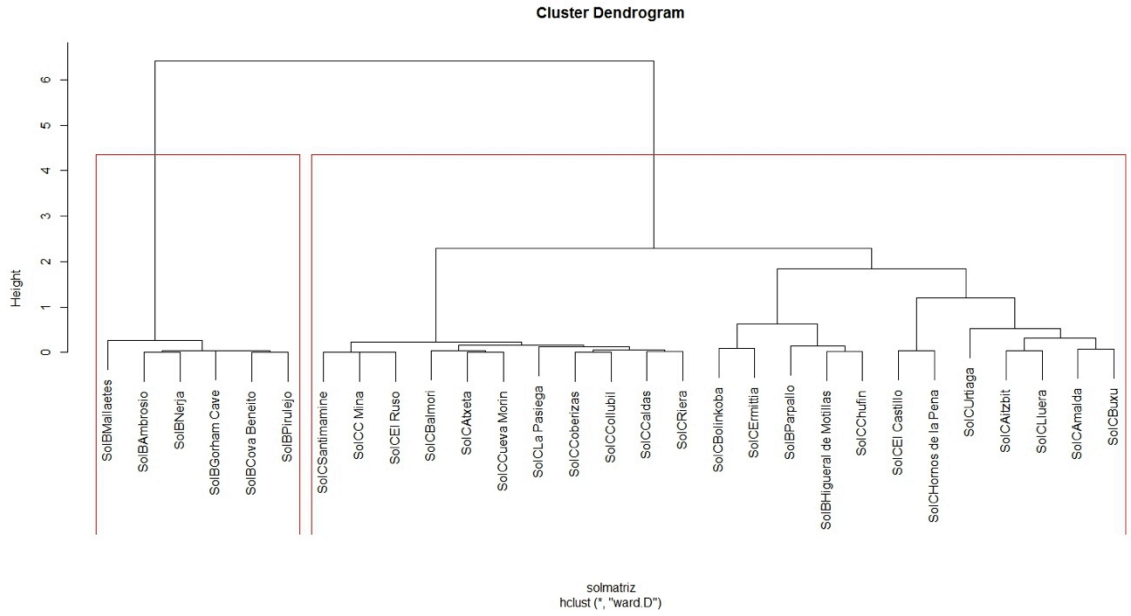


Figure 6.10. Cluster dendrogram of fauna assemblages of Solutrean sites of both regions.

6.3. CANNIBALISM

Cannibalism has been documented in several Middle Palaeolithic sites with Neanderthal remains in Europe including most notably Krapina and Vindija (Croatia) (Russell 1987; Ullrich 1989); Combe Grenal (Garralda & Vandermeersch, 2000), Moula-Guercy (Defleur *et al* 1999), Les Pradelles (Garralda *et al* 2014b), Les Rois (Rozzi *et al* 2009) (France) and the Troisième Caverne of Goyet (Belgium) (Rougier *et al* 2016). In the Iberian Peninsula two sites have evidence of cannibalism, Zafarraya (Barroso *et al* 2003, 2006, 2014) and El Sidrón (Rosas *et al* 2006). This extensive record, spanning decades of research, strongly suggest that cannibalism was an established part of Neanderthal culture, however its purpose, either food scarcity, violence between groups or ritualistic, has yet to be determinated.

According to Agustí & Rubio-Campillo (2016), cannibalism amongst Neanderthals might have been one of the causes of their extinction. They suggest that cannibalism can be an optimal subsistence strategy in hostile environments without competitors. However, when a competitor is introduced, in this case *Homo sapiens sapiens,* which these authors do not consider to be cannibals, then cannibalism can be a negative strategy. There is, however, ample evidence of cannibalism in *Homo sapiens* groups*,* for example at the Aurignacian site of Les Rois (Rozzi *et al* 2009), the Gravettian group of Buran Kaya III (Crimea) (Prat *et al* 2011), Magdalenian groups of Brillenhöhle site (Blabeuren, Germany) (Orschiedt 2002) and Gough´s Cave (Somerset, United Kingdom), as well in the Neolithic and Bronce Age in Europe (Boulestin 1999, 2012) and historical periods in various locations around the world (Pancorbo 2008). So, the initial assumption that Neanderthals are cannibals and modern humans are not appears unsupported by the data. In addition, in order to consider cannibalism as one of the causes of Neanderthal extinction, we would need to find many more instances of this behaviour, and not the few cases reported. Although it may have contributed to the Neanderthals` eventual demise, it cannot be considered as one of the main causes of their extinction.

A more recent hypothesis proposes the opposite. According to Guil-Guerrero (2017), cannibalism would have allowed humans to survive in the Palaeolithic. The hominins at the Middle Palaeolithic and Upper Palaeolithic transition had a deficit of both omega-3 fatty acids and ascorbic acid, with human organs containing such nutrients in amounts

much higher than mammal organs, and thus could have been a rich alternative source of those nutrients for Palaeolithic hominins. Therefore, Guil-Guerrero proposes that nutritional cannibalism, detected at this period, could have had the effect of alleviating these deficits. It is difficult to ascertain why cannibalistic behaviour amongst Neanderthal groups took place, as there can be many causes for this. A deficit of this type of nutrient, however, does not necessarily result in the practice of cannibalism, as nutrients such as Omega-3, for example, could have been obtained from the consumption of other foods such as fish and seeds, for which there is substantial evidence, as discussed below.

El Sidrón case (Cantabrian region)

This site is located in Piloña (Asturias). Neanderthal remains were documented, with at least 13 individuals, in stratum III of the Ossuary Gallery. The preservation of the bones is excellent, with very limited trampling or erosion and no large carnivore tooth marks. According to Cañaveras *et al* (2011), this is a secondary deposit for the Neanderthal bones and lithic artefacts in this assemblage. The primary deposit site was located outside the cavity, possibly in the open-air at the top of the karst, where a group of Neandertals would have carried out their butchering, the debris of which could have been carried by storm waters through one of the vertical channels into the cavity.

The taphonomic study of this asssemblage concluded that the bones suffered human modification. Anthropic evidence of cannibalism was identified on the bones, including cut marks, flaking, percussion pitting, and conchoidal scars on the bones, including immature skull fragments (frontal, temporal and parietal), long bones (humerus, ulna, radius and tibia), and mandibles. In addition, long bones show deep scars and others bones to have been cracked open to obtain the marrow (Rosas *et al* 2006).

Zafarraya case (Betic region)

At Zafarraya a total of 16 Neanderthal fossil remains were recovered equating to a minimum of 9 individuals. In this case, the preservation of the bones is excellent. The Neanderthal remains, fractured and with evidence of exposure to fire, were located within

the hearth denominated Q-18 area in the Mousterian levels (Barroso *et al* 2003, 2014). The human remains include:

Zaf. 4-5-18 mandible: broken into three pieces, and showing evidence of fire exposure.
Zaf. 6 scapula: its blackish surface is evidence of exposure to fire.
Zaf. 15 femur: was found heavily fragmented and burned.
Zaf. 17 coxis: whole bone, with signs of fire exposure.
Zaf. 19 rib: it is from a right rib 7, two-thirds of which are well preserved.
Zaf. 26 femur: fragmented into nine pieces, with evidence of burning.
Zaf. 27 tibia: consists of ten burnt fragments.

These burnt fragments, associated with a hearth, other faunal remains, and Mousterian lithics, were subject to fracture and defleshing and show evidence of Neanderthal cannibal activity (Caparrós *et al* 2012).

6.4. SMALL GAME

Historically, it has been accepted that Neanderthals were only capable of hunting more abundant large game animals found within their surroundings and actively avoided any "dangerous" prey. They have been considered largely incapable of capturing any fast-moving or winged small prey, such as rabbits, birds, or fish (Stiner *et al* 1999, 2000; Richards *et al* 2001, 2005; Drucker & Bocherens 2004), and of rarely being able to incorporate marine resources or edible plants into their diets (Klein 1989, 2001; Klein & Cruz-Uribe 1996, 2000; Klein *et al* 2004, 2007; Fa *et al* 2013). These assumptions stem from the school of thought that Neanderthals were an inferior species in relation to anatomically modern humans, in terms of cognition.

Different theoretical models for the interpretation of Neanderthal subsistence were discussed in the introduction to this chapter, and the apparent contradiction between these models with regards to small prey in Palaeolithic diets was highlighted. Whereas "The Optimal Foraging Model" proposes that small game, with their very little energetic return, are a marginal resource, exploited only by a distressed population (…), the "Broad Spectrum Revolution" model proposes that the systematic exploitation of small game is a modern behaviour carried out by a cognitively superior species (Stiner *et al* 2000). Some authors have highlighted how nutritionally rich small prey are, when compared to larger game, (Hockett & Ferreira Bicho 2000, Haws & Hockett 2004) and have drawn attention to their ease of capture and concomitant low risk of personal injury when hunting (Brown *et al* 2011). Ethnographic studies have also demonstrated that modern hunter-gatherer diets include small game and plants as well as large game (O`Connell et al 1988, Byers & Ugan 2005). Therefore, some authors have accepted that the same could have occurred during the Palaeolithic period (Haws 2004, Hockett 2006)

In this section I focus on evidence from the Middle Palaeolithic sites of the Cantabrian and Betic regions, comparing resource exploitation in both areas of study. The aim is to identify any similarities or differences in the exploitation of small game, within both regions, in order to assess whether Neanderthal behaviour differed between these two biogeographically different regions.

The first evidence of small game exploitation (both avian and lagomorph) as a food

resource in the Iberian Peninsula is documented from the Lower Pleistocene in Sima del Elefante (Atapuerca, Burgos) (Huguet 2007). In the Middle Pleistocene in Bolomor Cave, from MIS 9 – MIS 5e (350-100 ka), there is also evidence for the consumption of leporid, chelonian, and avian fauna, throughout the whole sequence (Blasco & Fernández 2012) and in Ángel Cave (Lucena, Córdoba) a few post-cranial bones of hare, tortoise and avifauna have been recorded in the sequence (Barroso *et al* 2011).

The following species of small prey have been found in several sites and regions dating to the Middle Palaeolithic :

Rabbits: *Cantabrian region:* Cueva Corazón; *Betic region:* Gorham´s Cave, Cova Negra, Cova Beneito, El Salt.

Tortoise: *Cantabrian region:* there are no sites; *Betic region:* Gorham´s cave, Cova Negra, El Salt, Abric el Pastor.

Shellfish: *Cantabrian region:* Morín, El Pendo, Amalda; *Betic region:* Cueva Perneras, Hoyo de los Pescadores, Cueva de los Aviones, Cueva Antón, Sima de las Palomas, Complejo del Humo, Bajondillo, Gorham´s Cave, Vanguard Cave, Higueral de Valleja.

Fish: *Cantabrian region:* Amalda, Millán; *Betic region:* Gorham´s Cave, Vanguard Cave, Horá.

Birds: *Cantabrian region:* there are no sites; *Betic region:* Gorham´s Cave, Ibex Cave, Vanguard Cave, Cova Negra, Cova Beneito, Zafarraya.

Middle Palaeolithic sites from both study regions which contain evidence for the consumption of rabbits, tortoise, birds, plants, fish and other marine resources are detailed below.

6.4.1. *Rabbits*

The rabbit is endemic to the Iberian Peninsula (Branco *et al* 2000) and its consumption has been documented since the Lower Pleistocene, with a leporid radius comprising two distinct cut marks recovered from Level 12a at the Sima del Elefante (Atapuerca) (Blasco

et al 2011, Huguet 2007, Huguet *et al* 2013). For the Middle Pleistocene, Bolomor Cave has evidence of rabbit exploitation, with bone from several levels showing anthropic marks (Blasco & Fernández, 2012). This exploitation continues into the Upper Pleistocene and Holocene in the Iberian Peninsula. Both the archaeological record and taphonomic analyses of the faunal remains confirm that rabbits were hunted and consumed by pre-Neanderthal, Neanderthal, and AMH groups within the Iberian Peninsula.

During the Upper Pleistocene and Holocene, the rabbit is very scarce in northern Iberia, compared to the south, where it was immensely abundant. This divide is reflected in the archaeological records of both regions. Rabbit distribution is principally influenced by low temperature and high rainfall. The Mediterranean region is therefore favourable. Here rabbits enjoy hot, dry summers, and an annual rainfall of around 500mm, living in scrub and pasture areas below 1000m.a.s.l., rarely venturing any higher than an altitude of 1500m (Sesé 2011).

The rabbit is an essential prey species for a variety of predators in Iberia (Delibes-Mateos *et al* 2008), mainly the imperial eagle (*Aquila adalberti*), the eagle owl (*Bubo bubo*), the lynx (*Lynx pardinus*), and fox (*Vulpes vulpes*), among others (Ferrer & Negro 2004).

Iberian Middle Palaeolithic sites were occupied intermittently by Neanderthals, carnivores and raptors, with all predators accumulating their own faunal assemblages within the same living space. Only five sites included in this study show direct evidence of human predation and consumption of rabbits. This low incidence, however, could be the result of a lack of taphonomic analyses carried out on rabbit bone assemblages at most sites, as these are often assumed to be accumulated by the activity of carnivores and raptors (Fa *et al* 2013). It is for this reason that it is imperative that the accumulating agent be identified for each faunal assemblage.

Sites containing rabbit remains with anthropic marks:

Cantabrian region

Cueva Corazón (Palencia): A NISP of 10 rabbit (*Oryctolagus cuniculus*) bones was recorded within the Mousterian levels. Several cut marks were identified on a rabbit humerus bone, which is significant given the scarce number of remains of this species at this site (Yravedra *et al* 2013a).

There are no more Middle Palaeolithic sites with recorded rabbit assemblages having anthropic marks in this region. As mentioned above, this could be because no thorough taphonomic studies have been carried out on the rabbit remains from these sites.

Betic region

Gorham´s Cave: A total NISP of 844 rabbit (*Oryctolagus cuniculus*) remains was documented from the Mousterian Level IV, recovered from the inner part of the cave (Brown *et al* 2011). In the Mousterian levels from the entrance area corresponding to the Waechter excavations (Waechter 1951, 1964): G (n=94); H (n=5); J (n=5); K (n=187); L (n=21); M (n=178); N (n=30); P (n=52); Q (n=17); R (n=56); T (n=3); U (n=1); From the excavations carried out by Barton *et al* (2012): LBSmff.4/LBSmcf.2 (n=219); LBSmcf.4 (n=240); LBSmcf.5/LBSmcf.5-.7 (n=172); LBSmff.8/LBSmcf.9 (n=597); LBSmcf.8 (n=52); LBSmff.10/LBSmcf.11 (n=335); LBSmff.11/LBSmcf.12 (n=61); SSLm(Usm).2 (n=45); SSLm(Usm).3 (n=14); SSLm(Usm).4 (n=31); SSLm(Usm).5 (n=92); SSLm(Usm).6 (n=251). The rabbit is the predominant mammal recovered at this site, with the assemblage presenting a variety of spiral fractures, epiphyseal fractures, and shaft fragments, which are attributed to their consumption by Neanderthals (Brown *et al* 2011).

Cova Negra: In Mousterian levels II to VI a total NISP of 1066 bones of rabbit (*Oryctolagus cuniculus*), and 1 bone of hare (*Lepus europaeus*) was documented (Martínez Valle 1996).

Cova Beneito: In Mousterian levels X to XII a total NISP of 1330 rabbit (*Oryctolagus cuniculus*) bones and one bone of hare (*Lepus europaeus*) was recovered (Martínez Valle 1996).

El Salt: In Mousterian level AFA5, layer X, an NISP assemblage of 53 bones of rabbit (*Oryctolagus cuniculus*) was recovered. This assemblage contained cut marks, percussion marks, and thermo-altered areas on bony surfaces. Within the combustion structures (EC30, EC32, EC33) several thermally altered faunal remains were documented. In the thermally altered bone assemblage, the leporids are the most abundant species and those with the greatest degree of thermal affection. The number of thermally altered bones in the different combustion structures is as follows: EC30 (n=52); EC32 (n=16), EC33 (n=14). With regards to cut marks on bones, two were documented on fragments of coxal. With

regard to percussion marks, a total of four marks were identified, one on sacral and three on coxal (Pérez 2014).

Sites with rabbit bones remains without anthropic marks:

Cantabrian region

Esquilleu: In the Mousterian levels a total NISP of 12 rabbit (*Oryctolagus cuniculus*) was recovered (Yravedra 2001).

Hornos de la Peña: In Mousterian Level F, a NISP of 2 hare (*Lepus capensis*) bones was documented (Yravedra 2010b).

Covalejos: In Mousterian Levels: rabbit remains were found in levels D (n=1 NISP) and J (n=2 NISP) and in Level 8 (n=5 NISP) hare (*Lepus capensis*) was identified (Castaños 2005).

Axlor: In Mousterian Levels: Level III, 1 rabbit (*Oryctolagus cuniculus*) bone and a NISP of 4 hare (*Lepus capensis*) bones were recovered (Castaños 2005).

Lezetxiki: In the Mousterian Levels: level V, 7 NISP of rabbit (*Oryctolagus cuniculus*) and in Level VI, 5 NISP of hare (*Lepus capensis*) were recovered (Altuna 1972).

Arrillor: In the Mousterian Levels: Lmc and Amk, 1NISP of hare (*Lepus capensis*) in each level was recovered (Castaños 2005).

Abauntz: In the Mousterian Level G, 2 NISP of hare (*Lepus capensis*) was documented (Altuna *et al* 2001).

Prado Vargas: In the Mousterian level TNAD were documented 6 NISP of rabbits (*Oryctolagus cuniculus*) was recovered (Navazo *et al* 2005).

Valdegoba: A total of 106 NISP of rabbits (*Oryctolagus cuniculus*) were recovered from the Mousterian levels (Díez *et al* 1989).

Betic region

Cueva Horá: In the Mousterian level 1-61 a total of 1637 NISP of rabbit (*Oryctolagus cuniculus*) and 39 NISP of hare (*Lepus capensis*) were documented (Fuentes & Mejide 1975).

Cueva Antón: In the Mousterian level N.WII a total of 215 NISP of rabbit (*Oryctolagus cuniculus*) was recovered (Yravedra 2001).

Cueva Perneras: In the Mousterian level 6 the rabbit is the main taxon represented (Montes 1985).

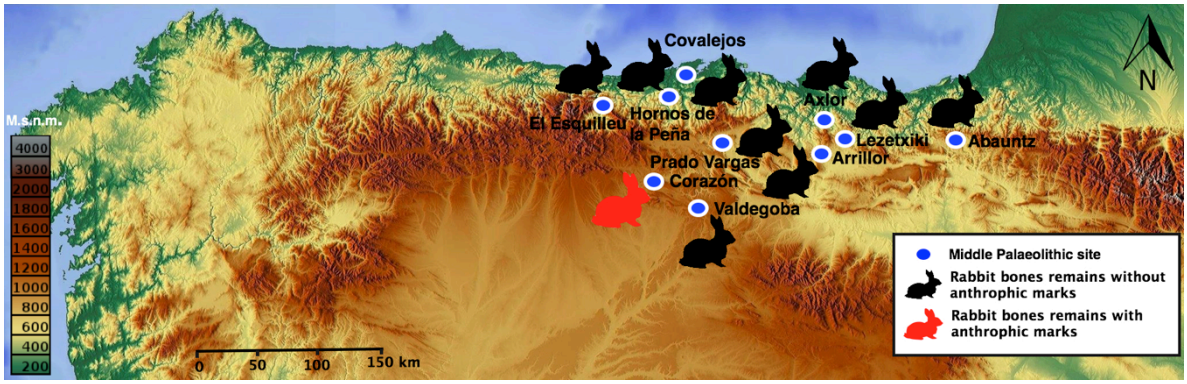


Figure 6.11. Middle Palaeolithic sites with rabbit remains in the Cantabrian Region.

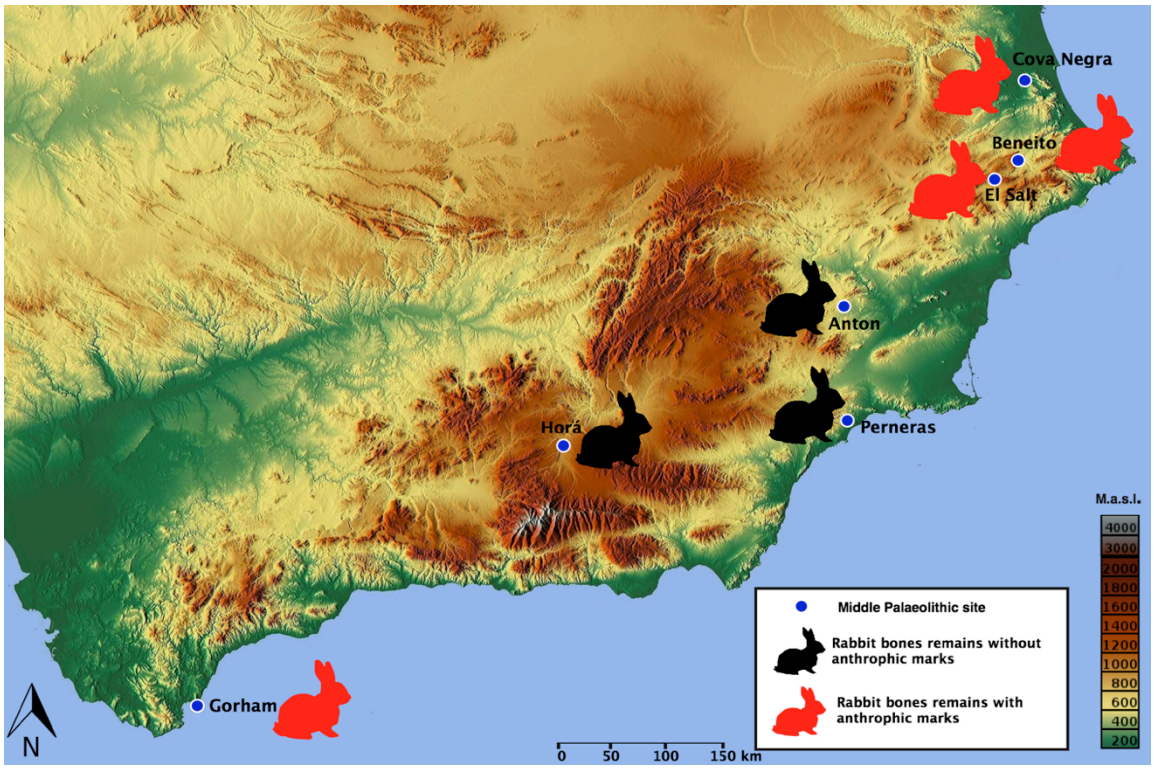


Figure 6.12. Middle Palaeolithic sites with rabbit remains in the Betic Region.

6.4.2. *Tortoise*

The consumption of tortoise (*Testudo hermanni*) in the Iberian Peninsula is documented from the early Late Pleistocene (MIS 5e), in Bolomor Cave, where the consumption of tortoise has been documented in several layers (Blasco 2008, Blasco & Fernández, 2012).

In the Late Middle Palaeolithic, several sites with evidence for the consumption of tortoise have been documented, in the Betic region the sites are: Cova Negra (Morales & Sanchis 2009); Sima de las Palomas (Walker *et al* 2010); El Salt (Pérez 2014); El Pastor (Galván *et al* 2007); and Gorham´s Cave (Finlayson *et al* 2001). The majority of tortoise fragments here seem to have an anthropogenic character, with cut marks, percussion marks and thermo-alteration all present on some bones. Other Middle Palaeolithic sites in this area which have tortoises without any anthropic marks include Carihuela (Ruiz Bustos *et al* 1982); Cueva Horá (Bailón 1986, 2001), and Boquete de Zafarraya (Barroso & Bailón 2003).

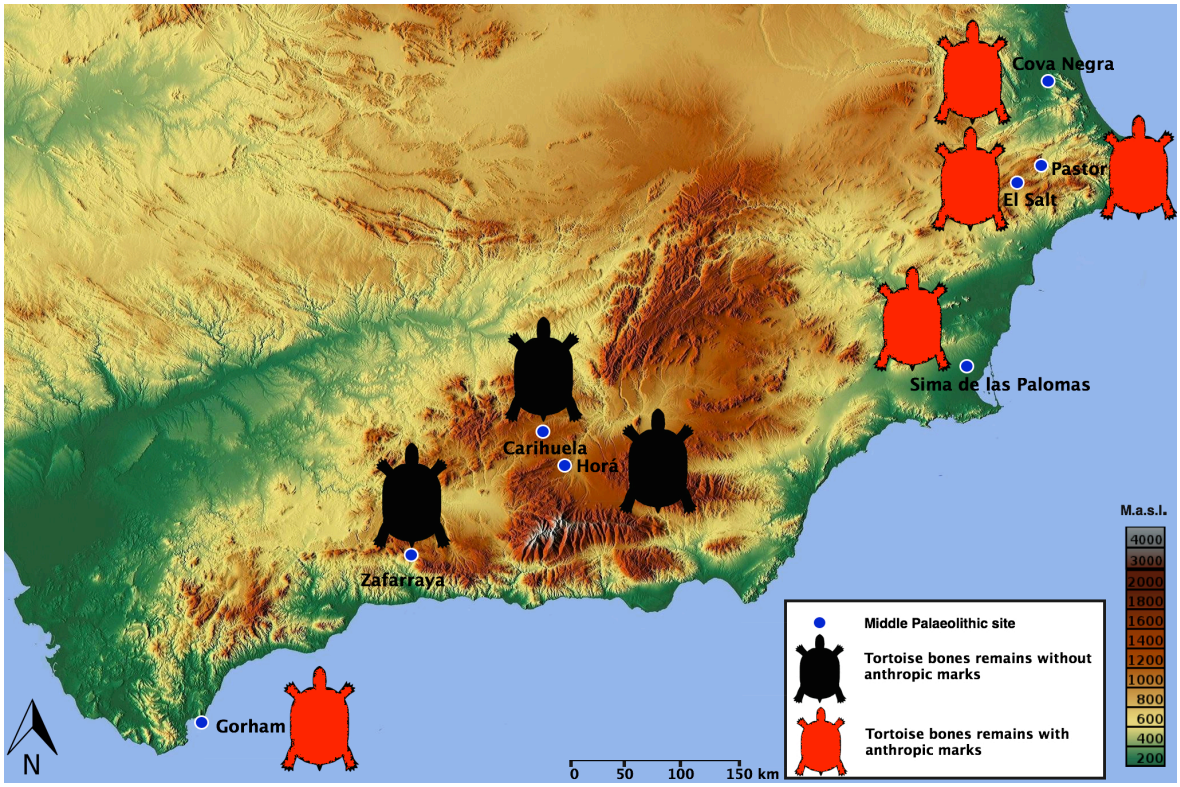


Figure 6.13. Middle Palaeolithic sites with tortoise remains in the Betic Region.

In the Cantabrian region there are no tortoise remains documented within any of its Middle Palaeolithic sites.

6.4.3. *Marine resource exploitation*

In the last decade, the role of coastal resources in the subsistence strategies of Neanderthals has become widely appreciated based on new archaeological fieldwork. This new evidence provides a wealth of knowledge with regards to the importance this resource, as well as the cognitive skills its exploitation entailed. The exploitation of intertidal marine resources by Neanderthals has been confirmed at numerous sites along the northern Mediterranean borderland and Iberian Atlantic coast, where the use of shellfish by Neanderthals is well documented. The sites include Costa del Balzi Rossi, Grotta dei Moscerini, Grotta dell´Alto, Grotta del Cavallo, Grotta Ulluzzo C, Grotta Mario Bernadini, Grotta dei Giganti (Italy) (Stinner 1994); and Kalamakia Cave, and Lakonis Cave I (Greece) (Richards *et al* 2008).

In the Iberian Peninsula similar evidence comes from the sites of Figuera Brava (Antunes 2000), Ibn Amar (Ferreira Bicho 2004; Ferreira Bicho & Haws 2008), Vale Boi (Manne *et al* 2011), Furninha (Antunes 2000) in Portugal as well as El Pendo (Madariaga de la Campana 1980); Morin (Madariaga de la Campana 1971); Amalda (Borja 1990, Imaz 1990) (Cantabrian region) and Cueva Perneras (Montes 1988), Hoyo de los Pescadores (Montes 1988), Cueva de los Aviones (Montes 1988, Zilhão *et al* 2010), Cueva Antón (Zilhão *et al* 2010), Complejo del Humo (Ramos *et al* 2011), Bajondillo (Cortés *et al* 2011), Higueral de Valleja (Jennings *et al* 2009), Devil´s Tower (Garrod *et al* 1928), Vanguard Cave (Barton 2000), Gorham´s Cave (Waechter 1964, Barton 2000) and Sima de las Palomas (Walker *et al* 2010) in the Betic region.

The gathering and consumption of shellfish resources by Neanderthals within the Iberian Peninsula is reported to date from 150 ka at Bajondillo (Málaga), almost contemporaneous to Pinnacle Point (South Africa), when shellfishing is first documented by archaic modern humans (Cortés *et al* 2011). In Europe, Neanderthals were exploiting marine mammals and other marine resources between MIS 6 and 3.

Hockett & Haws (2003) describe how shellfish provides additional nutritional value, as they contain carbohydrates not usually available from terrestrial mammals, as well as being rich sources of vitamins D and E. The addition of shellfish to the diet also resulted in a more varied, and therefore more beneficial, diet for humans.

Cantabrian region

Marine molluscs have been recorded within the Cantabrian region during the late Middle Palaeolithic, however, these equate to a small number of sites with very small quantities of marine remains and species variety. Therefore, the marine archaeological record documented, to date, would indicate a limited use of coastal resources in this region during this period (Álvarez Fernández 2005, Baena *et al* 2014).

Morin: From the Middle Palaeolithic levels 12, 16 and 17, shellfish remains were recorded, and within these assemblages, four species of shellfish (*Cochlicella acuta, Ostrea edulis, Oxychillus sp., Patella depressa-vulgata*) were identified (Madariaga de la Campana 1971).

El Pendo: In Middle Palaeolithic levels XI to XIII shellfish remains were documented comprising a single species (*Patella vulgata*) (Madariaga de la Campana 1980).

Amalda: Shellfish remains were recorded in the Middle Palaeolithic Level VII and within the assemblage four species of shellfish (*Patella vulgata, Littorina obtusata, Littorina rudis, Littorina saxatilis*) were identified (Borja 1990, Imaz 1990).

Another site of great interest is **El Cuco**, located in Castro Uridales (Cantabria), at 21m above sea level. The distance from the site to the current shoreline is approximately 350m. Recent studies have been published of the units from the Gravettian to the Aurignacian, where a large assemblage of shellfish has been recorded (Gutiérrez-Zagasti *et al* 2013). Although the shellfish remains recovered from the Middle Palaeolithic levels at this site are currently under investigation, this site is proving very interesting, because the Mousterian deposits provide exceptionally clear evidence for the exploitation of marine resources by Neanderthals. This site could change the current view on the exploitation of marine resources by Neanderthals within the Cantabrian region (Ríos-Garaizar pers. comm.).

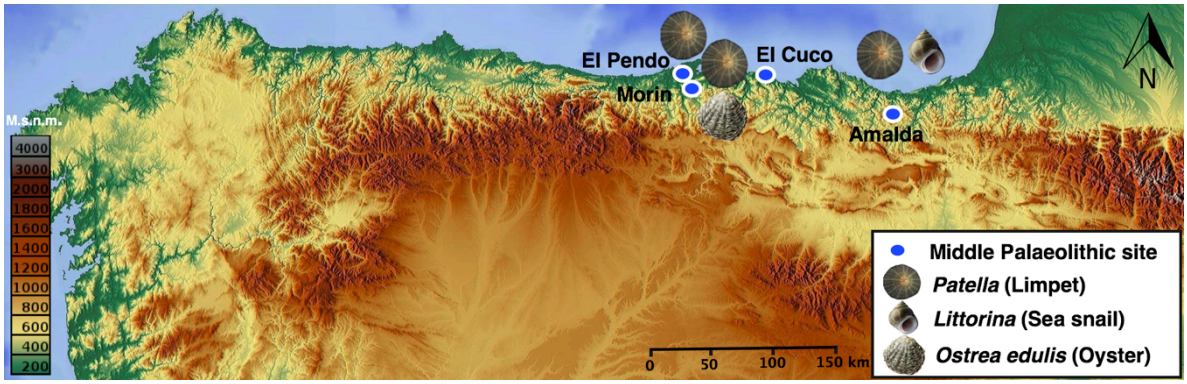


Figure 6.14. Middle Palaeolithic sites with marine molluscs in the Cantabrian Region.

Betic region

Cueva Perneras: In the Mousterian levels VI to IX**,** shellfish remains were recorded, of which six species were identified **(***Cardium echinatum, Charonia tritonis variegata, Monodonta turbinata, Mytilus edulis, Patella ferruginea, Pecten jacobeus*) (Montes 1988).

Hoyo de los Pescadores: Five species were identified at this site (*Monodonta turbinata, Mytilus edulis, Patella ferruginea, Patella vulgata, Pecten maximus*) (Montes 1988).

Cueva de los Aviones: In the Mousterian levels I to IV**,** shellfish remains were recovered, of which 22 species were identified (*Acanthocardia sp, Acanthocardia tuberculata, Callista chione, Cardium sp, Cerastoderma edule, Chama gryphoides, Charonia lampas, Gibbula sp, Glycymeris sp, Glycymeris insubrica, Glycymeris bimaculata, Laevicardium oblongum, Monodonta turbinata, Mytilus edulis, Nassarius incrassatus, Patella aspera, Patella ferruginea, Patella lusitánica, Pecten maximus, Spondylus gaederopus, Thais haemastoma (L), Truncularipsis trunculus L*)(Montes 1988, Zilhão *et al* 2010).

Amongst the marine mollusc shells, three umbo-perforated valves of *Acanthocardia* and *Glycymeris* were found alongside lumps of yellow and red colorants, and residues preserved inside a spondylus shell consist of a red lepidocrocite base mixed with ground, dark red-to-black fragments of hematite and pyrite. According to Zilhão *et al* (2010), these shells were use ornamentally by Neanderthals, like the material documented from the Near Eastern sites of Qafzeh, Hsar Akil, and Üçağizli, during the Middle and early Upper Palaeolithic periods and attributed to modern humans.

According to Zilhão & Villaverde (2008) the variety of mollusc species exploited suggests

in turn that the Cartagena OIS-3 coastline, although situated farther to the south, was topographically and ecologically similar to that of the present.

Cueva Antón: In the Mousterian level I-K a perforated Pecten shell **(***Pecten maximus*), painted on its external white side with an orange mix of gothite and hematite, was documented in this site. According to Zilhão *et al* (2010), this shell was used ornamentally by Neanderthals and therefore they give it a symbolic character.

Sima de las Palomas: Within the Middle Palaeolithic layers, a few fragments corresponding to two species (*Cardium edule, Pectem maximus*) were collected (Walker *et al* 2010).

Bajondillo: In the Mousterian levels 17 to 19**,** shellfish remains were recorded, of which ten species were identified **(***Acanthocardia tuberculata, Balanus sp., Balanus trigonus, Callista chione, Donacilla cornea, Glycymeris sp, Mytilus galloprovincialis, Panopea glycimeris, Stramonita haemastoma, Thracia sp.)* (Cortés *et al* 2011).

Higueral de Valleja: This site is located in Sierra Valleja (Arcos de la Frontera, Cádiz) at 190m above sea level, with a distance from the site to the closest current shoreline of 43km. A scallop (*Pecten maximus*) was recovered within the Mousterian level V, and for this reason Jennings *et al* (2009) consider that Neanderthal mobility patterns were greater than previously thought in southern Iberia.

Devil´s Tower: Dorothy Garrod reported large mussel shells from the Mousterian Levels 2-6, with a total of 11 species identified (*Cardium sp., Charonia nodifera, Lucina borealis L., Mytilus edulis, Mytilus galloprovincialis, Patella depressa, Patella ferruginea, Patella vulgata, Pecten jacobeus, Septa nodifera, Spondylus gaederopus*), with most of them being Atlantic species. However, within the elevated beach area, most shells belong to Mediterranean species. As a whole, the shellfish from the Middle Palaeolithic do not differ from those currently present in the Strait of Gibraltar (Garrod *et al* 1928).

Vanguard Cave: Barton (2000) identified a hearth, located within the Middle Palaeolithic layer called Upper Area (Unit B). Associated with this hearth, was a scattering of marine shells, both within the hearth itself, as well as around it, which were in turn associated with Mousterian lithic artefacts. A total of six species were identified (*Acanthcardia tuberculata, Balanus sp, Callista chione, Mytilus galloprovincialis, Patella vulgata,*

Patella caerula) (Barton 2000).

A taphonomic interpretation of these remains by Fernández-Jalvo & Andrews (2000), suggested that the Neanderthals were obtaining the mussels from the shoreline and transporting them into the cave. They also suggested that they collected branches from the surrounding area to prepare a fire. This fire was used to open and cook the mussels. Knapping stones were found around the hearth. After the cave was abandoned the mussel remains were rapidly buried by sand, probably by the action of the wind.

A study carried out by Douka and Higham (2012) using a growth-ring method of analysis for estimating the season of death of shells showed that the Vanguard Cave assemblage was harvested in mid-spring.

Gorham´s Cave: Throughout the several excavations in the Mousterian layers 17 species of intertidal and shallow water molluscs have been documented (*Acanthcardia tuberculata, Callista chione, Fissurella sp., Littorina obtusata, Littorina saxatilis, Monodonta articulata, Mytilus edulis, Mytilus galloprovincialis, Nucella lapillus, Osilinus articulatus, Osilinus turbiatus, Patella caerula, Patella depressa, Patella ferruginea, Patella vulgata, Pecten maximus, Semicassis undulata)* (Waechter 1964, Barton 2000). According to Fa (2008), the mode of exploitation of this resource remained essentially unchanged between the archaeological horizons occupied by both Neanderthals and anatomically modern humans.

Another site of great interest is the archaeological complex of Araña (Málaga), Abrigo 3 and Abrigo 4. These rockshelters provide exceptionally clear evidence for the exploitation of marine shellfish by Neanderthals as their Mousterian layers have a large accumulation of shellfish remains and their study will provide significant information regarding Neanderthal economies in southwestern Iberia.

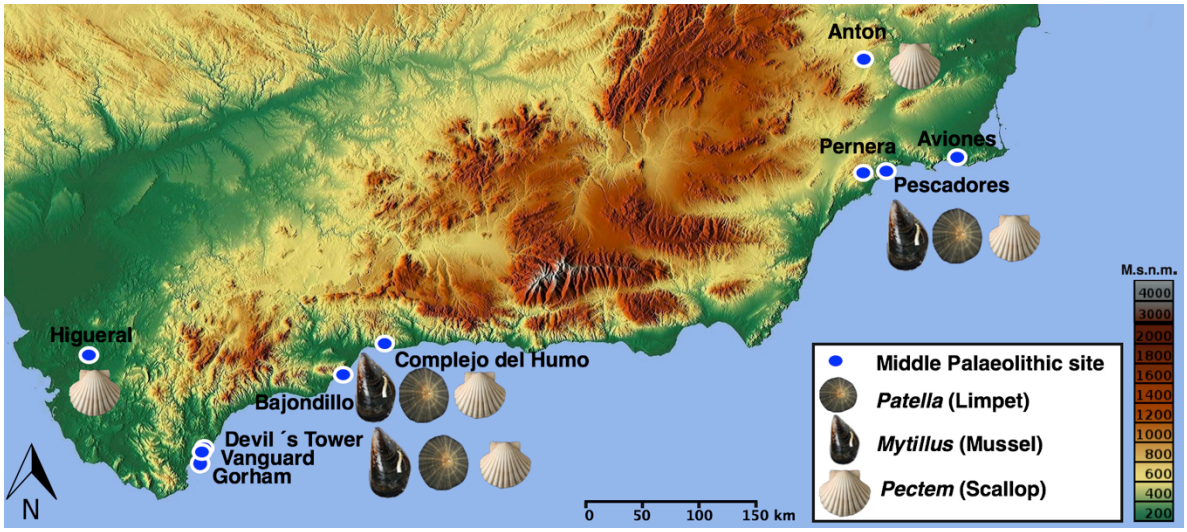


Figure 6.15. Middle Palaeolithic sites with marine molluscs in the Betic Region.

The exploitation of marine resources, such as shellfish, during the Mousterian does not seem to be as widespread throughout the Cantabrian region (Baena *et al* 2004), as it is in the Betic region (Cortés 2005). There are various factors that may have masked any evidence of activity within the Cantabrian region. These include:

1. The distance of the sites from the shoreline. The small number of remains recovered from Cantabrian sites could have a direct correlation with the distance from the shoreline of the sites, particularly as the shoreline was even further away than at present during the Middle Palaeolithic.

2. Submerged evidence. The scarcity of shells recovered from Middle Palaeolithic sites within the Cantabrian region could be as a result of shell-middens being located closer to their contemporary coastline. These would have subsequently been destroyed as a result of a sea level rise (Bailey 1973). During the Glacial Maximum, sea level would have been at -100 m, rising gradually after ca 24,000 BP, with a faster and greater rise occurring during the Holocene. This rise reduced the extent of coastal plains, destroyed cliffs and submerged many prehistoric sites, finally settling in ca. 650 cal AD into the present-day Cantabrian shoreline (Edeso 1991).

Given that several sites, within both study regions, show evidence for the exploitation of marine resources by Neanderthal, it can be concluded that these did in fact contribute a significant and regular part of the Neanderthal diet. With the variables considered above, it

is possible that the assemblages are indeed biased and that the presence of marine resources in the Neanderthal diet was even more frequent and significant than previously thought, and it started as early as 150ka in the Iberian Peninsula.

In terms of climatic data, the shellfish species documented in the archaeological record for both study regions suggest that ocean temperatures during the Middle Palaeolithic were broadly similar to the present day.

6.4.4. *Fish*

The fragile nature of fish remains, particularly in comparison with larger animals, results in them being very rarely documented in the archaeological record. There are few archaeological sites within the period under study where fish remains have been documented. In addition, the exploitation and capture of fish, like other fast-moving small game, has been considered an exclusive skill, requiring the superior cognitive ability of Anatomically Modern Humans (Hardy & Moncel 2011).

Evidence for fish remains within Neanderthal occupational levels in Middle Palaeolihic sites outside of the Iberian Penisula includes: Grotte XVI (France) (Rigaud *et al* 1995); Raj Cave (Poland) (Patou-Mathis 2004); Grotta Maggiore (Italy) (Fiore *et al* 2004); Ust-Kanskaya Cave (Siberia) (Derevianko *et al* 2005), and Figueira Brava Cave (Portugal) (Ferreira Bicho & Haws 2008).

The presence of fish remains in the Middle Palaeolithic in the Iberian Peninsula is very limited, both in terms of sample size and the number of sites. Direct evidence of fish fossil remains within the Iberian Peninsula has been documented in the following sites, in the north at Amalda (País Vasco) (Morales & Roselló 1990), Millán (Burgos) (Roselló & Morales 2005), Ermitons, and L´ Arbreda (Cataluña) (Muñoz & Casadeval 1997) and in the south at Horá (Granada) (Bailón & Desse 1986), and Vanguard Cave, and Gorham´s Cave (Gibraltar) (Stringer *et al* 2008).

Cantabrian region

Amalda Cave: Fish remains have been documented within Level VII, attributed to the Middle Palaeolithic. The ichthyofaunal assemblage is dominated by local salmonids (salmon and trout). According to Morales & Roselló (1990) there is a relative homogeneity

verified in the time of death of these fishes, as evidenced by their growth rings, suggesting they were captured in spring, therefore reaffirming the seasonal exploitation of resources.

Millan Cave: An assemblage of fish remains was documented during the archaeological excavations in 1980 and 1982. According to Roselló (1992), the differential abundance of fish vertebrae is indicative of seasonality in the death of the fishes, with the majority of the vertebrae analysed corresponding to benign periods of the year, when natural mortality in fish populations was minimal, pointing towards Neanderthals as the main causative agent of their mortality.

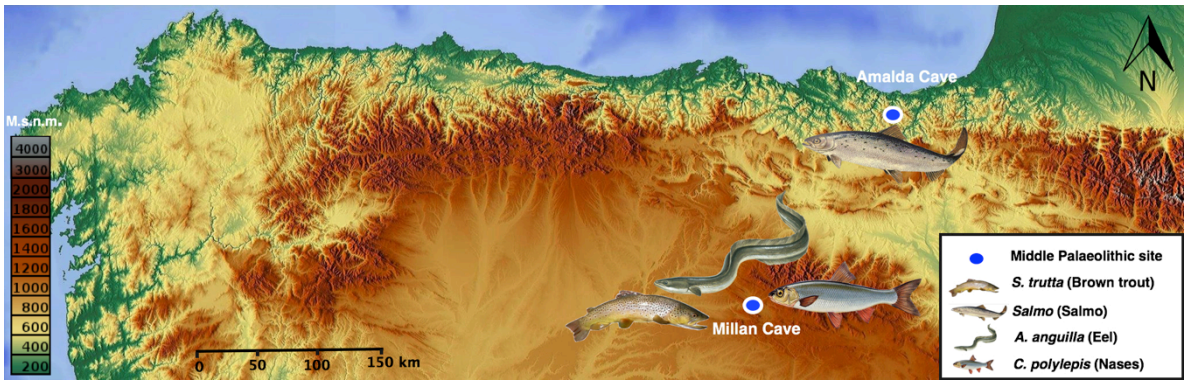


Figure 6.16. Middle Palaeolithic sites with fish remains in the Cantabrian region.

Betic region

Horá Cave: Several vertebrae of brown trout (*Salmo trutta*) have been documented in Levels XX, XXXVIII and XXXI attributed to Middle Palaeolithic deposits. The presence of this species indicates the presence of clear, oxygenated, running fresh water from the mountain, and a temperature of between 14º and 15ºC (Bailón & Desse 1986). The remains indicate that they were also exploited during spring, once again confirming the seasonal exploitation of resources by Neanderthals.

Vanguard Cave: As mentioned above, several assemblages of marine remains have been documented at this site. Between these remains, part of a left mandible of the edible sea bream (*Diplodus sargus /vulgaris*) was recovered from within the middle area of the cave (Stringer *et al* 2008).

Gorham´s Cave: Fish remains have also been documented at this site, namely remains of fish like edible sea bream (*Diplodus sargus /vulgaris*) and bluefin tuna (*Thunnus thynnus*)

within the Middle Palaeolithic level IV in the interior of the cave (Stringer *et al* 2008, Brown *et al* 2011).

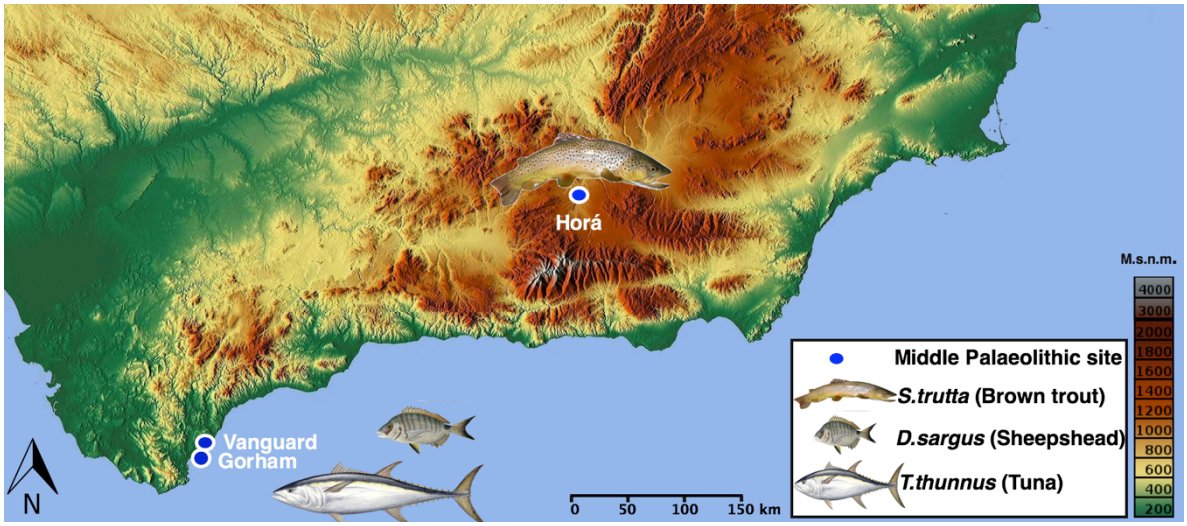


Figure 6.17. Middle Palaeolithic sites with fish remains in the Betic region.

With the exception of Gibraltar, the Middle Palaeolithic sites with documented fish remains are located inland. Most of the fish species identified are river species, suggesting a preference for river fishing during the Palaeolithic as opposed to open estuarine or coastal species. However, tides can prove advantageous in estuaries or on the coast because a rising tide can bring an abundance of fish to the shore, some of which can be left stranded amongst rocks or banks of sand once the tide descends, making them an easy catch.

Unfortunately, due to their fragility, fish remains are rarely preserved in Palaeolithic archaeological record. This obviously biases the assemblage, creating a false image of the possible taxonomic diversity existing within the fish biocenosis of the environments in which these sites are located. The few remains that are recorded have, however, provided sufficient evidence to suggest that this was not an accidental or isolated practice, but that fishing was an activity regularly employed by Neanderthals. Additionally, analyses of fish remains have further strengthened the hypothesis of seasonal behaviour of Neanderthals in their exploitation of particular resources.

6.4.5. *Avifauna*

Traditionally, it was accepted that Neanderthals did not have the cognitive capability to hunt birds. However, the capture and consumption of avian prey by Neanderthals has subsequently been documented in several archaeological sites (D´Errico *et al* 1998; Peresani *et al* 2011, Enloe *et al* 2000, Hardy *et al* 2001, Finlayson *et al* 2001, 2012, Blasco & Fernández 2012a,b).

The possibility that Neanderthals might hunt birds was proposed by Mourer-Chauvire in the following sites: Grotte de L'Hortus, Pech de L'Aze and La Baume de Cigny (Mourer-Chauvire 1972, 1975, 1989). Others sites with evidence for the consumption of birds are: Starosel'e (Crimea) (Harly *et al* 2001); Prolon II (Enloe *et al* 2000), Castelcivita and Fumane (Italy), (D´Errico *et al* 1998; Peresani *et al* 2011) and Payre (France), amongst others. An extensive database of Pleistocene sites, located within the Palaeartic region, with documented avifaunal remains, can be accessed freely online - http://web.telia.com/~u11502098/pleistocene.pdf. This is a supplement of the book "Pleistocene birds of the Paleartic: a catalogue" published by the Nuttall Ornithological Club (Nº 27, Cambridge, Mass. 1998, ix + 720 pp).

In the past, bird remains have been used solely as environmental and climatic indicators for archaeological sites. Only in recent decades has the focus shifted to in-depth taphonomic studies and the cultural significance of these bird assemblages. The anthropogenic evidence on bones, such as cut marks, intentional breakage, human tooth marks and burning patterns, is still considered unequivocal evidence for anthropic accumulations of the bird remains (Laroulandie 2005, Blasco & Fernández 2012a,b). For this reason it is necessary to carry out taphonomic studies of the bird assemblages in all sites with bird remains. A lack of cut marks and bone modification make it unclear whether or not their accumulation was caused by Neanderthals, natural processes or carnivores. Many bird remains, given their small size, would not show the typical taphonomic traces commonly attributed to human action, as these small birds would not require extensive disarticulation and filleting to cook, such as is needed for larger game. Additionally, they were likely cooked whole, not requiring high temperatures or long cooking time, therefore not showing extensive fire or stone tool damage (Brown *et al* 2011). However, on the larger sized birds, such as vultures, eagles, and swans, it is much easier to identify cut marks and others

anthropic traces, as these animals would have required additional processing before consuming.

In the Iberian Peninsula there are many sites with avifaunal remains, but very few have been taphonomically studied. The first instance of birds being exploited as a food resource is documented from the Lower Pleistocene, in Sima del Elefante (Atapuerca, Burgos) (Huguet 2007), with a proximal fragment of a radius of an unidentified bird and a tibiotarsus with cut marks. In Bolomor Cave there is evidence for the consumption of birds from MIS 9 in level XVII, as well as throught the whole sequence up to MIS 5e (350-100 ka) (Blasco & Fernández 2012a,b). Another Middle Pleistocene site with evidence for the consumption of birds is Ángel Cave, with 5 small burnt fragments of bird bones identified (Barroso *et al* 2011). Several of the Middle Palaeolithic sites within one of the study areas, the Betic region, also show evidence for the consumption of birds: Gorham´s Cave, Vanguard Cave, Ibex Cave (Finlayson *et al* 2001, 2012); Cova Negra (Martínez Valle *et al* 2016), Cova Beneito (Martínez Valle 1996, Iturbe *et al* 1993), Zafarraya (Barroso *et al* 2003). This is not the case in the Cantabrian region, where avifaunal remains with anthropic marks have not been recorded at Middle Palaeolithic sites.

Sites with anthropic marks on bird remains:

Betic region

Gorham´s Cave: In the assemblage of bird remains documented for this site, a total of 75 species were identified. Present day Gibraltar lies on an important migratory route for birds between Europe and Africa, which most likely was also the case during the Pleistocene, possibly explaining the high number of identified species within its assemblage. Many of these species would frequent this area during their wintering periods, such as the Eurasian Oystercatcher (*Haematoopus osrralegus)*, Red-Throated Diver (*Gavia stellate),* Long-tailed Duck *(Clangula hyemalis),* Velvet Scoter *(Melanitta fusca),* Little Auk *(Plautus alle)* and Lesser Black-backed Gull *(Larus fuscus)*. Amongst them there are some warm climate species present such as the Griffon Vulture (*Gyps fulvus)* and the Black-Winged Stilt *(Himantopus himantopus*) as well as species that commonly live and breed in the Arctic area, with movements towards the south, such as the Snowy Owl (*Nyctea scandiaca)* and

the Velvet Scoter *(Malanitta fusca*). The majority of the taxa are ubiquitous or common in the area (Eastham 1968, Cooper 2012, Brown 2009, Sánchez Marco 1996). The systematic exploitation of birds has been documented throughout all archaeological levels at this site, with the identification of anthropic marks on bird bones remains corresponding to pigeons, raptors, and corvids (Blasco *et al* 2014). In addition, Finlayson *et al* (2012) propose a symbolic use of feathers, from both birds of prey and Corvidae, as ornamental elements by Neanderthals.

Vanguard Cave: The assemblage of bird remains documented in this site is represented by 33 species. Bird bones remains were documented from almost all levels, though not in the quantities found at Gorham´s Cave. The most numerous taxa in this site is *Columba livia/oenas* as is the case at Gorham´s Cave (Cooper 2012). From 91 bones analysed, anthropic marks were identified on bones identified as Griffon Vulture (*Gyps fulvus)* and Chough *(Pyrrhocorax pyrrhocorax)* (Finlayson *et al* 2012).

Ibex Cave: An assemblage of 241 bird remains was recovered from which 32 species were identifiable (Cooper 2000). The assemblage reflects local species, as was the case in Gorham´s Cave and other sites, with most of them still common in the area today (Finlayson 1992), together with bird species from northern Europe. According to the taphonomic studies carried out by Fernández-Yalvo & Andrews (2000), the bird remains were not accumulated by Neanderthals, but by scavengers such as foxes, and wolves or hunted by other mammalian predators and birds of prey, such as raptors, and owls, etc. A more recent taphonomic study of a sample of 27 bones, carried out by Ruth Blasco and Jordi Rossel, identified cut marks on chough remains (*Pyrrhocorax pyrrhocorax)* (Finlayson *et al* 2012).

Cova Negra: The assemblage of bird remains documented for this site is represented by 37 species. In this site the focus is on level IIIb where a total of 244 bird remains from 22 species have been identified. According to Martínez Valle *et al* (2016), doves and corvidae, particularly choughs (*Pyrrhocorax sp.*), are the species most frequently represented. A total of 93 remains of 12 species (of doves, corvidae, partridge, lesser kestrel, roller and small passerines) show cut marks on bones remains. Furthermore, 53% of the bird remains were burnt to some degree. This evidence is a clear indication of bird

hunting and consumption by Neanderthals. The interesting features of this assemblage are: the absence of large birds, the prevalence of middle size birds, and the presence of small passerines. Their relative abundance indicates the practice of generalist hunting, focused on species that could be captured within the territory immediately surrounding the site (Martínez Valle *et al* 2016).

Cova Beneito: In the stratigraphic survey carried out in squares 3D, 3E, 5D and 5E, a total of 420 bone remains of birds were recovered. The best represented taxa among the bones found, are choughs (*Pyrrhocorax sp.*), partridges (*Alectoris sp.*), and pigeons (*Columba sp.*). In the Mousterian level D1-4 anthropic marks had been identified on dove, alpine chough, and partridge bones (Martínez Valle 1996, Iturbe *et al* 1993).

Zafarraya: 33 species were identified within the assemblage of bird remains documented for this site. Although there is an abundance of bird remains, these are quite fragmented, hindering their identification. There are various accumulating agents responsible for the assemblage including birds that simply died of natural causes within the cave and those that came in to the site as prey by raptors and small carnivores. Although anthropic accumulation cannot be unequivocally demonstrated, there is only one documented instance of a vulture bone showing traces of meat processing carried out by human action (Barroso *et al* 2003).

Sites with bird remain assemblages without anthropic marks:

Cantabrian region

Valdegoba: A large assemblage of bird remains have been documented for this site, with a total of 42 species identified. The dominant species present are choughs ***(****Pyrrhocorax graculus* and *Pyrrhocorax pyrrhocorax)* which surpass 50% of the total. According to Díez *et al* (1989), the presence of Quail (*Coturnix coturnix),* Black Vulture *(Aegypius monachus)* and Little Owl *(Athene noctua)* is indicative of warm climatic conditions. No taphonomic studies of these bird remains have been carried out to date (Díez *et al* 1989, Quam *et al* 2001).

El Esquilleu: Several small assemblages of bird remains have been documented within the different Mousterian levels: level III ***(****Anseriformes sp., Charadriiformes sp., Columba*

livia, *Turdus* sp., *Garrulus glandarius, Pica pica, Pyrrhocorax pyrrhocorax,);* level VIII *(Columba livia/oenas, Pyrrhocorax graculus);* and level XIf *(Columba livia/oenas)*. Most bird species are associated with rocky environments, forests, and marshes or lagoons. There is no evidence to suggest that humans were the accumulating agent responsible for this assemblage (Baena *et al* 2005).

Amalda: Within the Mousterian level VII nine species were identified, all of which occur locally: *Anas platyrrhynco, Aquila chrysaetos, Turdus sp., Turdus viviscivorus, Emberiza calandra, Corvus corone, Pyrrohocorax pyrrhocorax*. The distribution of bones is limited, and there are no concentrations of small bones in any one square metre, which Eastam (1990) suggests is an indication that they were accumulated by raptors.

Other Middle Palaeolithic sites in the Cantabrian region with low number of bird species identified are El Conde (one species: *Pyrrhocorax graculus*), El Castillo (five species: *Falco tinnunculus, Corvus monedula, Coccothraustes coccothraustes, Aegypius monachus?, Pyrrhocorax* sp) and Lezetxiki (two species: *Pyrrohocorax pyrrhocorax*, *Pyrrhocorax graculus*).

Betic region

Devil´s Tower: The assemblage of bird remains documented for this site is represented by 39 species. This assemblage is characterised by a high representation of species typically of coastal cliffs as well as a high number of raptors (Bate 1928). Sánchez Marco (1996) suggests that although not present within the site, cold climate species such as *Melanitta fusca and Mergus serrator*, which breed at higher latitudes, could have come near the site, as they do today. Of particular bioclimatic significance is *Pyrrhocorax graculus*, which currently inhabits high mountain ranges, although it was common in most sites during the Pleistocene.

Other Middle Palaeolithic sites in the Betic region with low numbers of bird species are: Sima de las Palomas **(**11 species: *Falco tinnunculus, Falco naumanni, Alectoris rufa, Columba livia, Athene noctua, Galerida cristata/theklae, Saxicola torquata, Monticola solitarius, Corvus corone, Pyrrhocorax pyrrhocorax, Passer domesticus)* (Walker *et al* 2004); El Salt (6 species: *Anas platyrhynchos, Alectoris rufa, Columba sp., Pyrrhocorax*

graculus, Pyrrhocorax pyrrhocorax, Phasianidae indet) (Eastham 2001); Carihuela (1 species: *Pyrrhocorax graculus)* (Sánchez Marco 2002) and Cova Forada: (1 species: *Pyrrhocorax pyrrhocorax)* (Eastham 2001).

From a palaeoecological point of view:

- Bird species corresponding to humid areas are very abundant in Iberian Peninsula during the Pleistocene (Sánchez Marco1996).

- The ornithological assemblages from archaeological sites located in the Mediterranean area of Iberia, are predominantly Mediterranean in character, with some inclusions of Nordic species (Sánchez Marco1996).

- The birds found in the Iberian Peninsula during the Quaternary are present there today (Lambrecht, 1933).

- The Betic region appears to have a more diverse avifauna than the Cantabrian region during the Middle Palaeolithic (Figure 6.18).

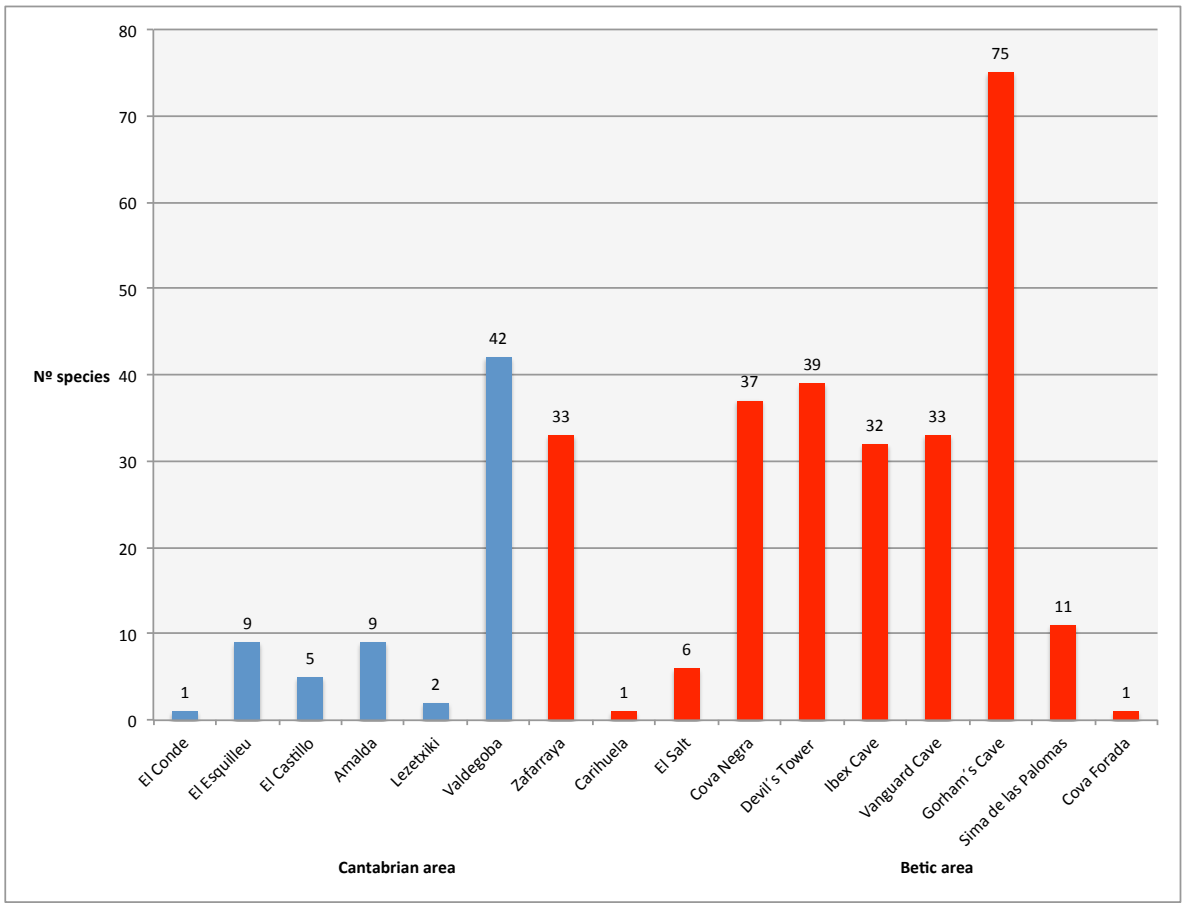


Figure 6.18. Comparison of number species of bird per Middle Palaeolithic site in both regions (Cantabrian and Betic).

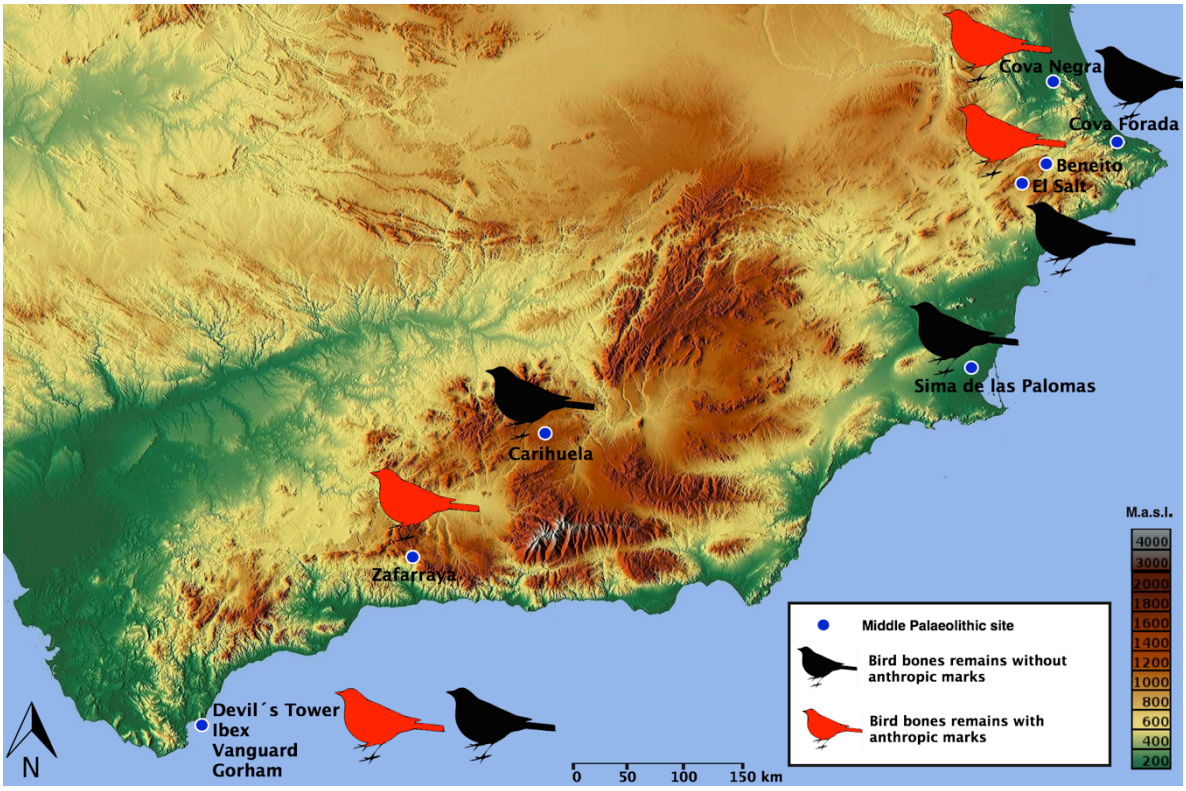


Figure 6.19. Middle Palaeolithic sites with bird remains in the Betic region.

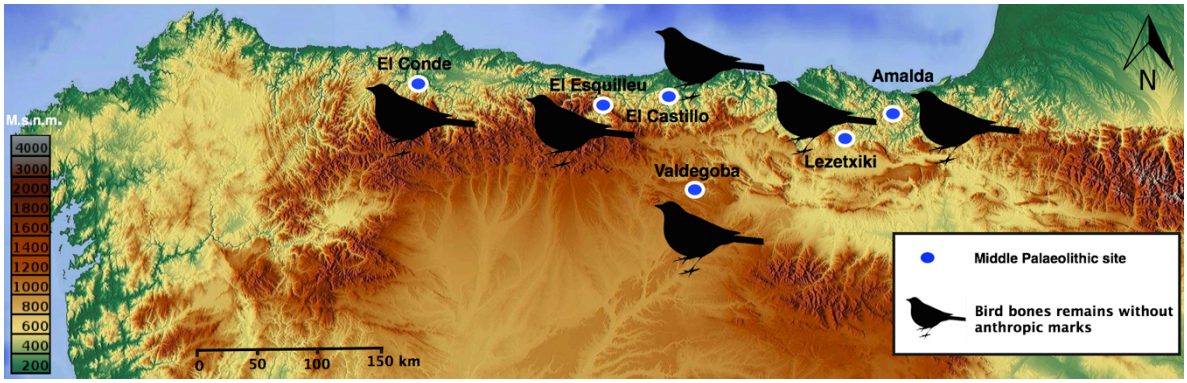


Figure 6.20. Middle Palaeolithic sites with bird remains in the Cantabrian region.

6.5. PLANTS

Until very recently, it was assumed that Neanderthals were predominantly meat-eaters; but new evidence suggests that their diet was broader and included plants. Our working knowledge of the Neanderthal diet is primarily derived from faunal remains recovered from archaeological sites and from stable isotope analyses measured on Neanderthal bone collagen. This has led to a bias towards indications of a predominantly protein-based diet. The role of plants in the diet has been largely overlooked due to the difficulty in finding evidence of their presence. Within the study regions, there are several sites with evidence for the consumption of seeds, fruits, nuts, vegetables, and other plants, thus changing all previous notions of a predominantly Palaeo-carnivore diet to one encompassing a broader spectrum of foods.

Evidence for plant exploitation during the Palaeolithic is extremely limited. From the Early Pleistocene, ca. 1.2Ma, in Sima del Elefante (Atapuerca, Spain), the analysis of dental calculus from a hominid molar has provided evidence of plant use and the consumption of

at least two different types of plants by this hominid (Hardy *et al* 2017). From the Middle Pleistocene the archaeological site of Gesher Benot Ya´aqov, located in Israel, ca. 800 ka, provides documented evidence of a macrobotanical assemblage of 55 food plant taxa, which was part of the hominid's diet (Melamed *et al* 2016).

Evidence for the exploitation of edible grass seeds from Middle Palaeolithic sites has been documented in several places, such as Amud Cave (Madella *et al* 2002), Kebara Cave (Lev *et al* 2005) both in Israel, and in the Iberian Peninsula at Gorham´s Cave (Barton 2000, *et al* 1999). Starch granules have been discovered within dental calculus of Neanderthal teeth recovered from Shanidar Cave, in Iraq, and Spy Cave in Belgium (Henry *et al* 2011). At the sites of El Sidrón and in El Salt, within the Iberian Peninsula, it has also been possible to recover faecal biomarkers from sediments and coprolites.

Microscopic residue analysis and use-wear of lithic tools are other methodologies used to establish the possible exploitation of plants by hominids. Using these methods, the exploitation of plant matter has been established at various Middle Palaeolithic sites with lithic assemblages, although the plant taxa have not been identified. Some of these sites include Starosel'e and Buran Kaya III (Crimea); La Quina, Maras, Payre Ardèche (France) and Moldova I and V (Moldova) (Hardy *et al* 2001, 2004, 2011, Paunescu 1989)

The availability of plants can, of course, be restricted due to adverse climate conditions. According to Roebroeks *et al* (1992), plant growth was absent during a large part of the year during the Middle Palaeolithic, within the Neanderthal range, because the latter lived at temperate latitudes in climates that were at times much colder than at present. Therefore plant foods would have been seasonal, with limited availability throught the year, making meat the only abundant constant. This might have been the case in the cold steppes of Northern Europe, but not necessarily within the bioclimatic refuges the various peninsulas of southern Europe would have provided, of which the Iberian Peninsula is an example. In addition, there was great climatic fluctuation in Pleistocene Europe, with temperatures ranging from as warm as present day, during the last interglacial, to as cold as the Last Glacial Maximum. We can surmise that Neanderthals lived during greatly fluctuating climatic periods, which would have included periods during which an abundance of edible plants would have been available for their consumption (Jones 2009, Hardy 2010, El Zaatari 2011).

Betic region

Gorham´s Cave

In the Middle Palaeolithic levels of Gorham´s Cave, the residue of food-processing activities has been identified within the various hearths documented. Some organic material has been exceptionally preserved within the carbonized residues, and has been identified as wild olives (*Olea sp.*) and stone pine nut (*Pinus pinea*). Additionally, large rounded stones, showing evidence of percussive marks on their surfaces have been found associated with this organic material, suggesting that they might have been used in processing the pine nuts for consumption (Barton 1999, 2000). In level SSLm. (Usm).2 a substantial accumulation with a total of 2128 individual pine cone/nut fragments were documented. Pine cones were also recorded for the Upper Palaeolithic levels at this cave, indicating that the *Pinus pinea* nut was a significant component of the Neanderthal and Anatomically Modern Human diet during the Upper Pleistocene in Gibraltar (Ward *et al* 2012).

El Salt

Sistiaga *et al* (2014), used faecal biomarkers from five sediment samples taken from different occupational floors corresponding to the Middle Palaeolithic levels of El Salt rockshelter in order to determine the components of the Neanderthal diet. This study concluded that although Neanderthals did eat meat primarily, vegetables were a significant component, given the regular presence of 5β-stigmastanol in the samples. The authors also concluded that the "Neanderthals, like Anatomically Modern Humans, have a high rate of conversion of cholesterol to coprostanol due to the presence of bacteria capable of doing so in their guts" (Sistiaga *et al* 2014).

Sima de las Palomas

Dental calculus analysis from eleven Neanderthal teeth at Sima de las Palomas was carried out by Walker and collegues (Walker *et al* 2011). The Mousterian tools were also analysed using the microscopic residue methodology, as described above. From the Neanderthal calculus phytoliths, starch grains, and nine microfossil types were identified, indicating that the Neanderthals consumed a diversity of plant species (Salazar *et al* 2013).

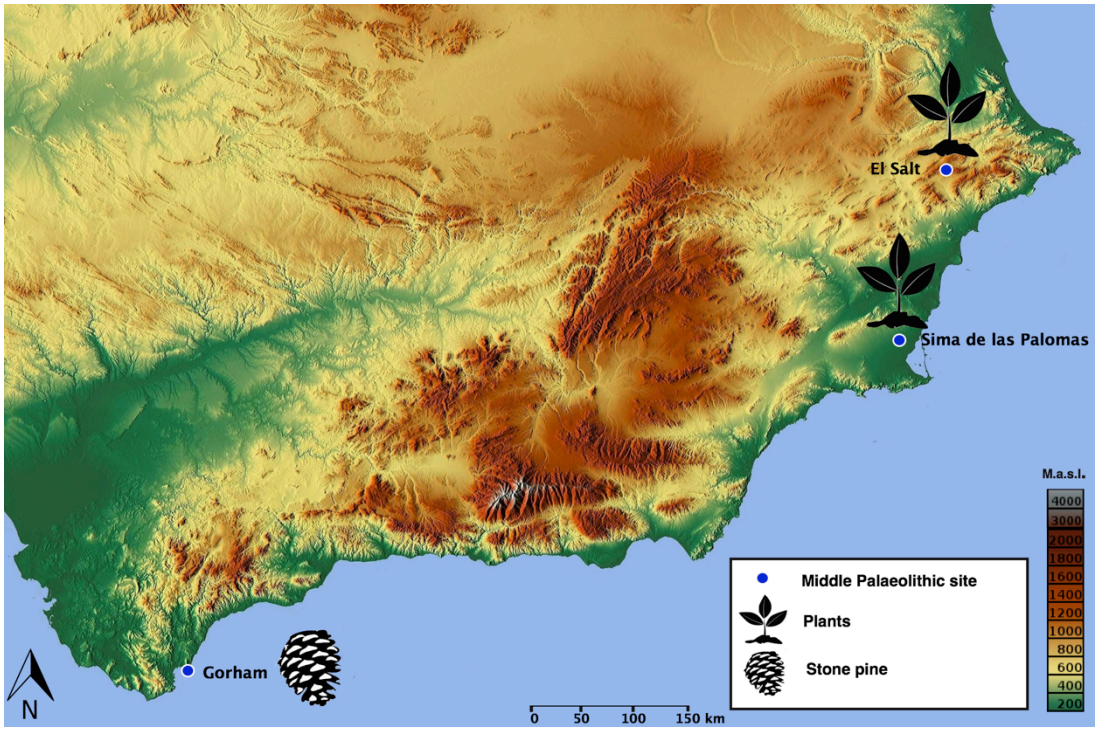


Figure 6.21. Middle Palaeolithic sites with plant remains in the Betic region.

Cantabrian region

El Sidrón

An analysis of the microfossil plants found in dental calculus from five Neanderthals individuals from El Sidrón site was carried out. The results provided the first molecular evidence of cooked plant foods. Starch granules and carbohydrate markers in these samples, indicated possible evidence for the intake of nuts, grasses, and possibly even green vegetables. The authors also offered the first evidence of the use of medicinal plants by Neanderthals. Their explanation for the presence of pigments and bitter-tasting appetite suppressants found within the calculus on one sample is of self-medication, as these bitter-tasting plants offered no nutritional value. In addition, given the variety of plants used, the authors suggest that the Neanderthals from El Sidrón had knowledge of the natural resources found within their territory and had the ability to choose and use different types of plants (Hardy *et al* 2012).



Figure 6.22. Middle Palaeolithic sites with plant remains in the Cantabrian region.

Given the abundance of evidence from various sites within both study regions, it can be concluded that Neanderthals, during the Middle Palaeolithic, did regularly exploit plant resources as part of their diet. From the various research undertaken it seems clear that Neanderthals in the Iberian peninsula consumed the local vegetation regularly, it was a significant component of their diet and an important source of nutrients and calories.

6.6. SUMMARY

A comparative discussion of the subsistence patterns of Neanderthals from both study regions follows focusing on any similarities and differences.

SPECIES EATEN		CANTABRIAN	BETIC
MOST CONSUMED	*Cervus elaphus* (Red deer)	+	+
	Capra pyrenaica (Ibex)	+	+
	Equus (Horse)	+	+
	Bos primigenius (Aurochs)	+	+
LESS CONSUMED	*Capreolus capreolus* (Roe deer)	+	+
	Rupicapra rupicapra (Chamois)	+	+
	Sus scrofa (Wild boar)	+	+
	Dicerorhinus (Rhinoceros)	+	+
COLD FAUNA	*Rangifer tarandus* (Reindeer)	+	
	Megaloceros (Giant deer)	+	
	Bos bison (Bison)	+	
	Mammuthus primigenius (Mammoth)	+	
COMPLEMENTARY DIET	*Oryctolagus cuniculus* (Rabbit)	+	+
	Shellfish	+	+
	River fish	+	+
	Sea fish		+
	Delphinus delphis (Dolphin)		+
	Monachus monachus (Monk seal)		+
	Birds		
	Testudo hermanni (Tortoise)		+
	Plants	+	+
CANNIBALISM	Neanderthal	+	+

Figure 6.23. Comparison of fauna consumed in both regions (Cantabrian and Betic).

Similarities

The groups of Neanderthals that lived in both study regions had a subsistence behaviour based on a broad-spectrum diet. Neanderthals were capable of hunting a wide range of prey, from dangerous animals, such as rhinos and wild boar, to large, medium and small-sized ungulates: horses, bovids, red deer, roe deer, reindeer, ibex, and chamois, as well as capturing small animals, such as rabbits, fish, and molluscs within both regions.

The zooarchaeological record of both regions show that red deer (*Cervus elaphus*), horse (*Equus*), bovids (*Bos/Bison*), and ibex (*Capra pyrenaica*) constituted the bulk of the ungulate fauna in most sites during the Late Middle Palaeolithic. This indicates that in both regions there was a preference for animals of medium size.

There does not appear to be a widespread specialization within either of the study regions, with only a few notable examples where any one particular species dominates the assemblage, such as El Esquilleu, Axlor, Zafarraya, and Horá, which have been considered as specialized hunting sites.

In both regions, the most dangerous animal to be actively hunted was wild boar (*Sus scrofa*) or rhino (*Dicerorhinus hemitoechus*) with megafauna from the Cantabrian region (e.g. mammoth, giant deer) being less represented in the zooarchaeological records.

The fauna documented in the sites of El Esquilleu, Arrillor, Abauntz, Axlor, and Lezexitki (Cantabrian region) and Zafarraya, Horá, Beneito, and El Salt (Betic region) demonstrate Neanderthal adaptation to hilly regions, showing that they were able to employ effective hunting strategies on mountain ungulates.

In both regions Neanderthals were able to adapt and apply different strategies of hunting and capture, to be able to exploit the species that were present in each different biotope, namely rocky areas (caprids), wooded areas (cervids and suids), open spaces (equids and bovids), and coastal areas (marine resources). Neanderthals did not, therefore, exploit single biotopes to the exclusion of others, but in fact exploited all different biotopes present within both regions, as well as exploiting prey that were specific to each macro-bioclimatic region (Cantabrian and Mediterranean).

Rabbits were hunted and consumed by Neanderthals within both regions, although in the Cantabrian region the evidence of rabbit consumption is less abundant than that documented for the Betic region. The presence of rabbit in northern Iberian is very rare, whereas its presence in the south is abundant and this is probably due to the favourable climatic conditions of this region for this species. In addition, taphonomic analysis of the rabbit bones recovered from the Cantabrian region has never been carried out, suggesting that there could be evidence of anthropic marks that have yet to be recorded.

The consumption of marine resources is reported in several Middle Palaeolithic sites, providing significant evidence of the exploitation of marine shellfish by Neanderthals in both regions. The abundance of sites with documented exploitation of marine resources, within coastal areas, suggests that they were a significant part of the Neanderthal diet.

Evidence for the consumption of fish by Neanderthals has also been documented in both regions. Given the numerous recorded examples, this behaviour does not seem to be accidental or isolated, instead it seems that fishing was an established strategy employed by Neanderthals, perhaps on a seasonal basis.

Several sites within both regions have documented evidence for the consumption of seeds, fruits, nuts, vegetables, and plants. This indicates that the Neanderthals had knowledge of the natural resources of within their territory and the ability to choose and use different types of plants, the consumption of which provided an important source of nutrients for Neanderthals.

Cannibalism has also been documented within both regions, although the reason for this behaviour has yet to be determined and we do not know whether it was for subsistence reasons or because of ritual or violence and fighting between groups, or a combination of all three factors.

Differences

The main difference identified is in the exploitation of region specific taxa, which corresponds to each macro-bioclimatic region. In some cases certain taxa are almost exclusive to their zones (e.g. cold-adapted fauna in the Cantabrian region, or *Testudo hermanni* in the Betic region; or the abundance of rabbits in the Betic region in comparison to the Cantabrian region).

Cold-adapted fauna is only present and exploited within the Cantabrian region although the number of remains recovered is small, with only reindeer being the most abundant in some sites. Woolly rhinoceros, giant deer and mammoth are also not present in the archaeological record of Middle Palaeolithic sites of the Betic area.

The exploitation of tortoise has only been documented within the Betic region in the following sites: Gorham´s Cave, Cova Negra, El Salt, Abric el Pastor. The species documented is *Testudo hermanni*, whose distribution and habitat correspond to the Mediterranean area, which would explain its absence within the Cantabrian area.

The exploitation of birds is also only documented within the Betic region. The taphonomic studies of the following sites: Gorham´s Cave, Vanguard Cave, Ibex Cave, Cova Negra, Cova Beneito, and Zafarraya show that a systematic exploitation of birds was undertaken by Neanderthals, mainly focused on species that were abundant in the areas surrounding the sites. The anthropic exploitation of birds has not been documented in any of the Middle Palaeolithic sites within the Cantabrian region, which, as with the rabbit remains, could be due to a lack of thorough taphonomic analyses of small prey remains.

The consumption of dolphin (*Delphinus delphis*) and monk seal (*Monachus monachus*) has been documented both in Gorham´s and Vanguard Caves, within the Betic region (Stringer *et al* 2008), with these two examples being unique within the whole of the Iberian Peninsula during the Middle Palaeolithic. These remains further indicate the wealth of resources, particularly marine, available to Neanderthals within this area.

To conclude, it can be established that Neanderthals responded to the bioclimatic regions they inhabited. The evidence suggests that the Neanderthal groups from both regions, which are in themselves bioclimatically and biogeographically distinct, share more similarities than differences in terms of subsistence strategies when exploiting large and small game. It suggest that the differences were not due to anomalies in behaviour, but in their ability to adapt and modify their hunting strategies in accordance with the different faunal resources available within each macro-bioclimatic region, from bison hunting in the north to rabbit hunting in the south. They simply “ate what is there” (Bar-Yosef 2004), exploiting the fauna from the surrounding environment.

CHAPTER 7

BIOCLIMATIC OCCUPATION PATTERNS

7.1. INTRODUCTION

This chapter focuses on Neanderthal settlement patterns, based on a climatic model with the aim to establish if Neanderthals inhabited both the Cantabrian and Betic regions in different or similar ways. In order to better address this theme, more detailed questions need to be tackled:

Is there a difference in Neanderthal settlement patterns between both regions?

Is there a preferred pattern of occupation in a specific bioclimatic level?

To best understand Neanderthal behaviour it is necessary to gather as much information as possible, particulary on how they occupied their territory. Many of the studies based on settlement patterns focus on the analysis of the proximity to water, raw materials, communication routes, and settlement hierarchies with polygons (Cantabrian region: Freeman 1994, Navazo 2006, Ríos-Garaizar & García 2015; Betic region: Mochales 1997). Although important, these studies do not focus on climate. It is my opinion that climatic maps can provide an essential source of information that could further help enable a better understanding of Neanderthal behaviour, particulary in terms of their occupation of diferent territories.

To provide a detailed comparison of settlement patterns of Middle Palaeolithic site from both regions, with respect to bioclimatic variables, a series of temperature and rainfall maps were created, following the methodology of Rivas-Martínez (1987), Finlayson (2004), Jennings (2007, 2012, *et al* 2011), and López & López (2008). Current temperature and rainfall values were used to model a warm/humid climate phase for both regions, and a drop of -3°C from the current mean temperature and a rainfall of -400 mm below the present level were used to model a cold/dry climatic phase. The methodology used to construct these models is described in detail in Chapter 4.

7.2. PRINCIPLES OF BIOCLIMATIC MAPS

My cartographic work is based on that carried out by Piñas Arteta *et al* (2008a,b) and López & López (2008) on Spain and Balear, which in turn was based on the World Bioclimatic Classification "Global Bioclimatics" of Rivas-Martínez (1987, 1995, 1997, 2007).

"Global Bioclimatics" is a multi-level classification system for describing climate, with three distinct levels: Macrobioclimate, Bioclimate, and Bioclimatic Belts. There are five main Macrobioclimates: Tropical; Mediterranean; Temperate; Polar; and Boreal. These are then subdivided into smaller Bioclimates, including: Steppic; Submediterranean; Bixeric; Continental; Oceanic and Desert. Bioclimatic Belts are defined by two parameters – thermotype or ombrotype – which are subject to altitude or latitude.

Climate data are used to establish the bioclimatic classification: average monthly temperature, expressed in degrees Celsius (ºC); and monthly precipitation, expressed in millimeters (mm). These thermopluviometric data are obtained from weather stations. For this thesis the data from 2376 weather stations were used (1204 from the Cantabrian region and 1172 from the Betic region), taken from the work of López & López (2008).

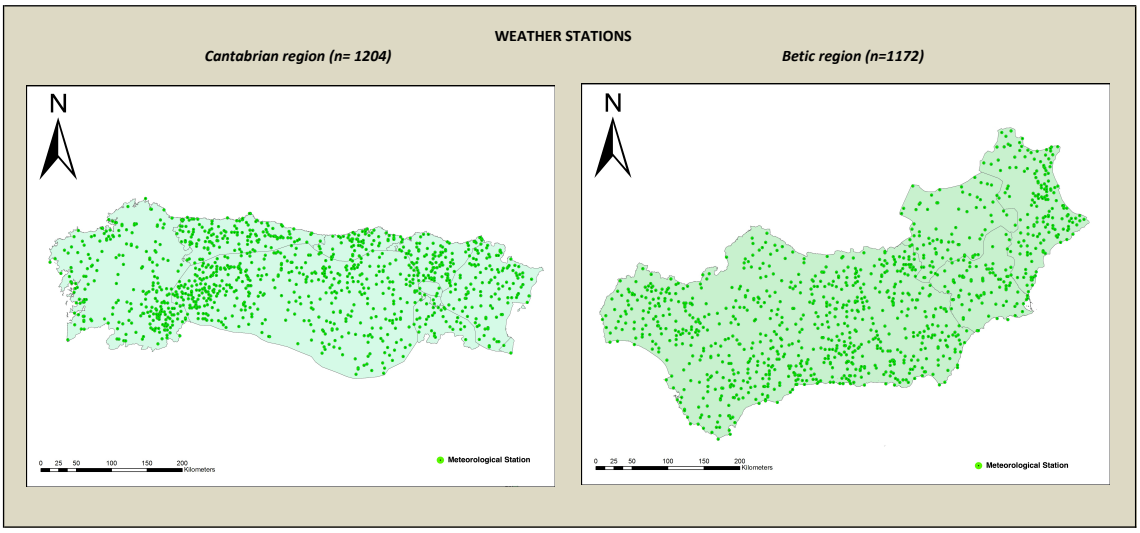


Figure 7.1. Weather stations maps in both Cantabrian and Betic regions.

Rivas-Martinez (Rivas-Martínez 1987) devised different "indexes" for the classification of "Global Bioclimatics". These indexes are numerical expressions that are elaborated by simple arithmetic operations of sum, subtraction, multiplication and/or division between parameters of rainfall and/or temperature, selected by seasonal criteria or by criteria from specific biological requirements.

The Thermicity Index (It) (ibid) is defined as a formula that measures the temperature in tenths of a degree from the mean annual temperature (T), plus the mean of the coldest month minima temperature (m), plus the mean of coldest month maxima temperature (M). It is expressed as: It= (T+m+M)10. This formula enables temperature values to be ranked

into a series of thermotype groups (Tables 7.1 and 7.2).

The Ombrotype Index (Io) (ibid) is defined as the ratio of dividing the value of annual positive precipitation (Pp)- the sum of monthly precipitation in mm of those months of the year where mean temperature is above zero degrees Celsius-; and the annual positive temperature (Tp)- sum in one-tenths of a degree of those months of the year where mean temperature is above zero degrees Celsius. It is expressed: Io = Pp/Tp. The resulting values allow precipitation levels to be ranked into a series of ombrotype groups (Table 7.3).

Thermotype

For the thermal climatic category, different parameters and indexes of temperature are considered. In the Iberian Peninsula, the Mediterranean and Temperate macrobioclimates are represented. The Mediterranean Macrobioclimate is located in the west, east, central and south with the Temperate Microbioclimate in the north of the Iberian Peninsula.

In the Betic region there are six Mediterranean thermal floors: Infra-Mediterranean, Thermo-Mediterranean, Meso-Mediterranean, Supra-Mediterranean, Oro-Mediterranean, and Cryoro-Mediterranean.

Mediterranean Macrobioclimate		
Thermotype	Thermicity Index(It)	Mean Annual Temperature
Cryoro-Mediterranean	−	<4°C
Oro-Mediterranean	−	4° to 8° C
Supra-Mediterranean	<220	8° to 13° C
Meso-Mediterranean	220-350	13° to 17° C
Thermo-Mediterranean	350-450	17° to 19° C
Infra-Mediterranean	450-580	> 19° C

Table 7.1. The Mediterranean thermotypes of southern Iberia today.

In the Cantabrian region there are five Temperate thermal floors: Thermo-warm, Meso-warm, Supra-warm, Oro-warm and Cryoro-warm.

Temperate Macrobioclimate		
Thermotype	Thermicity Index(It)	Mean Annual Temperature
Cryoro-warm	–	<2°C
Oro-warm	–	2° to 4° C
Supra-warm	<190	4° to 8° C
Meso-warm	190-290	8° to 15° C
Thermo-warm	290-410	15° to 18° C

Table 7.2. The Temperate thermotype of northen Iberia today.

Ombrotype

The Ombrotype is a category related to precipitation rates within a region. Six of a possible nine ombrotypes which exist in the world are present within the Iberian Peninsula: arid, semi-arid, dry, sub-humid, humid, and hyper-humid.

Ombrotype	Ombrotype Index (Io)	Yearly Precipitation(Pp)
Arid	0.4 to 1.0	<200mm
Semi-arid	1.0 to 2.0	200 to 350 mm
Dry	2.0 to 3.6	350 to 600mm
Sub-humid	3.6 to 6.0	600 to 1,000mm
Humid	6.0 to 12.0	1,000 to 1,600mm
Hyper-humid	12.0 to 24.0	> 1,600mm

Table 7.3. Ombrotypes of Iberia today.

Two types of thermotype maps (warm and cold conditions) and ombrotype (humid and dry conditions) have been created to model the archaeological site distributions in both regions. These maps were constructed following the models detailed by Finlayson (2004) and Jennings (2006), based on the site of Padul (Granada) that presents a terrestrial pollen core from the area containing palaeoenvironmental evidence that dates to MIS 4 and the pollen data from marine cores extracted from sourthern Iberia. Regarding the thermotype maps, the first type of map corresponds to a warm climate phase, using the present day mean annual temperature values, as equivalent to an interglacial period; the second type of thermotype map corresponds to a cold climate phase, subtracting -3°C from present mean annual temperature values, to recreate glacial conditions. Using this methodology, other maps, representing colder conditions, can therefore be made by substracting for example -5°C, -7°C, or -10°C from current actual temperatures. For the purposes of this thesis only

the model with a substraction of – 3°C was used for both study regions.

According to Finlayson (2004) the Mediterranean bioclimatic stages would not disappear altogether at -10°C although only the high montane components (oro- and crioro-) would remain. The Thermo-Mediterranean Stage disappears at -3°C, the Meso-Mediterranen at -7°C; and the Supra-Mediterranean at -10°C, but the Supra-Mediterranean area increases between -1°C and -5°C. The Oro- and Crioro-Mediterranean and the Euro-Siberian stages expand in area with declining temperatures. A drop of -3°C, a situation that may have been frequent in MIS 3, results in the disappearance of the Thermo-Mediterranean stage and the growth of the montane Mediterranean stages (Finlayson 2004).

Regarding the ombrotype maps, the first type of map corresponds to a humid climate phase using the present day mean annual rainfall values and the second map corresponds to an arid climate phase by subtracting -400mm from present mean annual rainfall values, recreating arid conditions, which according to the pollen data from marine cores from sourthern Iberia denote falls of this magnitude for Heinrich Events (Sanchez Goñi *et al* 1999, 2002).

Each archaeological site was assigned a thermotype and ombrotype map and the number of sites per individual thermotype and ombrotype was calculated for the Mousterian, Châtelperronian, Aurignacian, Gravettian and Solutrean cultural periods. The patterns of settlements during the Upper Palaeolithic have been included in order to see if there are any discernible differences in occupational patterns within the different bioclimatic belts between Neanderthals and Modern humans.

The number of archaeological sites by chronocultural periods is:

Mousterian: 387 sites (Cantabrian region), 312 sites (Betic region).

Châtelperronian: 15 sites (Cantabrian region).

Aurignacian: 44 sites (Cantabrian region), 10 sites (Betic region).

Gravettian: 38 sites (Cantabrian region), 18 sites (Betic region).

Solutrean: 53 sites (Cantabrian region), 82 sites (Betic region).

7. 3. ARCHAEOLOGICAL SITES DATASET

The archaeological sites that have been considered for this chapter come from studies conducted by numerous researchers throughout the 20th and 21st centuries, who have carried out surveys and systematic excavations in the study regions. The cultural ascriptions to the sites have been given based on the criteria set out by these researchers. In many cases it is difficult to establish a chronocultural attribution for materials from a particular archaeological site, because some sites are palimpsests and their deposits may be mixed by its secondary position. However, in these cases, the presence of technologically diagnostic elements forms the empirical data used to assign chronocultural ascription to these sites.

Studies of occupation of the territory in large regions are largely conditioned and limited by the following factors:

1. The intensity of archaeological research carried out in a region. There are areas where research has developed more intensively, others in an occasional way and others where there are no studies. This can influence interpretations about an area with differing concentrations of sites and/or gaps in the research.

2. The geological and geographical characteristics of the study region, since they condition the conservation of the record both in caves and open air sites.

3. Many sites are located on the surface, may be in secondary positions, or could be palimpsests, with dubious stratigraphic contexts, and without absolute dating, making their assignation to a particular chronocultural ascription somewhat difficult.

Certainly, sites with a long stratigraphic sequence are crucial gauging the diachronic evolution from a cultural, ecological, and climatic point of view. However, there are also other sites (such as the open air sites) that do not have large sequences, but offer complementary information to fully understand the occupation of the territory.

Despite these limitations, sufficient data are available to reconstruct the settlement patterns even though the data available are a fraction of the original data that entered the archaeological record.

In this chapter the focus is placed on the settlement patterns as related to the bioclimatic

zones in order to see in which bioclimatic zones there is a greater presence of sites.

The same value has been given to all sites, both caves and open air, grouping them by chrono-cultural periods. Although the main objective of this thesis is the comparison of Neanderthal behaviour, in this chapter the spectrum has been broadened to include the settlement patterns of Upper Palaeolithic sites in relation to the bioclimatic zones of the two study regions.

7.3.1.Mousterian sites

The term Mousterian typifies the lithic assemblages of the Neanderthal fossil site of Le Moustier (France). This cultural technology is associated with Neanderthals in Europe during the Middle Palaeolithic. This period starts in the Middle Pleistocene around 300 Ka, finishing at approximately 40 ka, depending on the region. During this period the first standard techniques of flake manufacture using the Levallois and discoidal knapping method were developed (Boëda 1993,1994; Peresani 1998; Van Peer 1992).

During the Middle Palaeolithic, Neanderthals occupied caves, rockshelters and open air campsites for short periods of time with a high residential mobility pattern in the Iberian Peninsula, as much in the north as in the south, both on the coastal and inland sites (Altuna 1990, Blasco 1997, Blasco *et al* 1996, Carbonell *et al* 1996, 2014, Maroto *et al* 1996, Aura *et al* 2002, Baena & Carrión 2006, Navazo 2006, De la Torre *et al* 2013, Sánchez-Hernández *et al* 2014, Terradillos-Bernal 2014, Ríos-Garaizar *et al* 2015, 2015, 2016,). Additionally, some authors point to evidence of seasonality in Neanderthal behaviour (Cabrera *et al* 2000, Yravedra 2001, Baena *et al* 2005, Baena & Carrión 2006, Cortés 2005, 2007).

The following are the Middle Palaeolithic sites from both regions of study:

Cantabrian region

In this region there is an abundance of Mousterian sites (n= 425) (caves and open air sites) located in very varied biotopes (coast, river basins and mountain). The largest concentration of sites is located in the coastal corridor, with less presence within the inland areas of rocky mountains, with the exception of the Basque Country, where a concentration of inland sites are observed.

The Cantabrian mountains would experience snow at an altitude of 600 m during the cold periods, which might explain the scarcity of occupation sites in this area. During benign periods human communities would enter the mountain zones, ascending via river valleys which are the main north-south routes used by humans in the Cantabrian mountain system. There are also zones with particular microclimates influenced by orographic peculiarities, such as further inland in the Liebana region in the province of Cantabria (Baena *et al* 2004).

Within the Cantabrian region there are three large areas with distinct ecological contexts: firstly, the coastal areas, where the mobility of human groups would be comfortable and where the Neanderthals acquired flint and marine resources; secondly, inland areas with river valleys, forest and open spaces with their respective fauna; and finally, the mountain areas, where the Neanderthal groups did not occupy areas higher than 900m asl but could hunt animals from rocky environments. The alternation in occupation of these zones would have a marked seasonal character (Muñoz 2005).

Basque Country

The Basque Country acts as a crossroads between the Cantabrian area with France in the East, and with the Ebro Valley towards the Mediterranean area and Castilian Plateau in the South. There is a greater concentration of Middle Paleolithic sites within inland rocky areas within the Basque Country than found within the Cantabrian and Asturian provinces, because of the areas´s lower orographic character (Carrión 2003). The main sites documented are: Axlor, Lezetxiki, Amalda, Arrillor, Arlanpe, Venta Laperra, Polvorín, Batzola, Manzanos, Askondo, Asuntze, Astigarraga, Urrunaga and Urkulu. In the coastal area the sites include: Kurtzia, Mendieta, Zarratu, Zabaletxe, Bareño and Hendaia (Barandarián *et al* 1960, Muñoz *et al* 1989, Baldeón 1990, Arrizabalaga 2005, Ríos-Garaizar 2008, *et al* 2010).

Cantabrian

The Cantabrian province is the richest area for Middle Palaeolithic sites in the region. There is an abundance of sites along the coastline, as well as in the middle and high valleys, including at high altitudes, located at the head of the valleys. Notable sites in this area include El Castillo, which presents a long sequence that has served as a model sequence in the prehistory of the Iberian Peninsula, as well as Morin Cave, El Esquilleu

and El Pendo.

The Delegation of Heritage of the Government of Cantabria provided me with a database of Middle Palaeolithic sites carried out by archaeologists through numerous archaeological surveys. The distribution of these sites (caves and open air sites) is presented below, along different river basins.

Deva basin: Habario, Cueva de Fuentepara, El Esquilleu, Arteu, Rodriguero, De la Peña, Panes II, Unquera; Los Martillos, Collado de los Pandos, Fuentepara, San Pedro de las Baheras I, II and Depósito del agua.

Nansa basin: Cueva de las Cabras, Encima de las Cabras, Al pie del Rejo, Luey, Cueto del Arco, Alto de Sobaño, Muñorrodero, La Boriza, Junto a la Ermita de Cabanzón, Escajo Suspino, Hoya Salceda, Serdio, Las Brañas and Serdio.

Escudo basin: Roiz I, Oyambre F, G, H, Del Portillo I, Río Bolado II and Peña Alta.

Saja basin: Sopeña, Linar, Castañera, Villanueva de la Peña, Los Solares, Sopeña-Coladorio, La Veguilla I, II, El Pernal, Villapresente I, II, III, Peñona de la Caranceja II, III, Cabezón, Vinueva, Bustablado, Helguera, Prado de la Cruz, Cueto, El Hondal, Suances A,B,C,CH,D, Pereo II, La Jerra, Yaciento de Despeñaperros, El Pedrero, Rotablín, La Tejera, El Castro, Alrededores de Altamira, Mies de Llanes and Ermita de San Roque.

Besaya basin: Hornos de la Peña, Gurugú II, La Gándara, Cudón, Milladero, La Maela, Ladrea, Llanda, Peñalva I, II, Zapatera, Hallazgo de la Mina de Mercadal, Los Murciélagos, La Masera, El Estorregao, La Guerrallana, Las Lastras, Pontanías, Alto de Pasaviento, Prao Santano, Polanco, El Cristo, El Caspano, Gasolinera de Gornazo, Junto a la Cueva de Cudón, Cudón II, Gornazo, Las Canteras de Cuchía, Miengo, Campuzano, Tanos and Viérnoles.

Ebro basin: Pantano del Ebro I, II, Espinilla, Hijar 1 and San Vicente de la Barquera.

Pas basin: Monedas, La Flecha, El Castillo, Covalejos, Santián, San Julián de Mortera, El Pendo, Al pie del Pendo, Liencres B, C, II, Covachos B, C, Bezana, Revilla I, Cercano a la Cueva del Cerro Tu, Al pie de la Cueva del Castillo, Junto al Museo de Velarde, Peñas Blancas, El Ruso I, Velo, Camino de Santa Ana I, II, La Canal II, Monte de la Ría II, Norte del Cueto del Espino, Muriedas 1, Cueva de Ruiloba II, El Agua, Polígono de Trascueto,

La Verde A, B, C, E, D, San Julián de Mortera, Somocuevas, El Convento II, Junto a la Cuevas del Tasugo, El Molinon, Usgo L-Ñ, CH-J, A-C, Barriomonte, Cementerio de Mogro, El Tasugo, Romilano, Maliaño, Pozón de los Dolores I, III, Alrededores del Ruso, Huerta de Ayllón, Las Cerrías, Junto al Calero II, Fuente la Vena, Barcenilla, Barcenilla II, Arce I, Ontanilla I, Cantera de Peñas Negras, La Endrinera, Cementerio de Revilla, El Mapa, Basurero A, B, Cortina, Peñas Blancas II, El Mapa IV, Cementerio de los Paragüeros, Cama Real, Bezana, Maoño A-B, La Mea and Las Presas.

Miera basin: Cueva Vieja, La Hazuca, Las Regadas, Los Moros, Morín, Al Pie de Morín, Mazo Morin II, Fuente del Francés, Mazo, Al pie del Mazo, Post-Antenas A, B, C, Antes de la Punta de Cabezón de San Pedro, Punta de Cabezón de San Pedro, Corbán, Lluja, Rosamunda, Faro de Bellavista B, Loredo, Cercano a los Tranquilos, Los Tranquilos, Isla de Jorganes, Llaranza, Langre, Vitores, Cueva la Prementera I, Suesa, Al pie de la Cueva de la Garma, El Bosque, Cueto Marín, La Cantera, Pinares de Somo, Galinazo A-B, C-CH, Lantilla, Los Tranquilos CH, La Garma A, Playa Merón, Cueva del Barcenal II, La Garma Galería Intermedia, Abrigo de el Covarón, Juntarnosa, El Hoyo, La Florida, Miés de Campo, Orejo I, II and Solahesa.

Agüera basin: Arenillas 1.

Campieso basin: Ajo III.

Asón basin: San Juan, Abandejos, Mirón, Cueva Venta de la Perra, Arco B, C, Venta de la Perra, Chiquita, Cofresnedo, Cubo, Punta de la Cueva, La Lereña, Cuevalisa, Abrigo Rojo, La Brena, Ramales, PK-128.8, Debajo de Venta de la Perra, Collado del Moro, Las Viñas, Santa Isabel and Santa Marina.

Coast: Fonfría I, Hallazgo de Puente Portillo, Hallazgo de Tusio, Hallazgos Venta de la Vega, La Concha, Hallazgo Barrio la Iglesia, El Hallazgo del Camping, Hallazgo de conducción del gas, Hallazgo cuneta carretera frente del camping, Cueva de Liandres VIII, Playa de Oyambre, Ramal 18 de Comillas, Pájaro Amarillo, Subida a la Cruz, La Estrada (Comillas); Hallazgo Corterio de Peñalba, Playa de Santa Justa, Ubiarco B-C, Junto a la Cachirula I, Cigüenza, Punta Calderón, Carretera de Ubiarco-Tagle, La Rojería (Santillana del Mar); La Llanilla, Virgen del Mar A, B, C-H, Faro de Bellavista B, Fuera de las Antenas, Corte Carretera de San Román, El Rostrío Ch, E, F, Al Este del Rostrío, Soto de la Marina, C, San Juan de la Canal 2, 3, 4, Cementerio de Ciriego A, Cercano Punta de San

Pedro, Punta del Cabezón de San Pedro, La Maruca, Dávila Park, Universidad, Bocal-Rosamunda, Las Antenas (Santander); Cuco (Castro Urdiales); Estación del Culebre II, III and Punta del Castillo (San Vicente de la Barquera).

Asturias

The main caves sites in this province include: El Conde, La Viña, El Sidrón, Sopeña, La Güelga, Llonin. Among these sites, two are particularly important: La Viña, because it has a long and reliable sequence, where the human occupations were recurrent and diversified in their activities (De la Rasilla & Santamaria 2011); and El Sidrón, with its accumulation of Neanderthal remains, offering a valuable insight into the artisans of the Middle Palaeolithic lithic technology (De la Rasilla *et al* 2011).

Many open air sites are located within two main areas: coast and inland. Sites along the coast include: Faro Busto, Cabo Peñas, Cabo Bustos, Playa del Bozo, Playa de Tenrero, Punta de Segareo, Playa de Antromero, Caroyas. Sites located inland, mainly within the medium and low river basins are: Honceu, Trasquirós, La Granda, El Bolao, Castiello, Sardin, Altu la Maya, El Fiensu, P. Deportes, C Negro, Veranes, Malablima and Barandiallu (Baena *et al* 2004, Estrada & Jordá 2003, Álvarez-Alonso & Rodríguez 2014, Rodríguez 2000, 2001)

Castilla y León (Palencia and Burgos)

The Castilla y León plateau and Duero River Basin are located in the sourthern part of the Cantabrian Mountain system. The Middle Palaeolithic occupation of this area is not as abundant as that of the coastal strip of the Cantabrian region. The main caves are: Cueva Corazón, Cueva de Guantes, Cueva de Mudá (Palencia) (Díez Martín *et al* 2011, Mateos *et al* 2014), La Ermita, Valdegoba, Cueva Millán, Prado Vargas and La Mina (Burgos) (Díez *et al* 1989, 2008, 2014). Some authors attribute the depopulation of the central Iberian Peninsula to a retreat of the Neanderthals towards the pre-mountains areas, in response to a worsening climate (Delibes de Castro 2006, Sánchez *et al* 2011). The pre-mountain areas would, in turn, act as ecotones of high biodiversity and a very favourable refuge for both animals and Neanderthals (Mateos *et al* 2014). The exception is the site of Prado Vargas, which, according to Navazo *et al* (2005), was occupied, amongst other reasons, because of its location within a natural passage between the inland and coastal areas.

However, in the last few decades a series of open air sites have been discovered, such as Campo la Laguna, San Millán I, Tomillares, Camino de Rocines, Vega de Abajo, San Medel VI, Castañares I, Castañares II, El Rebollar, Valle de las Orquidias, Hundidero, Hotel California (Burgos) (Navazo 2006, Carbonell *et al* 2014), and San Quirce (Palencia) (Terradillos-Bernal *et al* 2014), showing that the Neanderthals occupied these areas when the climate was not excessively harsh. The analysis of their assemblages suggest these sites were occupied for short but recurrent periods of time (Carbonell *et al* 2014).

La Rioja

In the Rioja province, the Ebro River and its tributaries form the backbone of the area. Middle Palaeolithic open air sites are all in relation to the rich flint outcrops that exist in the area, with all the sites sharing this workshop character: Cerro Villar, La Ra, Entrematas, Arenas, Arenillas, Pedernales, Charcón, Suertes Nuevas and Suertes Viejas (Utrilla 1987). Only one Middle Paleolithic cave site has been documented, Peña Miel, whose primary function appears to be related to hunting activities (Utrilla 1983, 2000).

Navarra

On the plateau of Urbasa (Navarra) several open air sites are found, including Murgaduria, Murba, Pozo Negro, Laberri, Regajo de los Yesos, Gorlasaro, Andasarri, Aciarri, Aranzaduia, Bioitzia, Azazuri 1, Canteras de Alaiz, Galar 1, Gazólaz, Ibero, Olabe, Ororbia, Salinas 1, Tudela and Viana (Montes 1988, Barandiarán & Montes, 1991). These sites are also linked to the exploitation of flint outcrops in the area, the "Urbasa type flint". A notable example, Coscobilo Cave, near Sierra of Urbasa, which has subsequently been destroyed, yielded Mousterian pieces (Vallespí & Ruiz 1971). In Navarra another important cave with a large sequence and rich assemblages is Abauntz, which is linked to the Pamplona basin, on the dividing line between the Mediterranean and Atlantic basins, for which the cave acted as a nexus between two areas. It is also an area rich in good quality black flint nodules (Beriguistain 2000, Utrilla *et al* 2015).

Galicia

In the area of Galicia the majority of Middle Palaeolithic sites are open air sites, located in the terraces of the Miño River basin with other sites geographically distributed around the province (Senín 1996, Cano 1993, 2000, Vázquez 2000, Giles *et al* 1999). The Monforte

de Lemos Basin includes several sites: O regueiral, As Gandariñas, Susao, San Mamede, Gullade I, III, As lamas, Gandara Chá, O Bao-I and Sobrado, with the presence of lithic assemblages with Levallois or discoidal knaping methods, documented along the Paleo-Cabe River. This area plays a strategic role because it is located on the natural pathway that joins inland Galicia to the western Plateau and northern areas of the Cantabrian coast. Also, the mean temperatures of the Monforte basin during the glacial periods would be milder than those in the surroundings areas (De Lombera & Fábregas 2011, Fábregas *et al* 2011). Following the course of the Miño another region of special interest is located near Orense, where several sites has been documented, such as: A Piteira, Carregal Bajo and A Barreira (Vázquez 2000). Two significant sites have been documented near Lugo: Da Valiña and Cova Eirós. Cova Eirós has the largest archaeological sequence and has provided the largest lithic assamblage and faunal remains from any other Middle Palaeolithic site in the inland of Galicia. Here, as in other Middle Palaeolithic sites within Galicia, the Levallois and discoidal knapping methods are applied on fine-grained quartzite and good quality quartz, while the unipolar and orthogonal methods are applied on medium quality quartz (Rodríguez *et al* 2011).

The scarcity of absolute dates prevent us from establishing a good chronological framework for this area.

The confluence of ecological, climate, geographical, geological, and topographical features could explain the high intensity of Neanderthals settlement identified at the Cantabrian areas during the Middle Palaeolithic.

The Cantabrian coast corridor could be regarded as a refuge area during the glacial periods while mountain and inland regions, with drier and colder conditions, would be covered by glacial sheets and herbaceous steppes.

Betic region

This region is geographically diverse and many Mousterian sites have been documented (n= 316) (caves and open air sites). They are located in varied biotopes (coast, river basins, and mountain). The pattern of settlement in this region is more dispersed than in the Cantabrian region.

The Mediterranean coast is a large and irregular corridor with east-west and north-south

orientation, where the Neanderthals moved frequently and acquired marine resources. In the Betic range the lithology features favour existence in caves, shelters, and sources of raw materials. In this region there is a large internal corridor from the provinces of Málaga to Alicante, which divide the Betic range into two parts. Within this corridor many Middle Palaeolithic sites were documented and in several sites, such as Carihuela and Horá, a great abundance of large animals, such as horses and bovids, were documented. According to the faunal remains documented, this corridor was an important pathway for the movement of fauna. The Guadalquivir River valley was the other great natural corridor in the north of the Betic range, which was very important for the Neanderthals as well as animals as a place of occupation. In this region the majority of Mousterian sites documented correspond to open-air sites. The alternation in occupation between these zones (as in the Cantabrian region) would have had a marked seasonal character.

Jaén

The province of Jaén includes the upper part of the Guadalquivir River basin, part of Sierra Morena and the Subbetic and Penibetic ranges of the Betic Mountain System. This region plays an important strategic role because it is located on the natural pathway that links the Betic plain with the plateau, the High Andalucía and the Levant. Other important natural pathways include in the south-east, where it connects the Alcala la Real basin with the Granada plain, while to the east the Pozo Alcón corridor connects directly with the Cullar-Baza and Guadiz depressions. The majority of the sites are open air located in the Guadiel valley and La Crolina, as well as in the high grounds of El Rumblar, Guadalimar and Guarrizas river basins. The main sites are: Cortijo del Ciego, Cortijo del Espino, Camping del Villar, La Calera, El Minao, Fuente Spis, El Barranquillo, Arroyo del Abandonado, Camporredondo, Puente Mocho, Casa de los Raya, Madrigueras, Espolón del Guadalen, Añoreta, Cable del Centenillo, Estacar de Robarina, Los Rubiales, Puente de Hierro, Linarejos, Los Jarales, El Bago, Cañada Incosa, Arroyo de la Vega, Collado del Lobo, Covalilla, Casa Palomino, Buenaplata, La Muela, Cruce de Baños, and Junto a Burguillos (López et *al* 2011). There are three open air sites located in the palaeolacustrine deposits near of Alcalá la Real: Llanos de Santa Ana, Ermita Nueva and Cerro del Cuco, situated near an area rich in raw material resources (Santiago *et al* 2004). Finally, there is only one cave with Middle Palaeolithic levels, the site of Bedmar I, located in the north area of Sierra Mágina, which is currently under study.

Córdoba

This province includes the areas of Sierra Morena, the middle part of the Guadalquivir basin and the Betic Mountain System. In the karstic area of the Sub-betic range there are many caves, among them, there are a series of caves with documented Middle Palaeolithic levels: Cueva de los Murciélagos, Cueva de los Mármoles, Cueva Sima Cholones, and Cueva de la Mina de Jarcas. In addition in this region there are several open air localities near fluvial and colluvian deposits: Cerro de las Viñas, El Monte, Genilla, Cortijo de Petrolino, Trance Pajares, El Salinero, Cerro de las Cárceles, Prado Arrebola, Arroyo del Lagar, and La Barqueta (Asquerino 1991, Araque 1992, Vera & Gavilán 1993, Carmona *et al* 1999)

Sevilla

This province is located in the lower Guadalquivir basin. The basin includes two geological zones, the Neogene and the Quaternary. The Neogene corresponds with an extension of the Betic range into the basin in the form of hills, and the Quaternary zone is formed by fluvial deposits from the Guadalquivir River and its tributaries. The majority of the sites are open air located along of middle and lower terraces of the rivers Guadalquivir and the Corbones. The main sites are: Tarazona II, Guadajoz, Arroyo Graneros, Arroyo Las Pipas, Santiche, Fuente de la Higuera, Fuente de la Reina, Tinajuela II, Casablanquilla, Marmol Alto, Pedro Cuñado, La Dehesa II, San José de la Rinconada, El Saltillo 2, Localización de Brenes, Aeropuerto, and Bajo Calonge (Fernández Caro 1998, 2000, Vallespí & Díaz del Olmo 1996). Only one cave with a rich Mousterian assemblage has been recorded in this area, namely Cueva de Santisteban (Morón de la Frontera) (Cruz-Auñón & Jiménez 1996, Fernández Caro 2003) which is located on the rim of the Betic range into the Guadalquivir Valley.

Huelva

This province is the area farthest away from the Betic range and is a continuation of the Guadalquivir basin terminating in the sea. The Sierra Morena and two rivers, the Tinto and the Odiel, cross the province from north to south. A series of terraces with Middle Palaeolithic open air sites were identified in this area: Gravera del Apeadero, El Gritillo, La Barca, La Dehesa, El Mentidero and Dehesa E (Castiñeira *et al* 1989)

Cádiz

Located in the South end of the Iberia Peninsula, it is characterised by the following geomorphological features: a large coastline, a broad alluvial plains and Mountains (Betic Range). The majority of the Middle Palaeolithic sites documented in this area are open air, located along the river basin. Only in one cave, Higueral de Valleja, is there evidence for a Middle Palaeolithic occupation (Giles 1999, Jennings *et al* 2009).

From its high course to its mouth, various Middle Palaeolithic sites have been identified, along the Guadalete River basin: Haza de la Sima, Los Llanos de Villaluenga o del Republicano, Cueva del Peñón Grande o Fuente Mahón, Arroyo del Pajarito, Abrigo de Chorreras, Laguna Estación de Villamartín, Villamartín, El Coto, Pelarranas, Hacienda Siret, Rancho de Gachas, Glacis de la Cerillas, Arroyo de Matavacas, Cortijo de la Perdiz Norte, Higuerón 2, Cerro del Carpintero, Cortijo de las Grateras, Cortijo del Novillero, Almendrillo- Cortijo de Picas, La Laguna, Cortijo de la Mediana, Pantano de Bornos sector, La Herradura, La Escalera I, La Escalera III, El Pinar, El Alcornocalejo, El Santiscal, Minas del Señor del Perdón, Vega de Albardén, Junta de los Ríos, Las Arenosas, Berlanga, Fuente de la Salud, José Antonio-Majarromaque, Graveras de Torrecera-Dehesa del Boyal, Graveras de El Torno, Cerro del León-Palomar de Zurita, Rancho Ponce, Los Respastadores, Lomopardo, Palmar del Conde, El Tesorillo, Laguna de Medina, Laguna de los Tollos, La Puntilla 2, El Aculadero, Campín Bajo, Venta Alta, and Fuentebravía (Giles *et al* 1989, 1992, 1993, 1995, 1998, 2003).

Palmones River basin: Garganta del Cura 2 and Altos del Ringo-Depósito de Agua (Castañeda 2008).

Atlantic coast: Arroyo de la Cueva, Playa de la Barrosa, Torre del Puerco, La Espartosa, Loma del Puerco, El Roqueo, Cabo Roche, Cerro Jándila (I,II,III,V,VI), Dehesa Jándila, Playa El Palmar, Playa de los Bancos, Barbate, Fuente del Viejo, Virgen de la Oliva, Cortijo de Tapatanilla, Cortijo de Tahivilla-Arroyo El Machorro, Cortijo del Aciscar, Cortijo de los Caserones-Arráez, Casa del Espinazuelo, Cerro de las Campanillas, Embalse de Almodóvar, Facinas, Realillo, Punta de Camiral, El Lentiscal, Arroyo de Puertobajo, Baños de Claudio, Punta Paloma, Km.77 Carretera Nacional 340, Torre de la Peña, Desembocadura del Guadalmesí, Loma Baja III, Dehesa Nueva II, La Caleta, and Santibáñez (Ramos Muñoz 2008).

Gibraltar

The Rock of Gibraltar is a karstic peninsula with a length of 5.2km and a maximum width of 1.6km, whith several caves with Middle Palaeolithic levels of occupation. The main sites are: Forbes Quarry, Devil´s Tower, Ibex Cave, Vanguard Cave, Gorham´s Cave, Beefsteak and Europe I. Neanderthal remains have been recovered from two sites: Forbes Quarry and Devil´s Tower (Busk 1865, Garrod *et al* 1928, Waechter 1951, 1964, Barton *et al* 1999, Stringer 2000, Barton 2000 a, b, Giles *et al* 2007, Bernal 2012, 2015).

Málaga

The relief is heavily mountainous and contains a large narrow corridor of coastline. In many places the mountains reach the coast, and there is a series of rivers that cross the province from north to south such as the Guadalhorce, Guadiaro, Guadaiza, Fuengirola, Guadalmedina, and Vélez. Along the coast several caves with Middle Palaeolithic sequences have been documented: Cueva de Bajondillo, Complejo Humo Abrigo 3, Cueva del Encanto and Abrigo Puerto Rico (Baldomero *et al* 2001, Cortés 2007, Ramos Fernández 2003, *et al* 2012).

Within inland areas many Middle Palaeolithic sites with occupational levels have also been recovered. These include Higueral-Guardia (Baena *et al* 2012), Cueva de Ardales (Ramos Muñoz *et al* 2014) Sima de las Palomas (Weniger & Ramos Muñoz, 2014), Cueva de Zafarraya (Barroso *et al* 1983, 2003), Cueva de Belda (Ramos Fernández 1982b), Cueva de las Grajas (Benito del Rey 1976, Toro & Jiménez 2014), and Cueva de la Pileta (Breuil *et al* 1915, Cortés & Simón, 2007).

Many open air sites also been documented along river basins: Cortijo Harillo, Majavea-Sauceda, Arroyo de la Parrita, Arroyo del Agua 1, Arroyo del Agua 2, Cueva Tajo de Las Palomas, Cucarra, Terrazas del Turón (junto a Ardales), Llano de Belén, Hoyo de Barbú, Morenito, Grajeras, Lomas del Infierno, Terrazas del Guadalteba (Peñarrubia), Plataforma de Peñarrubia, Eras de Peñarrubia, Tumba Guadalteba, Terraza Este, Terraza Norte, Huerta de Vitorino, Terraza Oeste 1, Terraza Oeste 2, Meseta, La Capellanía 2, Cerro del Almendro 2, Cjo. Casasola, T. Molino Arroyo Fuentezuela, Prado Chico, C. K. Las Palomas de Teba, Cuevas del Tormenta, Hoyo del Chopo, Guadalhorce-Guadalteba, Cueva

Gran Duque, Hondonero, Cuaterones, Ventorillo del Cojo, Arroyo Palancar, Terrazas del Arroyo del Palancar, Confluencia de los Arroyos Morales y Palancar, Terrazas del Sábar, Abrigo del Tajo de Doña Ana I, Lecho del Guaro, Venta de la Leche, Arroyo de las Ventanas, Canca Alorá, and Estación de Bobadilla (Leiva & Ruiz, 1977, Ramos Fernández 1982a,b, Ramos Muñoz 1988, Cortés & Sanchidrian 1999, Ferre Bueno 2003, Medianero *et al* 2012)

Granada

The principal geomorphological features of this province are: the Vega of Granada, the Genil River basin, Sub-betic Mountains, Guadix-Baza depression and the Sierra Nevada, which are the highest mountains in the Iberian Peninsula. A series of caves with Middle Palaeolithic levels have been documented. These are: Cueva de la Carihuela, Cueva Horá, Cueva Colomera I, Cueva del Puntual and Cueva Umbría. Two notable examples are: Carihuela and Horá Caves, with their extensive archaeological sequences and significant faunal and lithic assemblages (Obermaier 1934, Spahni 1995, De Lumley 1969, Fuentes & Mejide 1975, Toro & Almohalla 1981, Botella *et al* 1983, Vega Toscano 1988, Ruiz Bustos 2000, Samper 2010), as well as their Neanderthal fossil remains (García Sánchez 1960, Haber 2002). Open air sites have also been documented within this province. The main sites are: Pantano de Cubillas, Pandera Pino, Cerro de los Infantes, Abrigo de los Cabezones, Llano de la Estación de Huélago, Cerrillo de Orea, Fuente de la Zarza, Loma del Rubio, Venta de las Navas, Llanos de la Venta de las Navas, Haza de la Cabaña, Los Corralillos, Terre, W de Iznalloz, Puerto de Onitar, Villanueva de Mesía, La Esperanza, Cerro Pelado, and Barranco del Paso (Carrasco *et al* 1978, Haber 2002). One of the important peculiarities of these Middle Palaeolithic sites is that they are located within environments of more than 1000m a.s.l., making it likely that these sites were occupied during warm periods.

Almeria

Located to the south-east of the Betic region, this province contains a large narrow corridor of coastline, a large plain Neogene basin and the eastern extents of Sierra Nevada, Sierra de Gádor and Sierra de las Filabres. Only two Middle Palaeolithic sites have been documented in this area: Cueva Zájara I (Vega Toscano 1980) and Cueva del Hacho (Cuadrado 1977).

Murcia

Middle Palaeolithic sites have been documented, scattered along the coast, lowland and high plateau environments within this province. The main caves with evidence of Middle Palaeolithic occupation levels are: Sima de las Palomas (with Neanderthals remains documented) (Walker *et al* 2004, 2012, 2014), Cueva de los Aviones (Montes 1991), Cueva Antón (Martínez 1997), Cueva de Perneras (Montes 1985), Cueva Bermeja, Cueva del Palomarico, Cueva Hoyo de los Pescadores, Cueva de Morote, Cueva de Ascoy and Abrigo Grande del Cabezo Negro (Zilhão *et al* 2010).

The open air sites are located along river basins, and include: Artichuela/La Cierva, Ramblas de las Toscas, El Molar (Rambla del Moro), Loma Fonseca, Fuente del Madroño, Cerro de la Fuente, Fuente del Pinar, Rambla de Tobarrillas, Almadenes I-VIII, Almadenes, Bolvax, Barranco del Gatán, El Calvo, Fuente de la Solana, Loma de las Gateras, Ermita de Santa Leocadia, Las Peñicas, El Fenazar, El Montañal, Ermita de Beltrán, Salada I and Cejo del Águila (Montes 1984, 1996, López 1994, 1997, 1998, *et al* 2003, *et al* 2004, *et al* 2007, Zilhão & Villaverde 2008).

Alicante

The province is mountainous, especially in the north and west (Subbetic Range), and mostly flat to the south. The coast is a large narrow corridor, which links the Levant with the south of Iberia. There are no long rivers, but instead ramblas (dry rivers), which flood when torrential rains occur. A series of caves with Middle Palaeolithic levels have been recorded in this area, and include: El Salt (with Neanderthals remains documented) (Garralda *et al* 2014, Galván *et al* 2001*,* 2014), Abric del Pastor (Galván *et al* 2007, 2009), Cova Beneito (Iturbe *et al* 1993), Cueva del Cochino (Soler 1956), Coves D´Estroig (Faus 2000), Cova del Corb (Sarrión 1990), and Cova de les Calaveres (Ripoll *et al* 1982). Several Middle Palaeolithic open air sites were also documented: Els Bancals de Pere Jordi, La Llacuna, Les Majones, Pla D´en Palau, Polop Alto, Penella, Alt de la Capella, Exterior Cova del Calanons, La Coca (Fernández 1998, Bel & Eixea 2015).

Albacete

This province is located inland, southeast of the Central Plateu of Castilla la Mancha. It presents a plain in the north located to about 700 masl and in the south the mountainous

area (Subbetic Range). The majority of Middle Palaeolithic sites documented in this area are open air sites located along the river basins: El Palomar, Rambla del Fontanar, Rambla de la Jara, Rambla del Moriscote, Cerro de la Cantera, Calderón del Moro, Rambla de Talave, Fuente del Halcón, Canalizo del Rayo, Laguna del Polope and Pedernaloso (Serna 1990, 1999, López & Jordán 1995, Jiménez *et al* 1996, García *et al* 2014). El Niño is the only cave with documented evidence of Middle Palaeolithic occupation (García *et al* 2014).

Valencia

The Valencia province occupies a varied geographic area limited to the east by the sea, framed by mountainous areas to the west that extends in coastal plains to the north and the south. Only those sites within this province that fall within the Betic region have been used as part of this study. Two sites with long Middle Palaleolithic sequences and Neanderthal remains were identified: Cova Negra (Villaverde 1984, *et al* 2014; Arsuaga *et al* 1989, 2007; Bonilla & Villaverde 2009) and Cova Foradá (Aparicio 2014, *et al* 2014). Other documented caves are: Cova de la Petxina, Cova del Puntal del Gat. Open air sites in the area close to the Betic range are Las Fuentes and Penya Roja (Aparicio 1974, Mochales 1997).

7.3.2. Châtelperronian sites

The Châtelperronian technocomplex is characterised by curved, backed, pointed blades (Breuil 1909, 1911). The cultural material attributed to this group is stratigraphycally located between the Middle Palaeolithic and the Upper Palaeolithic. In the Iberian Peninsula it is only present in the Cantabrian region. The Châtelperronian´s origin and authorship is highly contested, with some authors claiming it was developed by Neanderthals, evolving from local Mousterian, whereas others believe it resulted from Neanderthal acculturation *Homo sapiens*. Some authors point to stratigraphic mistakes produced by processes of redeposition and admixture (Zilhao & d`Errico 1999). In addition, the Chalteperronian levels are problematic to attribute due to a reduced number of diagnostic pieces. A total of 16 Châtelperronian sites have been considered in this study (Table 7.4) (Cabrera *et al* 2004; Maíllo 2008; De Andrés 2009, De Andrés & Arrizabalaga 2014; Ríos-Garaizar 2008, *et al* 2012; Ruebens *et al* 2015

REGION	PROVINCE	CHÂTELPERRONIAN
CANTABRIAN	Galicia	Cova da Valiña
	Asturias	El Conde La Güelga Cueva Oscura de Perán
	Cantabria	El Castillo Cueva del Cudón El Pendo Morín Cueva del Otero
	País Vasco	Ekain El Polvorín Santimamiñe Labeko Koba Aranbaltza Ollagorta

Table 7.4. Châtelperronian sites

7.3.3.Aurignacian sites

The Aurignacian culture is the earliest modern human culture in Europe. Aurignacian populations came to Europe from the Middle East during dry and cold climatic conditions, in steppic environments with large fauna (Otte 2015). Their technology is characterized by blade-based tools that show a high degree of standardization, including antler, ivory, and bone projectile points. The typical diagnostic piece is the so-called split base point generally referred to as the "pointe d´Aurignac". The name originates from the type site of Aurignac (France). The problem with these sites is that some authors consider some levels attributed to the Initial Upper Palaeolithic in the literature, correspond assemblages with few diagnostic pieces and its attribution has been questioned, because has been made using as diagnostic pieces some artefacts (Dufour bladelets, carinated pieces), which can be found also in other Upper Palaeolithic and Epipalaeolithic industries of the same region. In addition in some sites there are no clear dates. However, all authors seem to agree that there is a marked break with the Middle Palaeolithic (Bon 2006, *et al* 2002; Bar-Yosef 2006, *et al* 2006; Mellar 2006).

A total of 44 Aurignacian sites were considered in the Cantabrian Region for this study (Table 7.5) (Freeman & González Echegaray 1970; Bernaldo de Quirós 1982; Arrizabalaga & Iriarte 1995; Cabrera *et al* 1996, 2002, 2004; Arrizabalaga 2000; Straus 2005; González *et al* 2003; Fortea *et al* 2010; Fábregas & Lombera, 2010; De Andrés & Arrizabalaga

2014; Wood *et al* 2014) and 10 sites in the Betic Region (Table 7.6) (Cacho 1980; Iturbe *et al* 1993; Cortés *et al* 1996; Cortés 2007a, b, 2010; Casabó 1997; Villaverde 2001).

REGION	PROVINCE	AURIGNACIAN
CANTABRIAN	Asturias	El Conde
		La Güelga
		Cueva de Arnero
		La Viña
		Sopeña
		Cueva Oscura de Perán
		Cueva del Cierro
		Cueto de la Mina
		Cueva de La Riera
	Cantabria	Hornos de la Peña
		El Castillo
		El Pendo
		Morín
		El Cuco
		El Ruso I
		Cueva del Rascaño
		Cueva del Otero
		La Garma
		Cueva de Camargo
		Cueva del Salitre
		Cudón
		Cueva del Arco B
		Ciriego
	País Vasco	Amalda
		Lezetxiki
		Coscobilo
		Venta Laperra
		Antoliñako Koba
		El Polvorín
		Kurtzia
		Santimamiñe
		Bolinkoba
		Labeko Koba
		Aitzbitarte V
		Ollagorta
		Iturralde
		Aspiribie
		Lumentxa
		Praile Aitz
		Zatoya
		Agirremendi
		Goierri
		Urtxubi
	Galicia	Cueva Eirós

Table 7.5. Aurignacian sites from the Cantabrian Region.

REGION	PROVINCE	AURIGNACIAN
BETIC	Málaga	Cueva de Bajondillo
	Jaén	Camping del Villar El Minao
	Murcia	Cueva del Tesoro Cueva Pernera
	Alicante	Cova Beneito Cova Foradada Abrigo Ratlla del Bubo
	Valencia	Cova de les Malladetes Les Ronxes

Table 7.6. Aurignacian sites from the Betic Region.

7.3.4. Gravettian sites

Different hypotheses have been proposed for the regional identification and origin of the Gravettian (De la Peña 2013), whether or not it was contemporaneous with the Aurignacian (Breuil 1912; Perignon 1933) and its classification as an independent techno-complex (Garrod 1938). Its name comes from the site of La Gravette in France. Technical characteristics of Gravettian assemblages are the predominance of abrupt retouched and backed elements, the burin on truncature being the characteristic tool and most abundant within the assemblages. A bone industry is less common. The early Gravettian is absent in some sequences due to the survival of the Aurignacian until relatively late. Gravettian assemblages usually have a low percentage of typical Gravettian tools. The geographical distribution of the Gravettian sites is very similar to the Aurignacian (Pesesse 2008, De la Peña 2009).

Within the Cantabrian region a total of 38 Gravettian sites were considered for this study (Table 7.7) (Barandarián & Cava, 2008; Cava *et al* 2009; Tapia *et al* 2009; Arrizabalaga & Iriarte 2010; Iriarte & Arrizabalaga, 2012; Bernaldo de Quirós *et al* 2015;) and 18 sites from within the Betic Region (Table 7.8) (Villaverde 2001; Villaverde & Roman 2004; De la Peña 2009, 2013; Cortés *et al* 1996, 2007a,b, 2010, 2012; Jennings *et al* 2009).

REGION	PROVINCE	GRAVETTIAN
CANTABRIAN	Asturias	La Viña
		Llonin
		Cueva Oscura de Perán
		Cueva de La Riera
		Coimbre B
		Cueto de la Mina
	Cantabria	Fuentes del Salín
		El Castillo
		El Cuco
		Miron
		El Pendo
		Morín
		Cueva del Rascaño
		La Garma
	País Vasco	Ekain
		Amalda
		Lezetxiki
		Antoliñako Koba
		El Polvorín
		Santimamiñe
		Bolinkoba
		Aitzbitarte III
		Zatoya
		Atxurra
		Atxuri
		Askondo
		Ametzagaina
		IriKaitz
		Pelbarte
		Mugarduia Sur
		Prado
		Aldatxarren
		Kobalde-Usategi
		Lezia
		Alkerdi
		Agirremendi
		Aranbaltza
	Galicia	Cueva Eiros

Table 7.7. Gravettian sites from the Cantabrian Region.

REGION	PROVINCE	GRAVETTIAN
BETIC	Cádiz	Higueral de Valleja
	Málaga	Cueva de Bajondillo
		Toro
		Ardales
		La Pileta
		Cueva de Nerja
	Almería	Cueva Zájara II
		Cueva del Serrón
		Cueva Humosa
	Jaén	Peña de la Grieta
	Murcia	Cueva de la Paloma
		Cueva de Morete
	Alicante	Cova Beneito
		Cueva de les Cendres
		Abrigo Ratlla del Bubo
	Albacete	El Palomar
	Valencia	Cova de les Malladetes
		Parpalló

Table 7.8. Gravettian sites from the Betic Region.

7.3.5. Solutrean sites

During the Glacial Maximum there was an apparent population increase in southern Europe, with the following likely consequences: a higher competition for resources, a change of social networks, a marked territoriality of human groups, and the symbolic meaning of certain artefacts (Carbonell *et al* 2008). The term Solutrean comes from the type-site of Cros du Charnier located at Solutré (France) and the technocomplex was named by Gabriel Mortillet. Its technological characteristics are: flat retouch, unifacial points, convex-base laurel leaf-shaped point, shouldered points of Mediterranean type, pedunculated artefacts and assemblages with many endscrapers, sidescrapers, denticulates and notches as well as the presence of a bone industry, dominated by sagaies of circular section with a simple-beveled base (Carbonell *et al* 2008).

A total of 53 Solutrean sites from within the Cantabrian Region were considered for this study (Table 7.9) (Straus 1975, 1983; De la Rasilla 1989; Montes & Rasines 2003; Fortea *et al* 2008; Rios-Garaizar *et al* 2008; De Lombera *et al* 2012) and 76 sites within the Betic Region (Table 7.10) (Waechter 1951, 1964; Ripoll, 1961; Ripoll 1994; Cáceres & Anconetani 1997; Giles *et al* 1992, 1998, 2000; Villaverde 2001; Cortés *et al* 1996, 2007a,b, 2010, 2011; Aura *et al* 2006; Martínez 2008; Ramos Muñoz 2008; Aura & Jordá 2012; Torres *et al* 2012; Gutiérrez *et al* 2012).

REGION	PROVINCE	SOLUTREAN
CANTABRIAN	Galicia	Valverde
		Áspera
		Pedrouzo de Mourelos
	Asturias	Peña de Candamo
		La Viña
		Llonin
		Cueva Oscura de Perán
		Cueva del Cierro
		Cueto de la Mina
		Cueva de La Riera
		Coimbre A
		Tres Calabres
		Cueva del Sel
		Balmori
		Coberizas
		El Buxu
		Las Caldas
		La Lluera
		Cova Rosa
	Cantabria	Los Canes
		Abrigo de los Huracaos
		Hornos de la Peña
		El Castillo
		La Pasiega
		Morín
		El Ruso I
		Fuente del Francés
		Cueva del Rascaño
		El Mirón
		Cobalejos
		La Garma
		Cueva de Camargo
		Cueva del Salitre
		Cueva Chufín
		Altamira
		Bona
		Haza
		Peña de Caranceja
	País Vasco	Arlanpe
		Amalda
		Lezetxiki
		Abauntz
		Coscobillo
		Antoliñako Koba
		Santimamiñe ?
		Bolinkoba
		Aitzbitarte IV
		Lumentxa
		Atxurra
		Atxeta
		Ermittia
		Atxuri
		Urtiaga

Table 7.9. Solutrean sites from the Cantabrian Region.

REGION	PROVINCE	SOLUTREAN
BETIC	Cádiz	Higueral de Valleja
		Llanos de Don Pedro
		Abrigo del Bombín
		VR7
		VR15
		Casa de Postas
		La Fontanilla
		Cueva de las Palomas
		Cueva de Atlanterra
		Cueva del Moro
		Barranco Blanco
		Los Frailes
		Llanos de Don Pedro
		El Jadramil
		El Pinar
		La Escalera I
		La Escalera 3
		Las Arenosas
		Vega de Albardén
	Gibraltar	Gorham´s Cave
		Vanguard Cave
		Martin´s Cave
		Sewel´s Cave
		Goat´s Hair Cave
		Genista 2
	Málaga	Higueral-Guardia
		Cueva de Bajondillo
		Cueva de Nerja
		Cueva del Higuerón
		Cueva de la Pileta
		Tajo de Jorox
		Abrigo 3 Complejo Humo
		Abrigo 4 Complejo Humo
		Abrigo 6 Complejo Humo
		Hoyo de la Mina
		Cueva de Zafarraya
		Cueva Navarro
		Cueva del Toro
		Cueva Victoria
		Cueva de Ardales
		Roca Chica
	Granada	Pantano de Cubillas
		Cueva de los Ojos
		Cueva de Malalmuerzo
		Cueva de las Ventanas
		Cueva Horá
	Almería	Cueva Zájara II
		Cueva del Serrón
		Cueva Ambrosio
		Cueva de los Morceguillos
		Cueva de Almaceta
		Piedras Blancas
	Córdoba	Cueva Sima Cholones
		El Pirulejo
	Jaén	Peña de la Grieta
		Cueva del Morrón
		El Minao
		La Calera I
		La Calera II
	Murcia	Cueva Bermeja
		Cueva del Palomarico
		Cejo del Pantano
		Los Mortolitos
		Cueva de Hernández Ros
		Los Tollos
		Cueva del Negro
		Abrigo Finca de Doña Martina
		Abrigo de la Boja
		Cueva de la Tazona
	Alicante	Els Bancals
		Cueva de les Cendres
		Abrigo Ratlla del Bubo
		Cova del Racó del Duc
		Calaveres
	Albacete	El Palomar
	Valencia	Parpalló
		Mallaetes
		Barranc Blanc
		Meravelles
		Rates Penaes
		Llop
		Porcs

Table 7.10. Solutrean sites from the Betic Region.

7. 4. ARCHAEOLOGICAL SITES SCATTERED WITHIN THE BIOCLIMATIC BELT

7.4.1.Thermotype

7.4.1.1.Warm phase

Betic region

The thermo-Mediterranean belt (17°C-19°C mean annual temperatures) expands over the coastal area and the Guadalquivir Valley. In this bioclimatic stage there is a greater presence of Mousterian (n=160; 51%) and Solutrean (n=45; 59%) sites; although Aurignacian (n=4; 40%) and Gravettian (n=8; 44%) sites are also well represented with a percentage almost half of the total number of documented sites. However, these are relatively sparse in the Betic region to be statistically significant.

The Meso-Mediterranean belt (13°C-17°C m.a.t.) expands throughout the large area of central Andalucía except for the highest mountainous areas. In this bioclimatic stage there is a greater percentage of sites of the Aurignacian (n=6; 60%) and Gravettian (n=10; 56%), with a lower presence of Mousterian (n=134; 42%) and Solutrean sites (n=28; 37%)

When fully considered, there is no significant difference in the presence of sites from all chronocultural periods within both bioclimatic belts, Thermo- and Meso- Mediterranean, probably because these are the most benign areas for humans, animals, and plants to occupy.

The Supra-Mediterranean belt (8°C-13°C m.a.t.) expands through the mountainous areas and usually presents a more robust climate. Only Mousterian sites have a high presence (n=22; 7%) within this bioclimatic stage in comparison with the other chronocultural periods, with the exception of (n=3; 4%) Solutrean sites that one also finds present within this biocimatic stage. This could be indicative of the fact that Neanderthals lived longer in this area than the first anatomically modern humans, and inhabited most of the biotopes. Neanderthals were able to inhabit these uplands in warm periods. Some authors, who defend the seasonal behaviour of Neanderthals, propose that they could visit these areas

during spring and summer times (Cortés 2005, 2010, 2011). In addition, the data could illuminate when anatomicallly modern humans arrived in the region as perhaps they avoided these higher and cooler areas. It may be that it was from the Solutrean chronocultural period, with larger populations, that these higher areas began to be inhabited.

The Oro- and Cryoro- Mediterranean belts (<8°C m.a.t.), which expand through the higher mountainous areas, are only present in the Sierra Nevada (Granada), within the Betic region. No sites have been documented for any of the chronocultural periods studied.

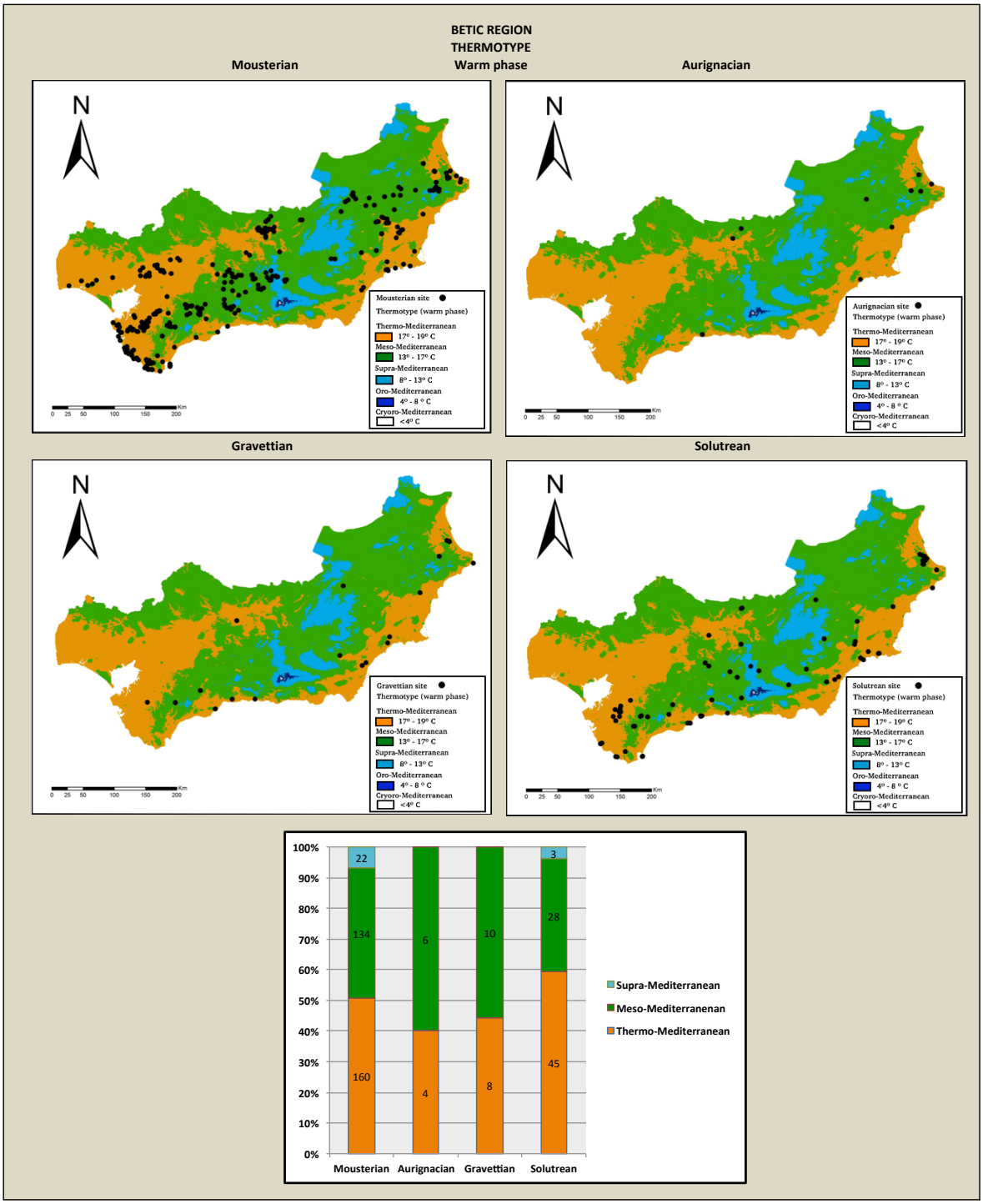


Figure 7.2. Thermotype maps in a warm climate phase from the Betic region.

Cantabrian region

The Thermo-warm belt (15°C-18°C m.a.t.) expands almost continuously along the Cantabrian-Atlantic coast (except for some capes, estuaries, the Bay of Biscay, and some parts of the south coast of Galicia) and in some deep valleys, near the coast of the Basque Country and Navarra. This is the bioclimatic belt with the most sites across all of the chronocultural periods under study: Mousterian (n=279; 66%), Châtelperronian (n=10; 67%), Aurignacian (n=28; 65%), Gravettian (n=22; 58%) and Solutrean (n=30; 57%).

The Meso-warm belt (8°C-15°C m.a.t.) is the most predominant bioclimatic stage in the Cantabrian region. Towards the northwest, it expands into the greater part of Galicia, and extends to the valleys and piedemonts of the Cantabrian Mountain range, to the north, the Basque coast and mountains system of Basque Country and Navarra. This bioclimatic belt follows after the Thermo-warm belt in terms of the number of sites: Mousterian (n=112; 26%), Châtelperronian (n=5; 33%), Aurignacian (n=14; 33%), Gravettian (n=12; 32%) and Solutrean (n=23; 43%).

As was the case in the Betic region, the majority of sites from all chronocultural periods are located within both Thermo- and Meso-warm bioclimatic belts, these being the most benign areas for humans, animals, and plants to occupy within this region.

The Supra-warm belt (4°C-8°C m.a.t.) extends onto the piedmont of the north and south of the Cantabrian Mountain System, and north of the Castilla-León plateau. As in the Betic region only Mousterian sites predominate (n=34; 8%) by comparison to the other chronocultural periods. The Aurignacian (n=1; 2%) and Gravettian (n=4; 11%) are present, but with markedly lower percentages. The cause of this can be explained with the same arguments that I used for the presence of sites within the Supra-Mediterranean belt in the Betic region.

The Oro- and Cryoro-warm belts (<4°C m.a.t.) are only present in the highlands of the Cantabrian mountain system, where no sites has been documented from the chronocultural periods studied, as in the Betic region.

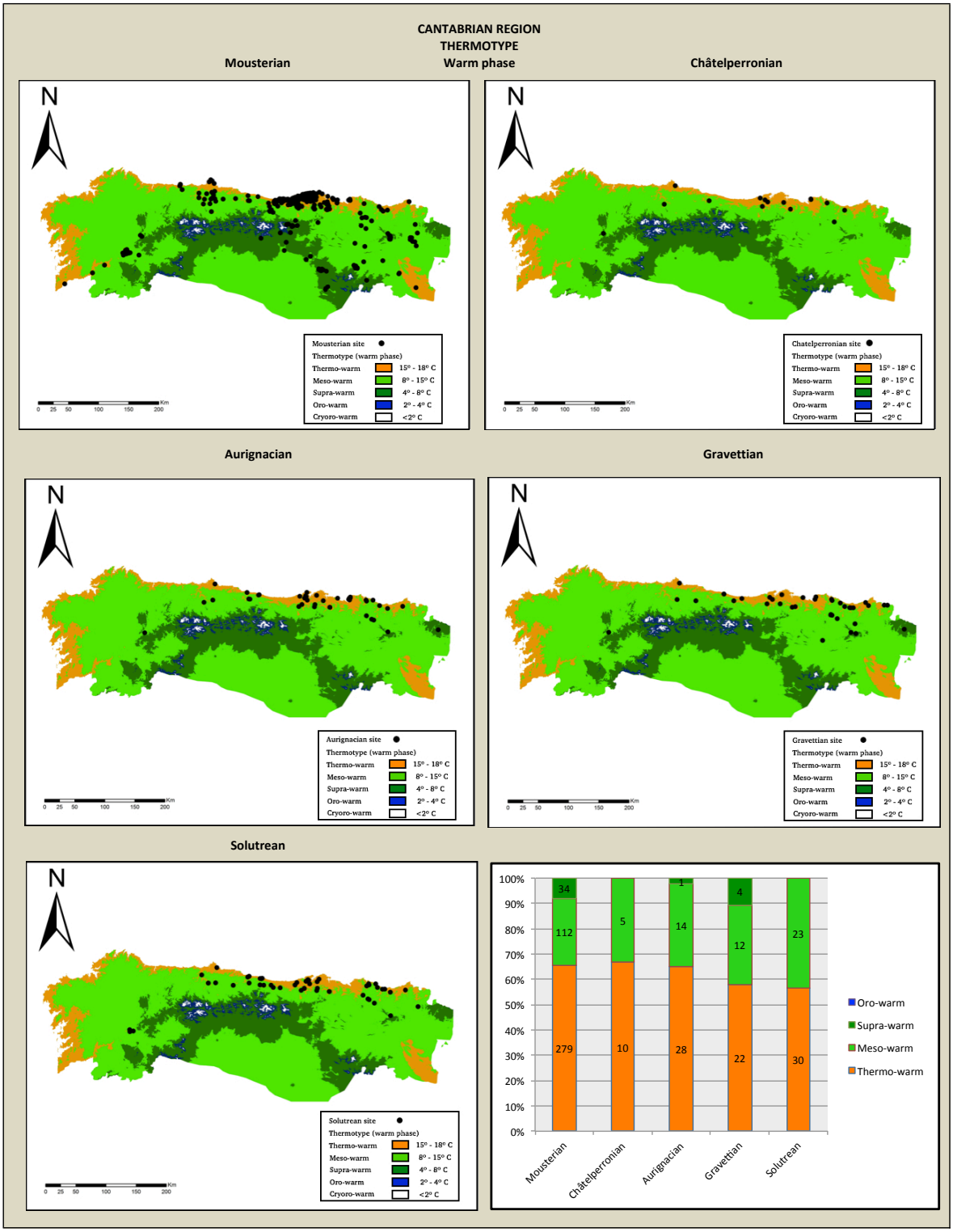


Figure 7.3. Thermotype maps in a warm climate phase from the Cantabrian region.

7.4.1.2. Cold phase

Betic region

In this cold weather condition model, with a temperature on average 3°C lower than present mean annual temperatures, the thermo-Mediterranean belt disappears within the Betic region. The presence of sites of all chronocultural periods studied is reduced to two bioclimatic belts: the Meso-Mediterranean and the Supra-Mediterranean.

The Meso-Mediterranean belt (13°C-17°C m.a.t.) expands over the coastal area and the Guadalquivir Valley, and Murcia. In this bioclimatic belt we have the most presence of sites in all chronocultural periods: Mousterian (n=242; 77%), Aurignacian (n=9; 90%), Gravettian (n=14; 78%), and Solutrean (n=61; 80%).

The Supra-Mediterranean belt (8°C-13°C m.a.t.) increases in size along most of the entire Betic Mountain System. In this bioclimatic belt there is a presence of sites in all chronocultural periods, but in a lower percentage than in the Meso-Mediterranean belt. The number of sites by chronocultural period is: Mousterian (n=74; 23%), Aurignacian (n=1; 10%), Gravettian (n=4; 22%) and Solutrean (n=15; 20%).

The Oro-Cryoro- Mediterranean belt (<8°C m.a.t.) also increases in the highest mountains of Sierra Nevada and Sierra de Baza (Granada); Sierra de los Filabres (Almería); Sierra de Cazorla and Segura (Jaén). However, no sites have been documented from any of the chronocultural periods studied.

Even in cold conditions the percentage of number of sites in all chronocultural periods predominate in areas of more benign temperatures, only around 20% in the Mousterian, Gravettian and Solutrean and 10% in the Aurignacian are within cold zones (Supra-Mediterranean belt). It is also not known if these sites originated in a cold period and as several authors suggest, as per the seasonal behaviour hypothesis, these areas were possibly populated at warmer times such as spring and summer during cold periods.

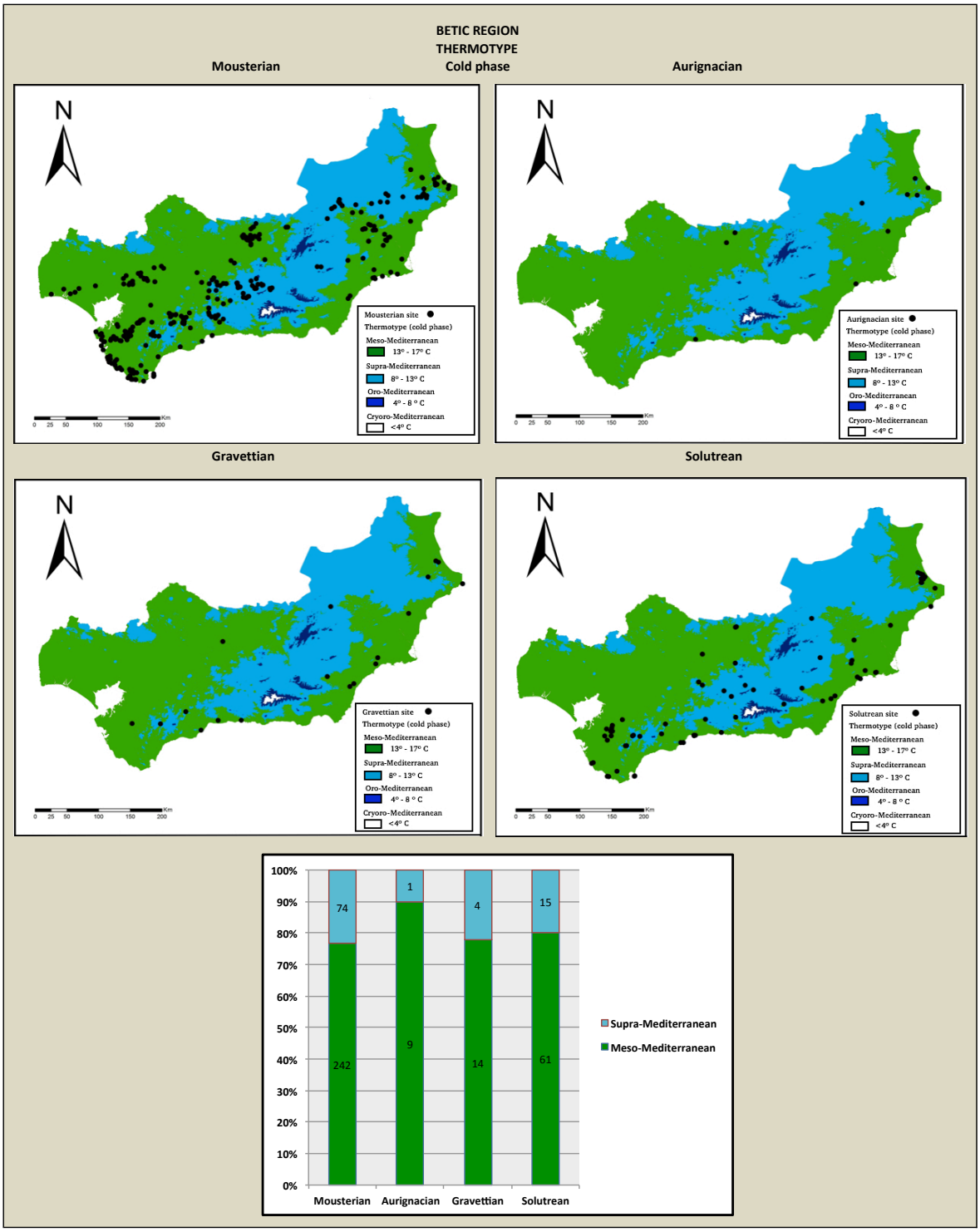


Figure 7.4. Thermotype maps in a cold climate phase from the Betic region.

Cantabrian region

In this cold weather conditions model with 3°C less than present mean annual temperature, the thermo-warm belt disappears within the Cantabrian region, as the Thermo-Mediterranean did in the Betic region.

The Meso-warm belt (8°C-15°C m.a.t.) expands over the coastal area and all river valleys. In this bioclimatic belt we see the most presence of sites from all chronocultural periods: Mousterian (n=334; 81%), Châtelperronian (n=14; 93%), Aurignacian (n=39; 91%), Gravettian (n=31; 82%) and Solutrean (n=49; 92%).

The Supra-warm belt (4°C-8°C m.a.t.) increases in size in inland Galicia, Castilla y León Plateau and the south of the Basque Country. In this bioclimatic belt there is a presence of sites from all chronocultural periods, but in lower percentages than in the Meso-warm belt. The number of sites by chronocultural period are: Mousterian (n=59; 14%), Châtelperronian (n=1; 7%), Aurignacian (n=3; 7%), Gravettian (n=5; 13%) and Solutrean (n=4; 8%).

The Oro-warm belt (2°C-4°C m.a.t.) also increases in the Cantabrian Mountain System. Only a lower percentage of sites are located within this bioclimatic belt in cold climatic conditions: Mousterian (n=23; 5%), Aurignacian (n=1; 2%), and Gravettian (n=2; 5%).

The Cryoro-warm belts (<2°C m.a.t.) increase greatly in size, in the highlands of the Cantabrian Mountain System, where no sites have been documented from any the chronocultural period studied.

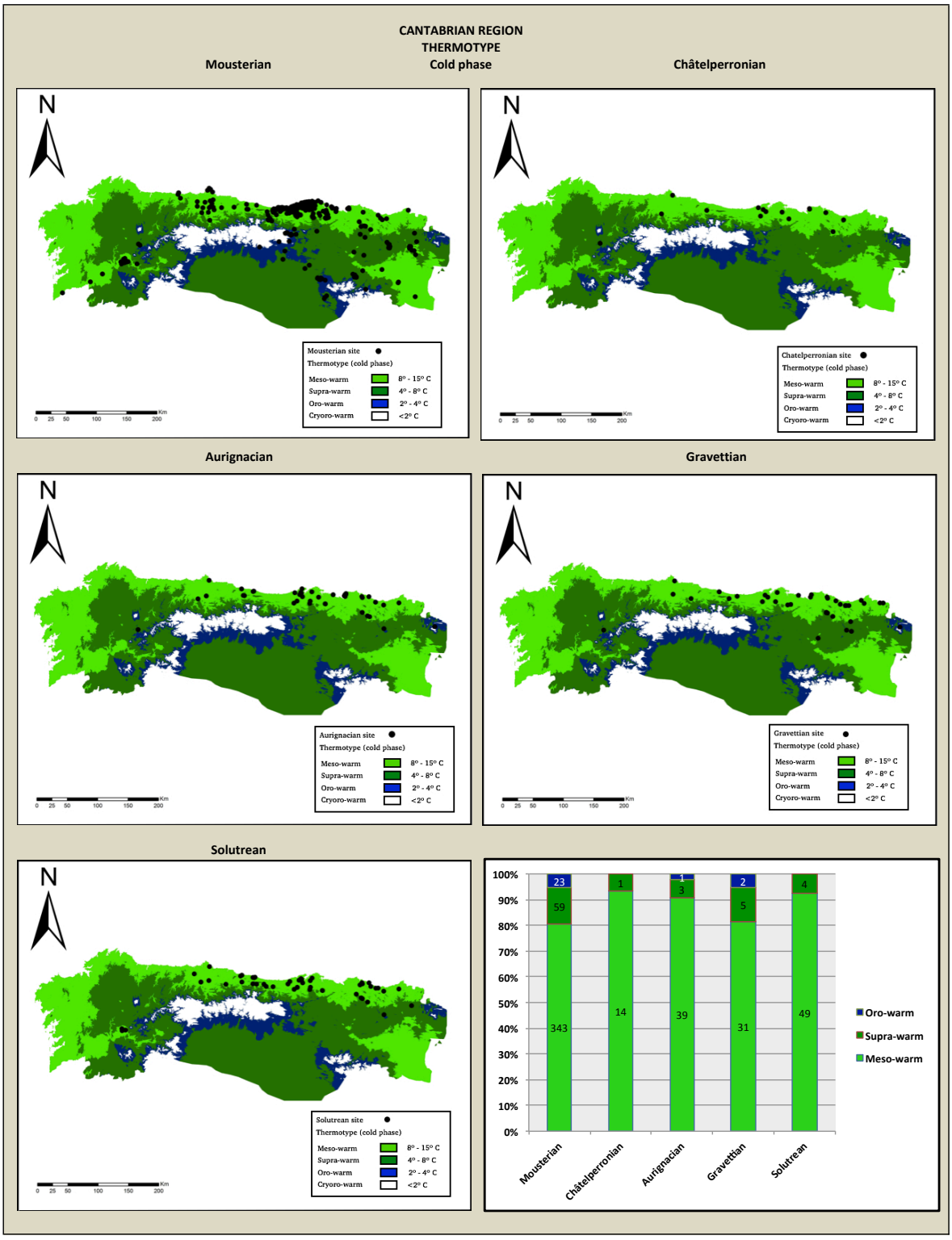


Figure 7.5. Thermotype maps in a cold climate phase from the Cantabrian region.

7.4.2. Ombrotype

7.4.2.1.Humid phase

Betic region

Looking at the map of the Ombrotype of the Betic region, the eastern area is much more diverse, with drier zones, than in the west.

The Arid belt (200mm mean annual rainfall) expands along part of the coast of Almeria and Murcia. A very small number of sites are located within these ombrotype belts: Mousterian (n=1; 0,3%), Gravettian (n=1; 6%), and Solutrean (n=2; 3%).

The Semi-arid belt (300mm m.a.r.) is located in part of the coast and inland of Almeria and Murcia. In this bioclimatic belt there is a presence of sites from all chronocultural periods, but not in high numbers: Mousterian (n=34; 11%), Aurignacian (n=3; 30%), Gravettian (n=5; 28%), and Solutrean (n=11; 14%).

The Dry belt (400mm m.a.r.) occupies a large part of the Betic region, along the coast and inland (highlighting areas such as Guadalquivir Valley, Málaga, Granada, and Alicante). In this bioclimatic belt there is a high presence of sites from all chronocultural periods: Mousterian (n=132; 42%), Aurignacian (n=3; 30%), Gravettian (n=6; 33%), and Solutrean (n=24; 32%).

The Sub-humid belt (700mm m.a.r.) occupies the relief of Sierra Morena, the Sub-Betic Mountains System, and the Alicante area. In this bioclimatic belt there is a high presence of sites from all chronocultural periods: Mousterian (n=126; 40%), Aurignacian (n=4; 40%), Gravettian (n=5; 28%), and Solutrean (n=33; 43%).

The Dry- and Sub-Humid ombrotype belts are the stages with the most presence of sites from all chronocultural periods, which is very distinctive from the other types.

The Humid belt (1000mm m.a.r.) expands in a discontinuous diagonal from the northeast to the southwest, occupying the high zones of the Sierra de Cazorla, Sierra de Alhama, Sierra de Grazalema, Serrania de Ronda and Alcornocales Natural park area. The number of sites in this ombrotype belt is reduced for all chronocultural periods: Mousterian (n=20; 6%), Gravettian (n=1; 6%), and Solutrean (n=4; 5%).

The Hyper-humid belt (1600mm m.a.r.) occupies only the highlands of Sierra de Grazalema and Ronda, which by their elevation and location take advantage of the effect of stagnation of the storms that enter through the Gulf of Cádiz. Once again, a lower percentage of sites is located within this ombrotype belt and only for the longest chronocultural periods: Mousterian (n=3; 1%), Solutrean (n=2; 3%).

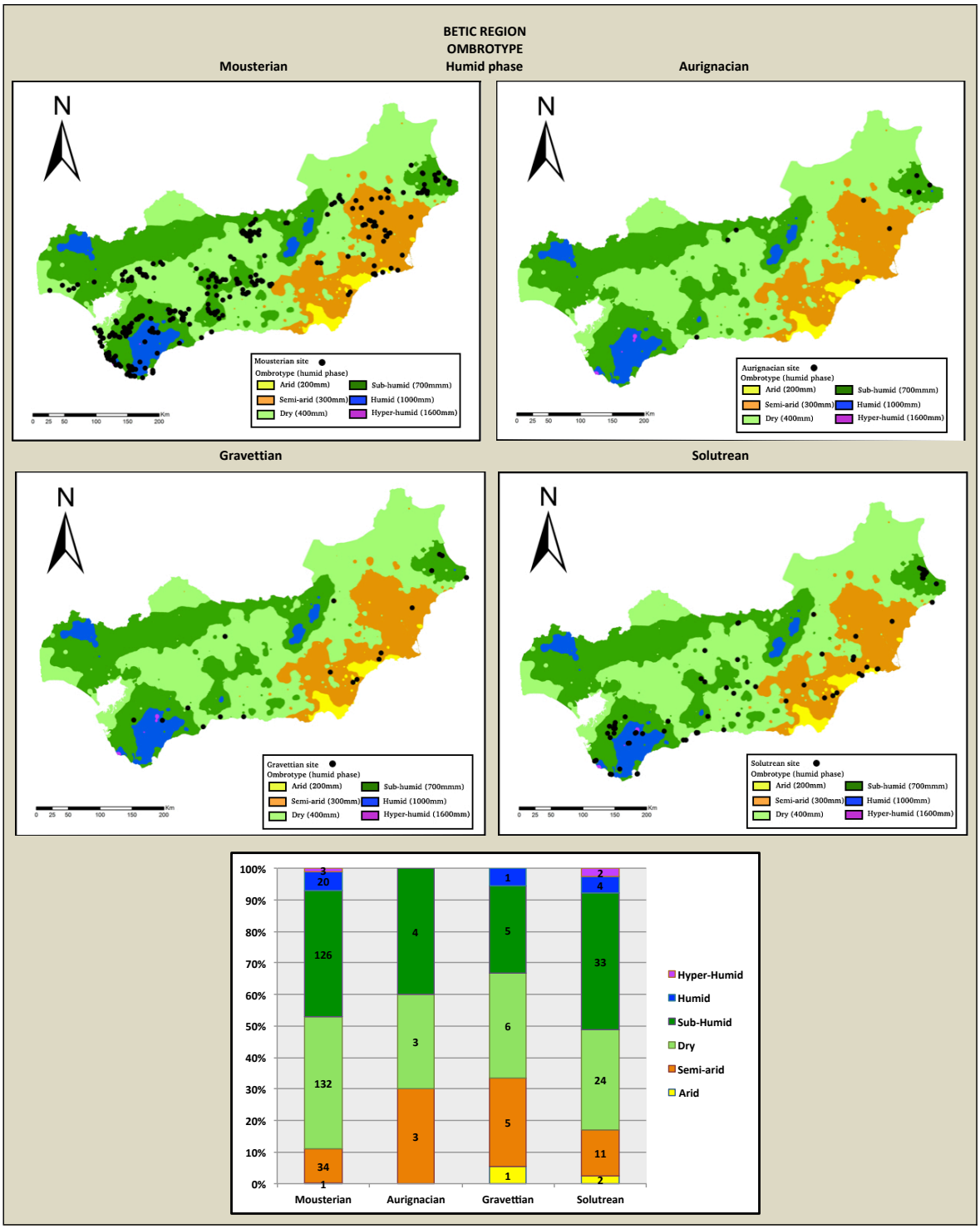


Figure 7.6. Ombrotype maps in a humid climate phase from the Betic region.

Cantabrian region

The Dry belt (400mm m.a.r.) expands along the Castilla-León Plateau and the upper part of the Ebro river valley. There is only one chronocultural period documented in its sites: Mousterian (n=7; 2%).

The Sub-humid belt (700mm m.a.r.) expands in the south of the Cantabrian Mountains system from Galicia, north of the Castilla-León Plateau to Navarra. In this ombrotype belt the following chronocultural sites are present, but in low numbers: Mousterian (n=76; 18%), Gravettian (n=1; 3%), and Solutrean (n=3; 6%).

The Humid belt (1000mm m.a.r.) occupies great part of Galicia, Asturias, Cantabria, and the País Vasco. In this ombrotype belt the most sites are present from all chronocultural periods: Mousterian (n=321; 76%), Châtelperronian (n=13; 87%), Aurignacian (n=35; 81%), Gravettian (n=23; 61%), and Solutrean (n=39; 74%).

The Hyper-humid belt (1600mm m.a.r.) expands in a discontinuous form from northwest to northeast of the Cantabrian region. In this bioclimatic belt there are all chronocultural periods present, but with lower percentages: Mousterian (n=21; 5%), Châtelperronian (n=2; 13%), Aurignacian (n=8; 19%), Gravettian (n=14; 37%), and Solutrean (n=11; 21%).

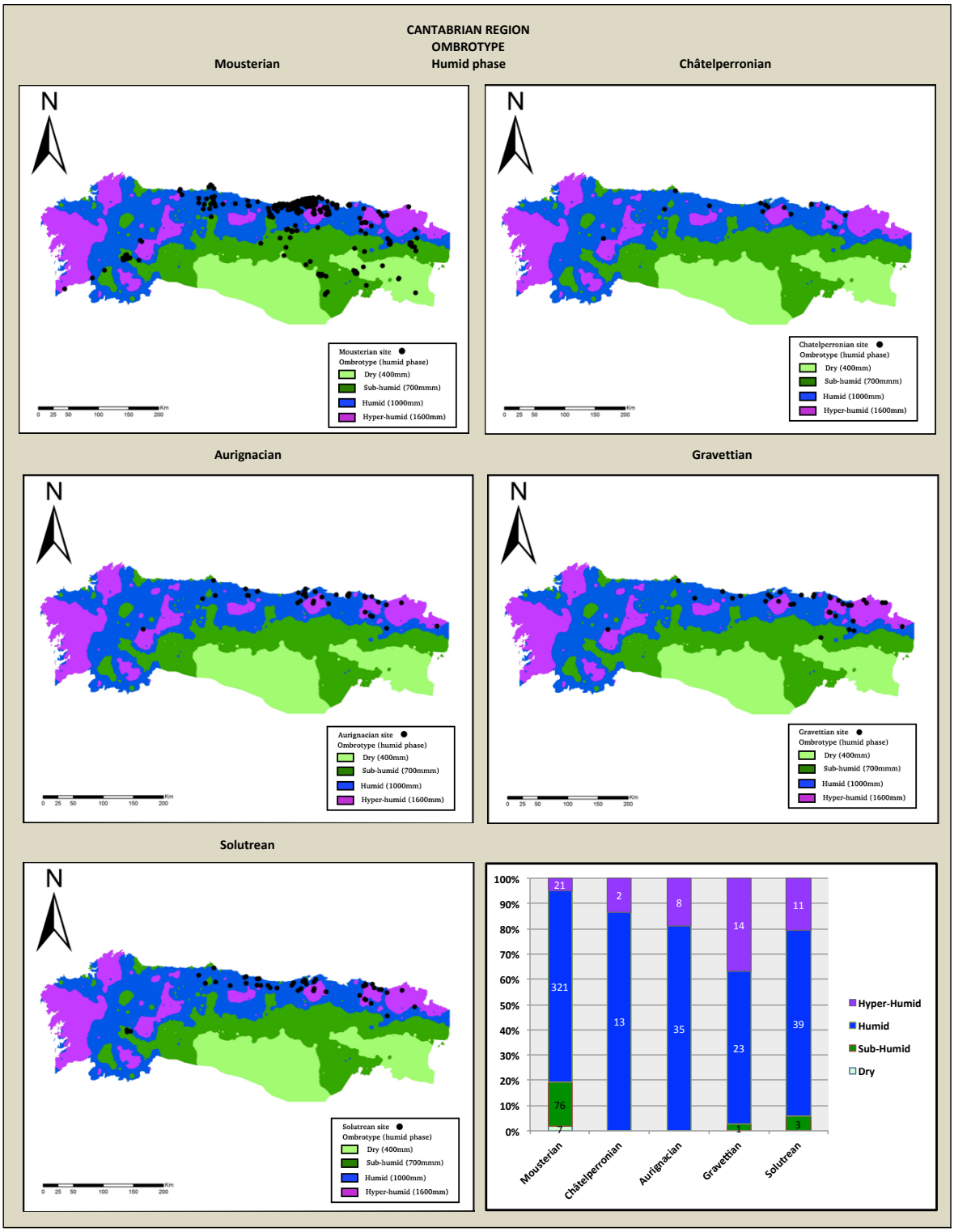


Figure 7.7. Ombrotype maps in a humid climate phase from the Cantabrian region.

7.4.2.2.Dry phase

Betic region

In this Dry conditions model with 400mm less than present mean annual rainfall, the Arid, Semi-arid, Dry ombrotype belts increase in size, however the Sub-humid, Humid and Hyper-humid ombrotypes belt are considerably reduced.

The Arid belt (100mm m.a.r.) increases in the southeast of the Betic region, covering the provinces of Almería, Murcía, and the south of Albacete. In this ombrotype belt there is a presence of sites from all chronocultural periods: Mousterian (n=46; 15%), Aurignacian (n=3; 30%), Gravettian (n=7; 39%), and Solutrean (n=18; 24%).

The Semi-arid belt (200mm m.a.r.) appears in new scattered areas such as southeast of Sevilla, in the central part of Jaén, Albacete, and the south of Valencia. The presence of sites in this ombrotype belt is reduced in percentage and chronocultural periods: Mousterian (n=30; 9%), Gravettian (n=1; 6%), and Solutrean (n=5; 7%).

The Dry belt (300mm m.a.r.) increases considerably in the west area and Alicante. In this ombrotype belt sites are present from all chronocultural periods: Mousterian (n=230; 73%), Aurignacian (n=7; 70%), Gravettian (n=9; 50%), and Solutrean (n=48; 63%).

The Sub-humid belt (700mm m.a.r.) is reduced to two small, high areas the Sierra de Cazorla and the Sierra de Grazalema, and consequently reduces the number of sites and chronocultural periods present: Mousterian (n=5; 2%), Gravettian (n=1; 6%), and Solutrean (n=3; 4%).

The Humid belt (1000mm m.a.r.) is further reduced in the same areas cited above, and only two chronocultural periods are identified from their sites: Mousterian (n=5; 2%) and Solutrean (n=2; 3%).

The Hyper-humid belt (1600mm m.a.r.) virtually disappears, and there are no sites recorded for this ombrotype belt.

The Betic region in a Dry conditions model suffers from severe aridity, especially within the southeast area. The majority of the sites would be located in a Dry ombrotype belt in the west and central part of the region, but during the Mousterian period many sites would be within Arid ombrotype belt in the southeast area.

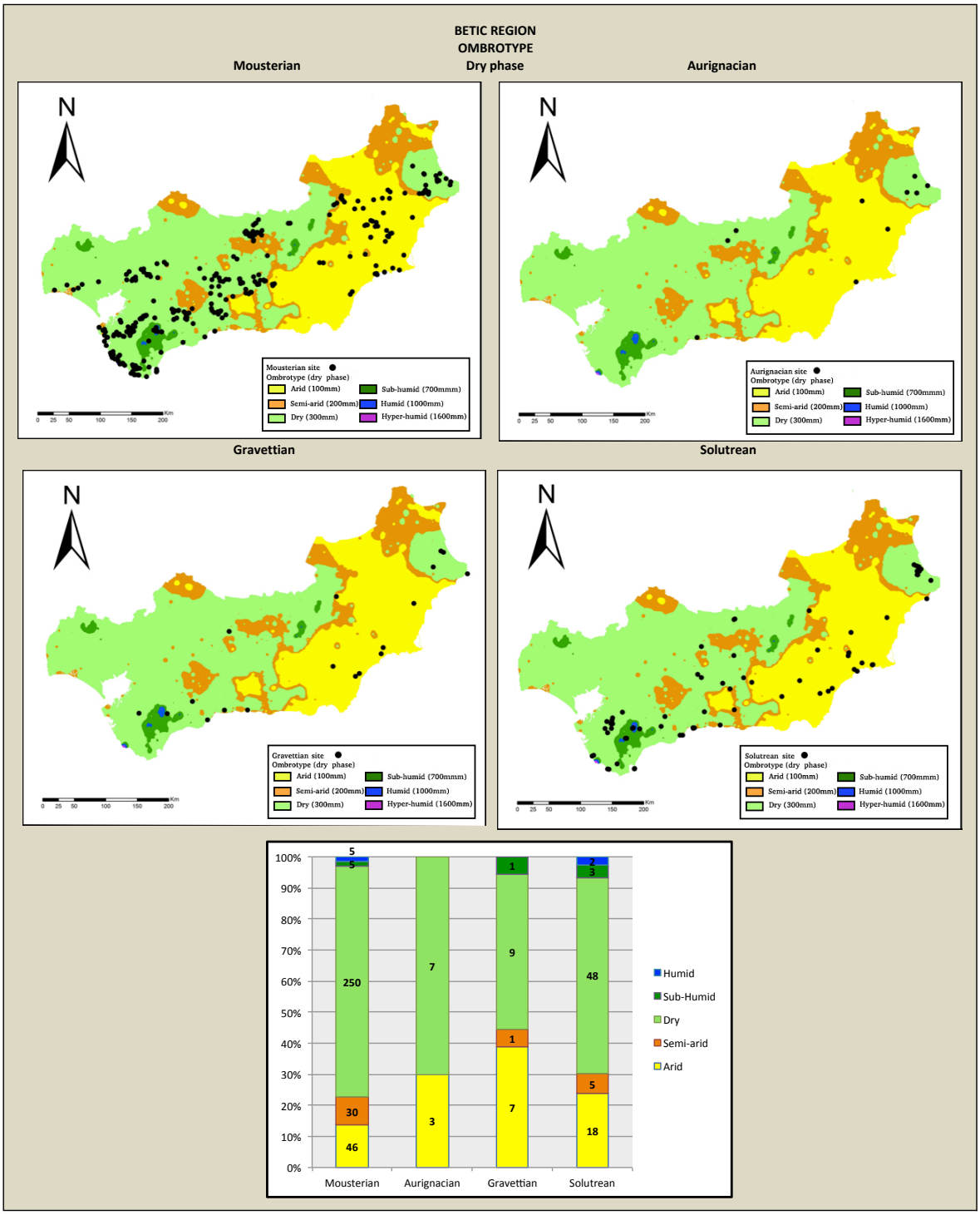


Figure 7.8. Ombrotype maps in a dry climate phase from the Betic region.

Cantabrian region

In this Dry conditions model with 400mm less than present mean annual rainfall, the Arid, Semi-arid, Dry ombrotypes belt increases in size, however the Sub-humid, Humid and Hyper-humid ombrotypes belt is considerably reduced.

The Arid belt (100mm m.a.r.) appears in the central part of the Castilla-León plateau and the middle basin of the Ebro River, with only some sites present from one chronocultural period: Mousterian (n=5; 1%).

The Semi-arid belt (200mm m.a.r.) occupies the north part of the Castilla-León plateau and the upper basin of the Ebro River. In this ombrotype belt there are sites from two chronocultural periods: Mousterian (n=26; 6%) and Gravettian (n=1; 3%).

The Dry belt (300mm m.a.r.) expands along the south side of the Cantabrian Mountain System. Also in this ombrotype belt there are sites from only two chronocultural periods: Mousterian (n=52; 12%), and Solutrean (n=3; 6%).

The Sub-humid belt (700mm m.a.r.) in this model is reduced in size and occupies areas from the north side of the Cantabrian Mountain System to the coast. Although reduced in size, most of the sites for all chronocultural periods are present within this ombrotype belt (though fewer in the Gravettian): Mousterian (n=284; 67%), Châtelperronian (n=8; 53%), Aurignacian (n=26; 60%), Gravettian (n=14; 37%), and Solutrean (n=26; 49%).

The Humid belt (1000mm m.a.r.) in this model is reduced in size and occupies discontinuous areas from northwest to northeast of the Cantabrian region. Although it has reduced in size, there are sites from all chronocultural periods present in high percentages: Mousterian (n=58; 14%), Châtelperronian (n=7; 47%), Aurignacian (n=17; 40%), Gravettian (n=23; 61%), and Solutrean (n=23; 43%).

The Hyper-humid belt (1600mm m.a.r.) in this model is reduced to very small areas dispersed in the territory, with only one site present in the Solutrean (n=1; 2%).

In this Dry conditions model the ombrotypes with greater presence of sites in all chronocultural periods are the Subhumid and Humid belts corresponding with the north side of the Cantabrian Mountains system along the coastal corridor and rivers valleys. Although a dry model of rainfall was made, this area is still very humid and with abundant rainfall, so it is considered the wettest area within all of the Iberian Peninsula.

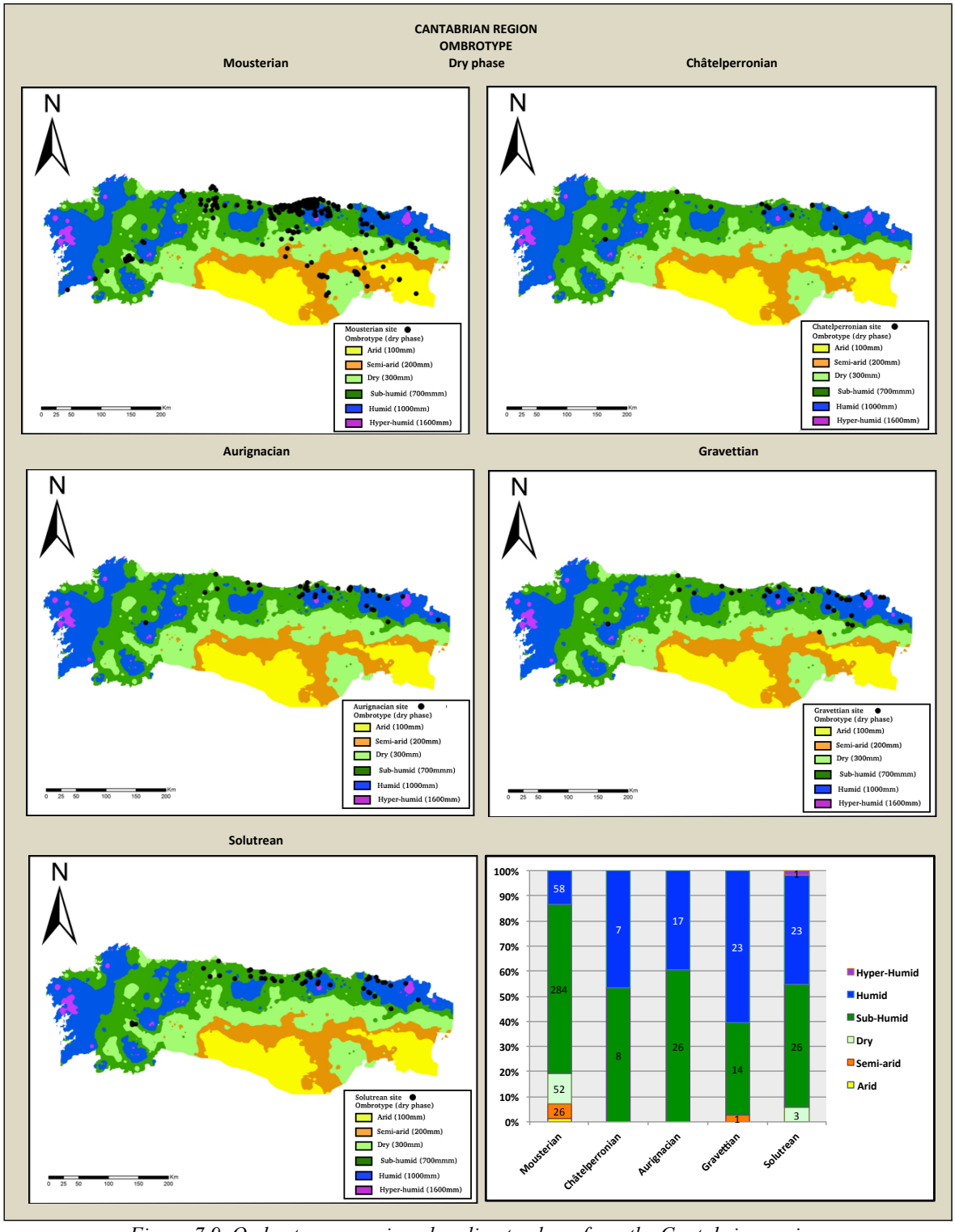


Figure 7.9. Ombrotype maps in a dry climate phase from the Cantabrian region.

7.5. SUMMARY

The occupation of territory and the mobility patterns of humans are influenced by social and environmental factors. The latter include geological and orographic characteristics, climatic conditions due to latitude, the geographical location and the availability of biotic and abiotic resources. Prehistoric populations would settle in areas where they could exploit natural resources (water, vegetation, animals, and rocks). In addition, they also appear to have had a high capacity of adaptation to adverse natural conditions.

In this case study I focused on the climatic conditions. The two regions of study (Cantabrian and Betic regions) are two distinct macro-bioclimatic regions; a Euro-Siberian climatic region along the Cantabrian Mountains System, and a Mediterranean climatic region in the Betic Mountains System. The bioclimatic map models have simulated a series of climate models, which help us to understand the correlation between the distribution of archaeological sites by chronocultural periods with bioclimatic belts.

Similarities

The bioclimatic maps indicate that both regions experienced great variation in temperature and rainfall. Within this picture of bioclimatic diversity it is clear that Neanderthals and anatomically modern humans occupied environments with the most favourable living conditions in both regions, with sites in areas of extreme climates scarce, and most likely occupied only during benign climate phases.

Regarding the thermotype maps, during warm phase conditions the majority of sites from all chronocultural periods from both regions are located within the same two bioclimatic belts, Betic region: Thermo (17°C-19°C)- and Meso (13°C-17°C)- Mediterranean; Cantabrian region: Thermo (15°C-18°C)- and Meso (8°C-15°C)- as these are the most benign areas for humans, animals, and plants to live. In Cold phase conditions most sites from all chronocultural periods from both regions are located within one bioclimatic belt, in the Betic region the Meso-Mediterranean belt (13°C-17°C) and in the Cantabrian region the Meso-warm belt (8°C-15°C).

Neanderthals appear to occupy the coast, valleys, plateau and mountains. In addition, according to the archaeological sequence records of numerous sites, different biotopes within both regions were occupied by Neanderthals in a persistent and continuous pattern.

Neanderthals occupied the Iberian Peninsula for approximately 300,000 years and experienced climate fluctuations, including alternation of cold (glacial period) and warm phases (interglacial periods), so they could occupy territories in both regions, which in cold periods are very inaccessible but in warm periods were accessible. Only the Mousterian sites have a high presence within Supra-Mediterranean bioclimatic stages in both regions, in comparison with the other chronocultural periods. The initial Upper Palaeolithic sites are associated with low areas, but we see an increase in sites during the Solutrean period, particularly in the occupation of higher areas.

Differences

There is a clear difference in the spatial distribution of sites by territory in both regions. In the Cantabrian region due to its geographical, orographic and climatic conditions, the occupation is concentrated along the coastal corridor from east to west and on the alluvial plains, during all chronoclutural periods. However, in the Betic region, with its different orography and climatology, the sites are more scattered throughout, especially in the Mousterian and Solutrean. Very few sites are documented for the Aurignacian or Gravettian periods and it is therefore difficult to read too much into the distribution of these sites.

Regarding the thermotype maps within the Cantabrian region in the cold climate model there are sites within the Oro-warm belt (2°C-4°C) during the Mousterian, Aurignacian, and Gravettian. Although there is a low percentage of sites within of this ombrotype belt, in the Betic region these are non-existent.

Regarding the Ombrotype maps, there are differences between both regions due to their being different macro-bioclimatic zones: the Cantabrian is a humid region where the rainfall is abundant, and the Betic is a Dry region, except for some mountainous areas.

In Humid phases within the Betic region the Dry (400mm) and Sub-humid (700mm) ombrotype belts are the stages with the most presence of sites in all chronocultural periods. In the Cantabrian region within the Humid belt (1000mm) most sites from all

chronocultural periods, are present.

In the Dry phase in the Betic region, within the Dry (400mm) ombrotype belt, most sites are present from all chronocultural periods. However in the Cantabrian region, the most sites from all chronocultural periods are present within the Sub-humid belt (700mm) and Humid belt (1000mm).

In the case of the ombrotype belts in the Betic region, humans regardless of chronocultural periods do not look for areas with more humidity because these are only located in very high areas, but instead they occupy the valleys and piedmonts within the Dry and Sub-humid ombrotype belts. In the Cantabrian region, on the other hand, the majority of sites are located in the Humid ombrotype belt, because it is the most common in these valley and piedemont areas. Human communities do not choose these areas for their humidity, then, but because they are orographically more optimal to live and they adapt to the rainfall these areas receive.

Neanderthals did not have a specific predilection for any specific biogeographical or climatic domain, since the two regions are very different in terms of biogeography and climate and were equally occupied very intensely by them. They inhabited almost all the bioclimatic belts, a great variety of landscapes and altitudes, showing their adaptative capacity. In addition, the data also indicate that they were present more in warm and humid areas and also in the Dry and Sub-humid areas as in the Betic regions. Finally, it can be seen that Neanderthals and anatomically modern humans in both regions adapted to the territory and climatic conditions in a similar way.

CHAPTER 8

DISCUSSION AND CONCLUSIONS

8.1. DISCUSSION

8.1.1. Introduction

This chapter aims to summarise the results of this study and to highlight possible ways in which this field of research can advance in the future. Additionally, it will show how all the factors addressed relate to one another. The main objective of this thesis was to answer the question: Did Neanderthal technological behaviour, subsistence practices, and bioclimatic settlement patterns differ under diverse environmental conditions?

In order to address this question, I analysed each type of behaviour separately, within two ecological and climatic regions of study: the Cantabrian and Betic regions. This provided an opportunity to see the behaviour of the only human species present, in this case *Homo neanderthalensis*, in different stages, and allowed me to take advantage of the fact that there is a large number of Middle Palaeolithic sites documented in both regions.

The approach adopted was regional, integrative, and comparative. Regional, because two large areas were comprehensively examined; integrative, because the different types of evidence have been brought together; and comparative, because the results were compared between both regions.

8.1.2. Technological behaviour

It would be reductionist to consider that Neanderthal technology can be reduced exclusively to the exploitation of lithic raw materials. The Neanderthals alternated their raw material use, also using bone (e.g. Peña Miel, Covalejos, Morin, Axlor, Prado Vargas (Spain)) (Mozota 2008, 2009, 2015), wood (e.g. Abric Romaní (Spain) (Valverdú *et al* 2014), and marine shell (e.g. Grotta del Cavallo (Italy) (Romagnoli *et al* 2015a, b) to produce tools. From a methodological point of view, this study has focused on the lithic inventory and, in spite of the limitations of the collections analysed, it has been possible to demonstrate variability, differences, and similarities in levels of technological patterns within both regions.

A high variability in the Middle Palaeolithic assemblages has been observed in this study, reflecting the fact that Neanderthals had an adaptive capacity to apply different strategies of knapping depending on the quality, size, and availability of raw materials and the types of tool they wanted or needed in order to develop different activities.

Another interesting point to consider for the Late Mousterian in the Cantabrian region is the hypothesis that a "Climate Crisis influenced the behaviour of the last Neanderthals" as proposed by Baena & Carrión (2006); *et al* (2012) in accordance with Finlayson & Carrion (2007). There was great fluctuation and a steady deterioration in the climate of Europe from 50 to 35 ka BP, which produced a mosaic of environmental conditions and diverse territories, and this, in turn, gave way to a cultural mosaic. According to these authors, external influences can be observed in the lithic tool production of this period, and these are thought to be associated with increasingly mobile groups and more ephemeral and shorter occupations. These are observed in the archaeological record as small assemblages with little specialization, a lack of raw material selection, and an increase in the reuse and recycling of lithic tools. This pattern is recorded in El Esquilleu, El Habario, El Arteu (Baena *et al* 2012), and Axlor (González Urquijo *et al* 2005; Ríos Garaizar 2007, 2008).

This hypothesis can also be seen in the Betic region, particularly when analysing the lithic assemblages recovered from Gorham´s Cave and Zafarraya. Here, last Mousterian levels show short occupations, with a preference for the use of localised raw materials and an increase in expedient knapping strategies, both possibly caused by an increase in group mobility as a result of a deteriorating climate during MIS3. Shipton *et al* (2013), however, observes a reduction in residential mobility within refugium areas, instead of an increase.

From the analyses carried out in this thesis, there appears to be a greater technological homogeneity amongst the different assemblages within the Betic region, than within the Cantabrian region. Additionally, there is a presence of seemingly contemporary antagonistic technocomplexes in a geographical proximity within the Cantabrian region (Baena & Carrión 2006). This could be produced by the influence of the French region, the persistence of small mosaics of techno-cultural traditions, or other factors.

The conclusions obtained from the analyses of the different lithic assemblages can be summarised as follows:

Raw material

The study of raw material indicates that Neanderthals in both regions generally employed an opportunistic strategy, exploiting locally available raw materials from secondary or derived positions. Where flint was sparse, they used local raw materials such as quartzite,

limestone, quartz, etc. This reflects a cultural preference for selecting the highest quality raw materials best suited for their final purpose, as well as an economizing behaviour, explaining the predominance in the use of flint and quartzite, despite a great variety of raw materials available within both regions. In addition, a greater range of raw materials used produced a greater variety in knapping schemes.

Cores

In both regions of study the method of knapping most largely used was discoidal and recurrent centripetal Levallois. However, in the Cantabrian region there is a greater presence of the discoidal method and a lower representation of the Levallois method in comparison with the Betic region. The Levallois method most dominant in both regions is the centripetal recurrent Levallois, with very few examples of the preferential Levallois method, although the exhaustion of cores may in many cases mask the method of knapping employed. This high degree of core exhaustion in both regions, with very small sized cores at the moment of their final abandonment, shows an economizing behaviour. The blanks obtained by method of reduction are mainly flakes with thick butts and peripheral cutting edges. The Quina method is used in the late Mousterian levels in the Cantabrian region, in the sites within the Basque Country, whereas in the Betic region this method is practically absent.

Flakes

The flakes have very similar measurements in both regions. The majority of flakes in both regions do not present cortex on the surface or on the butt; the sinuous delineation of ventral face, platform and plain butt are the most common in all assemblages. In addition, a multidirectional pattern of directions of scarring is predominant in both regions. Within the Betic region the flakes are dominated by pronounced bulbs, whereas in the Cantabrian region these are dominated by diffuse bulbs. The concave delineation, bifaceted and multifaceted butt, centripetal and the bidirectional directions are more represented within the Betic region than the Cantabrian region. These differences are probably caused by the type of raw materials and methods of knapping used

Retouched tools

The kind of blanks that were selected for retouching in all assemblages from both regions are flakes, which have very similar measurements. The main characteristics of retouching, shared by both regions are: unifacial retouch, localised mainly on the sides (left and right); a semi-abrupt angle of retouch; the marginal and extensive extent of retouch; the direct direction of retouch; and the fact that scrapers and denticulates make up the largest group. The main difference is that the retouched tool pieces in the Cantabrian region are thicker than those from the Betic region. The edges of the blanks are also more extensively retouched, with semi-abrupt and abrupt angles of retouch, and denticulate morphology being the most common in the Cantabrian region. Simple angle retouch, continuous delineation and sinuous, convex and straight morphologies are most common in the Betic region.

From a typological point of view, denticulates are most represented in the Cantabrian region and scrapers in the Betic region. In the Cantabrian region we find the Quina scraper, which is absent in the Betic during the Late Middle Palaeolithic. The flake cleavers present in the Cantabrian region are also non-existent in the Betic region during the Late Middle Palaeolithic.

8.1.3. Subsistence practices

The groups of Neanderthals that lived in both study regions had a subsistence behaviour based on a broad-spectrum diet. They were capable of hunting a wide range of prey from large, medium, and small-size ungulates (horses, bovids, red deer, roe deer, reindeer, ibex, and chamois), as well as capturing small animals, such as rabbits, fish, and molluscs within both regions.

There are several key main characteristics of the faunal assemblages in both regions. The bulk of the ungulate fauna comprise red deer, horse, bovids, and ibex, with a primacy for animals of medium size. There is little in the way of widespread specialization, with the exception of a few sites such as El Esquilleu, Axlor, Zafarraya, and Horá. Dangerous animals such as wild boar or rhinoceros are less represented in the archaeological records. Neanderthals were able to adapt and apply different strategies of hunting and capture, to be

able to exploit the species that were present in each different biotope, rocky areas (caprids), wooded areas (cervids and suids), open spaces (equids and bovids), and coastal areas (marine resources) and prey that was specific to each macro-bioclimatic region (Cantabrian and Mediterranean). Several sites within both regions have documented evidence for the consumption of seeds, fruits, nuts, vegetables, and other plants, indicating that the Neanderthals had knowledge of the natural resources and had the ability to choose and use different types of vegetables. Cannibalism has been documented within both regions of study, although the reason for this behaviour has yet to be determined.

In summary, Neanderthals responded to the specifics of the bioclimatic regions they inhabited. The evidence suggests that the Neanderthals adapted and modified their hunting strategies in accordance with the different faunal resources available within each macro-bioclimatic region. They simply "ate what is there" (Bar-Yosef 2004), exploiting the fauna from the surrounding environment.

8.1.4. Bioclimatic occupation patterns

The two regions that have been studied in this dissertation are distinct macro-bioclimatic regions a Euro-Siberian climatic region along the Cantabrian Mountain System, and a Mediterranean climatic region along the Betic Mountain System. The bioclimatic models indicate that both regions had great variation in temperature and rainfall. Neanderthals and anatomically modern humans occupied environments with the most favourable living conditions within both regions, favouring warm and stable temperatures and humid and sub-humid zones.

Neanderthals occupied the coast, valleys, plateau and mountains. They experienced climate fluctuations during the Pleistocene, alternating cold (glacial period) and warm phases (interglacial periods), so that they could occupy territories in both regions, which in cold periods were very inaccessible but in warm periods accessible.

There is a clear difference in the spatial distribution of sites by territory within both regions. In the Cantabrian region due to its geographical, orographic, and climatic conditions, occupation is concentrated along the coastal corridor from east to west and on the alluvial plains during all the chronocultural periods examined in this study. However,

in the Betic region, with a different orography and climatology, sites are more scattered throughout the territory, especially during the Mousterian and Solutrean.

The Neanderthals did not have a predilection for any specific biogeographical or climatic domain, since the two regions are very different in terms of biogeography and climate and were equally intensely occupied by them. They inhabited almost all the bioclimatic belts, and a great variety of landscapes and altitudes, showing their adaptive capability. Additionally, the data indicate that they intensely occupied warm and humid areas, as well as Dry and Sub-humid areas, as was the case in the Betic region.

It can be concluded that the Neanderthals adapted to the territory and climatic conditions in a very similar way within both regions.

8.2. FUTURE AVENUES OF RESEARCH

This study has only just begun to address the question of whether the Neanderthals varied their technological behaviour, subsistence practices, and bioclimatic settlement patterns under diverse environmental conditions. This question covers a wide range of factors influencing Neanderthal life, which in itself is still the subject of continuous debate, new data and new methodologies, which keep updating what we know. Therefore, further analyses and research need to be carried out to fully approach and better answer this question and thereby enhance our collective knowledge of Neanderthal behaviour.

Further research on technological behaviour needs to be carried out, with a comparison of the lithic assemblages from our regions of study with those from sites within the central part of the Iberian Peninsula in order to know if there are any differences or similarities in technological patterns between the lithic assemblages from coastal regions with those inland. Also diacritic studies, refits and functional analysis of the use-wear of some assemblages from both regions could be carried out.

With regard to subsistence practices, further information from new publications on faunal assemblages from both study regions needs to be collected, especially those with taphonomic studies, and including the identification of the minimum number of individuals. Additional comparisons of the subsistence practices from the interior of the

Iberian Peninsula and with the record from the Upper Palaeolithic levels need to be carried out in order to know if any differences or similarities exist in Neanderthals and anatomically modern humans diets.

The bioclimatic occupation patterns of the whole Iberian Peninsula should be explored in order to have a better understanding of occupation patterns at a larger scale, as well as adding multivariate statistical analyses and studies of other variables such as the analysis of the proximity of sites to bodies of water (rivers and coast); raw material sources, optimal communication routes, elevation, slope and visibility range analysis.

Other types of studies at regional levels can be carried out too, such as the analysis of vegetation and micro-mammals, analyses of habitats and climate conditions using bird species, diachronic analyses of the most occupied sites and their relationships to the types of environmental surroundings.

These lines of future research are ambitious and will require a very long term multidisciplinary study.

8.3. FINAL CONCLUSIONS

The main objective of this thesis was to attempt to address the question of whether Neanderthal technological behaviour, subsistence practices, and bioclimatic settlement patterns differed under diverse environmental conditions. The comparison of the data from the two regions indicates a certain similar behavioural base in Neanderthal use of raw materials, lithic technologies, subsistence strategies, occupation, and selection of natural shelters to live in, with certain differences with regard to cultural adaptations to the environment, access to the availability of biotic and abiotic resources, and climate oscillations.

From a technological point of view, the Neanderthals had a complex system of efficient technological options, where different operating systems coexisted. The main differences visible are in the application of the methods of knapping, dependent on the type of blanks and raw materials used, as well as the final product that was to be obtained. There appear

to be some aspects of cultural traditions that may have influenced the last Neanderthals, such as the use of the Quina method of knapping or Cleaver flakes, only present in the Cantabrian region, and absent in the Betic region during this period.

Cognitive ability appears to have had no effect on the subsistence practices of Neanderthals. Their foraging behaviour was a reflection of regional conditions and prey availability in each macro-bioclimatic region.

In both regions Neanderthals occupied areas with the most optimal living conditions, not just for them, but also for plants and animals. The two regions studied present a high biodiversity, a very varied assemblage of faunal species, ecotonal and mosaic landscapes with coastal, rivers, wetlands, and rocky habitats. This is reflected in the concentration of sites documented within both regions, becoming “hot spots” for Neanderthals.

During the great fluctuation and deterioration of the climate towards the end of the Neanderthal occupation, which produced a mosaic of environmental conditions and cultural mosaic situations, they had a high mobility and exploited locally available resources, showing their adaptive capabilities in adverse natural conditions. This high mobility could provoke a high fragmentation of their communities and a further combination of factors could have led to their extinction.

These factors, or chance, benefited one species, and not the other, and so today it is we who tell their story. We must be cautious in not inflicting our biases onto studies of Neanderthals, but instead try to understand them from their perspective. Neanderthals were a successful human species, with high cognitive capabilities, many of which can be described as modern, with many traits that show a humanity that cannot be dismissed by the scientific community today.

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