Tel-Aviv University
Faculty of Humanities
The Chaim Rosenberg School of Jewish Studies
Department of Archaeology and Ancient Near Eastern Cultures

Understanding the use of Quina scrapers at Middle Pleistocene Qesem Cave (Israel), and its implications for the study of the Quina phenomenon in the Levant and beyond

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by

Andrea Zupancich

Under the supervision of Prof. Avi Gopher, Prof. Ran Barkai and Prof. Cristina Lemorini

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Department of Archaeology and Ancient Near Eastern Cultures

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תשע"ט

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Introduction

Stone tools represent the largest and most direct source of behavioural clues relating to the Palaeolithic era and are the most enduring evidence of *hominin* evolution for at least the last 3.4 million years. Lithic artefacts can be defined as “*exosomatic objects that organisms use to manipulate energy, modify other materials from their natural state, and to insulate them-selves from environmental stresses*” (Shea 2017 pp 202). Given this definition, the analysis of stone tool technology and its use provides some of the most relevant insight into the lives of ancient humans. To this end the study of the technology and use of lithic implements represents a valuable opportunity to investigate behavioural and cognitive traits of Palaeolithic human groups, such as skill development, knowledge transmission and cultural behaviour, as well as the roles played by specific stone tools.

The research presented here focuses on the use of Quina and demi-Quina scrapers at the Late Lower Palaeolithic site of Qesem Cave, Israel. Proposing an innovative methodological approach combining techno-morpho-functional, use-wear and residue analyses, this work presents new data that enhances our current understanding of the *Quina phenomenon* at this site, specifically, and more generally in the region. In the Levant these tools, characterised by a specific scaled stepped (*écailleuses scalariforme*) retouch of their edge/s, are found exclusively in Acheulo-Yabrudian contexts and are absent from the preceding Acheulean and the subsequent Mousterian contexts of the region (Lemorini et al. 2015; Bourguignon 1997; Barkai and Gopher 2011, 2013). To date, only a few studies have focused on the technology of Acheulo Yabrudian Quina and demi-Quina scrapers (e.g. Shimelmitz et al. 2014), and no research investigating the use of these tools has been performed. This research represents the first attempt to focus on a detailed analysis of the function of Levantine Quina and demi-Quina scrapers, performed through an innovative combined methodological approach. The analyses presented in this work allowed for the gathering of new and detailed evidence regarding the technology, “life cycle” and use of these specific tools, and represents an invaluable opportunity to better understand the life and behaviours of the early human groups that occupied the Levantine region between 420,000 and 200,000 years ago. In order to obtain this data, the methodological approach applied in this research focused on the integration of techno-morpho-functional analysis (Lepot 1993; Bourguignon 1997) with use-wear and residue analyses (Lemorini et al. 2016; Rots 2010; Van Gijn 2010; Nunziante-Cesaro and Lemorini 2014). For the assessment of the activities and the materials processed by the Qesem cave inhabitants using Quina and demi-Quina scrapers, a dedicated experimental framework was designed and performed. This led to the creation of a use-wear reference collection that could then be compared with the observations made on the archaeological artefacts. The analysis of the entire Qesem cave assemblage allowed for the investigation of the use of Quina scrapers both from a diachronic point of view through the entire stratigraphic sequence, as well as from a synchronic point of view, underlining spatial differences in the use of the tools at this site. In order to provide a thorough and detailed overview of the "*Quina phenomenon*" both regional and chronological comparisons were conducted. The data regarding the use of Quina and demi-Quina scrapers at Qesem Cave was compared to the functional data from the analysis of two Middle Palaeolithic Western European Quina Mousterian contexts: Roc de Marsal (Level 2), located in France, and Cueva de El Esquilleu (Level XIII), located in Spain. Such a comparative analysis was of paramount importance given the fact that Quina and demi-Quina scrapers "*appear*" in Western Europe approximately 250,000 years ago, nearly 200,000 years later than in the Levant, and represent an important feature of the Mousterian techno-complexes of the Old World (Bourguignon 1997; Turq 2000). Applying the same methodological framework adopted for the analyses of the Levantine Quina assemblage allowed for the identification of existing affinities and/or differences in the use of the tools both from geographic and chronological poinst of view. Overall this research contributes to the understanding of ancient human behaviours by analysing the use and technology of curated tools (here Quina and demi-Quina scrapers), and provides useful evidence for the understanding of critical behavioural aspects such as technological skills and knowledge that characterise Middle Pleistocene early human groups.

The first Chapter (I) of this work is dedicated to a review of the current state of research concerning the Levantine Acheulo Yabrudian Cultural Complex and that of the Western European Quina Mousterian. Here the main characteristics concerning the Levantine AYCC are presented, with an overview of the history of research and a focus on the data concerning the production of Yabrudian Quina scrapers. This chapter also presents an overview of the Quina evidence from Western European Mousterian contexts, providing a summary of the information concerning the anthropological, geographical and environmental settings, along with a detailed description of the data currently available concerning the production and use of Quina scrapers.

The methodology applied in this research is presented in Chapter II. Here, details concerning the techno-morpho-functional approach and its application to the analysis of Quina scrapers are presented. Moreover, details concerning the observation at low and high magnification of the experimental and archaeological materials are provided, along with a description of the variables adopted in the interpretation of use wear on flint and quartzite. The application of residue analysis through Micro-FTIR, to which the archaeological sample from the Qesem Cave has been subjected, is here described with details concerning the adopted sampling strategy.

Chapter III is devoted to the experimental framework that was developed specifically for this research project. Here details concerning the experimental trials performed and applied to the use of Quina and demi-Quina scrapers are provided. The use of the tools in the processing of animal substances (e.g. hide, bone and meat) and vegetal materials (wood, plants and USOs) is described, along with details concerning the use wear associated with each of the activities performed and the substances processed.

The results that emerged from the analyses of the Quina and demi-Quina scraper assemblages from Qesem Cave, Roc de Marsal and Cueva de El Esquilleu are presented in Chapters IV and V. Chapter IV is dedicated to the Quina and demi-Quina assemblage of Qesem Cave. Here, a description of the site and its main characteristics is provided, followed by the data that emerged from the techno-morpho-functional analysis of the artefacts. A description and interpretation of the wear recognised on the Quina and demi-Quina scrapers is then presented, followed by a description of the organic and inorganic residues identified on the tools.

Chapter V focuses on the results from the analysis of two Western European Quina and demi-Quina samples from Roc de Marsal (Level 2) and from Cueva de El Esquilleu (Level XIII). Here the techno-morpho-functional characteristics of the scraper specimens are described along with a description and interpretation of their identified wear patterns.

Chapter VI is devoted to a general discussion of the results of this study. An overview of the techno-morpho-functional and use-wear analyses as they relate to each of the analysed samples is provided, followed by a comparison of the Qesem Cave samples with those from Roc de Marsal and Cueva de El Esquilleu within the framework of the techno-morpho-functional and use-wear data.

Chapter I

I.1 The Acheulo-Yabrudian Cultural Complex

The Acheulo-Yabrudian Cultural Complex (AYCC) of the Levant is an entity chronologically coinciding to the Lower to Middle Palaeolithic transition of the region (Ofer Bar-Yosef 1994; Barkai and Gopher 2011; Gopher and Barkai 2017).

So far, researches in AYCC contexts, and in particular at Qesem Cave, highlighted the emergence, in the Levant, of a set of relevant, innovative behaviours. These include a high degree of intra-group social interaction, as suggested by evidence of habitual use of fire, meat processing (roasting) (Barkai et al. 2017; Blasco et al. 2014; Stiner, Gopher, and Barkai 2011). A high degree of technical knowledge demonstrated by evidence regarding deep flint quarrying (Verri et al. 2005) and the exploitation of different flint sources (Wilson et al. 2015), flint and bone recycling (Venditti et al. 2019; Parush et al. 2015; Rosell et al. 2015), the systematic production of Quina scrapers and laminar items (Gopher et al. 2005; Lemorini et al. 2006; Zupancich et al. 2015, 2016; Lemorini et al. 2016; Shimelmitz, Barkai, and Gopher 2011) along with probable evidence of complex know-how transmission mechanisms (Assaf, Barkai, and Gopher 2017).

The term Acheulo Yabrudian was first defined by Rust (1950) to describe three different lithic industries – Yabrudian, Acheulo-Yabrudian and Pre-Aurigancian - preceding the Mousterian levels at the Site of Yabrud I, in Syria (Zaidner and Weinstein-Evron 2016). Rust (1950) described the three lithic entities as follows:

- **Yabrudian**: an industry dominated by scrapers made on thick blanks and bearing a scaled stepped (Quina) retouch and a low presence of handaxes.
- **Acheulo-Yabrudian**: an industry with many bifaces associated with scrapers.
- **Pre-Aurignacian**: an industry dominated by the production of laminar items.

Lithic assemblages bearing the same characteristics as the ones described by Rust at Yabrud I were found by Dorothy Garrod in Level E of Tabun Cave (Mount Carmel) (Garrod and Bate 1937; Zaidner and Weinstein-Evron 2016). At first, Garrod described the lithic assemblages from Level E of Tabun Cave as Upper Acheulean or Micoquian. However, the conspicuous number of scrapers found in Level E at Tabun lead Garrod to adopt Rust's terminology to describe the assemblages. Defining it as a regional phenomenon, Garrod later proposed the term Amudian, based on the blade dominated assemblage found at Zuttiyeh Cave in Wadi Amud, which she thought was somewhat different than Rust's Pre-Aurignacian blade dominated collections from Yabrud. Garrod and Rust agreed in associating the Yabrudian industry with Late Upper Acheulean groups, while the Pre-Aurignacian/Amudian was considered evidence of newly arrived populations. However, the results of the new excavations carried out by Jelinek at Tabun Cave Unit XIII-X (Garrod's Level E) led him to define the Acheulean, Yabrudian and Amudian as three *facies* belonging to a single cultural tradition – the Mugharan (Jelinek 1982; Jelinek 1981). New data coming from the analysis of lithic assemblages of other Acheulo Yabrudian contexts, including both Amudian and Yabrudian such as Qesem Cave, have raised the possibility that these are two spatially and functionally differentiated facies of the same entity (Barkai and Gopher 2013; Gopher et al. 2016; Shimelmitz et al. 2014).

Indeed, Jelinek found that at Tabun Cave Yabrudian scrapers and handaxes occur together, along with Amudian blades, not allowing a distinction of the three industries based on technology and tool type frequencies. At Qesem Cave, Amudian blades are found in Yabrudian assemblages, and Yabrudian scrapers occur in Amudian ones (Gopher & Barkai 2016; Barkai and Gopher 2013; Parush et al. 2014; Assaf et al. 2014 and reference therein), yet their frequencies differ. We, therefore, entertain the hypothesis that rather than being the result of cultural differences, the blanks and tool categories characterising Acheulo Yabrudian contexts are the result of a sophisticated toolkit reflecting the different activities performed by Acheulo-Yabrudian hominin groups.

From a geographical point of view, AYCC contexts are found in Syria, Lebanon and Israel including the sites of Tabun Cave, Yabrud I, Zuttiyeh Cave, Misliya Cave, Jamal Cave, El Masloukh, Abri

Zumofen, Bezez Cave and Qesem Cave (Fig. 1) (Jelinek 1982; Solecki and Solecki 1970; Bar-Yosef and Gisis 1974; Zaidner and Weinstein-Evron 2016; Zaidner et al. 2005; Gopher et al. 2005).

Site	**Chronology (kya)**	**Reference**
Tabun Cave	390– 270	Rink et al. (2004)
Qesem Cave	420 – 200	Falgueres et al (2016)
Yabrud I	256 - 200	Mercier & Valladas (1994)
Mislya Cave	273 – 243	Zaidner & Weinstein-Evron (2016)
Hummal	422 - 243	Le Tensorer et al (2007)
Jamal Cave	>225	Weinstein-Evron et al. (1999)
Zuttiyeh	>200	Bar-Yosef (1998)

Table 1. Chronology available for Acheulo Yabrudian

The results emerging from the dating of several Acheulo Yabrudian contexts (e.g. Qesem Cave, Tabun Cave and Misliya Cave) indicate the beginning of the AYCC in MIS 11 continuing through MIS 8 and possibly MIS 7. TL, ESR and U-Series dating suggests a time for the Acheulo Yabrudian between 330,000 to 250 - 220,000 years ago (Zaidner & Weinstein-Evron 2016). However, TL and ESR dates from Qesem cave, and Tabun Cave may suggest an earlier appearance of the AYCC at around 400,000 years ago (Mercier et al. 2013; Gopher et al. 2010; Falguères et al. 2016).

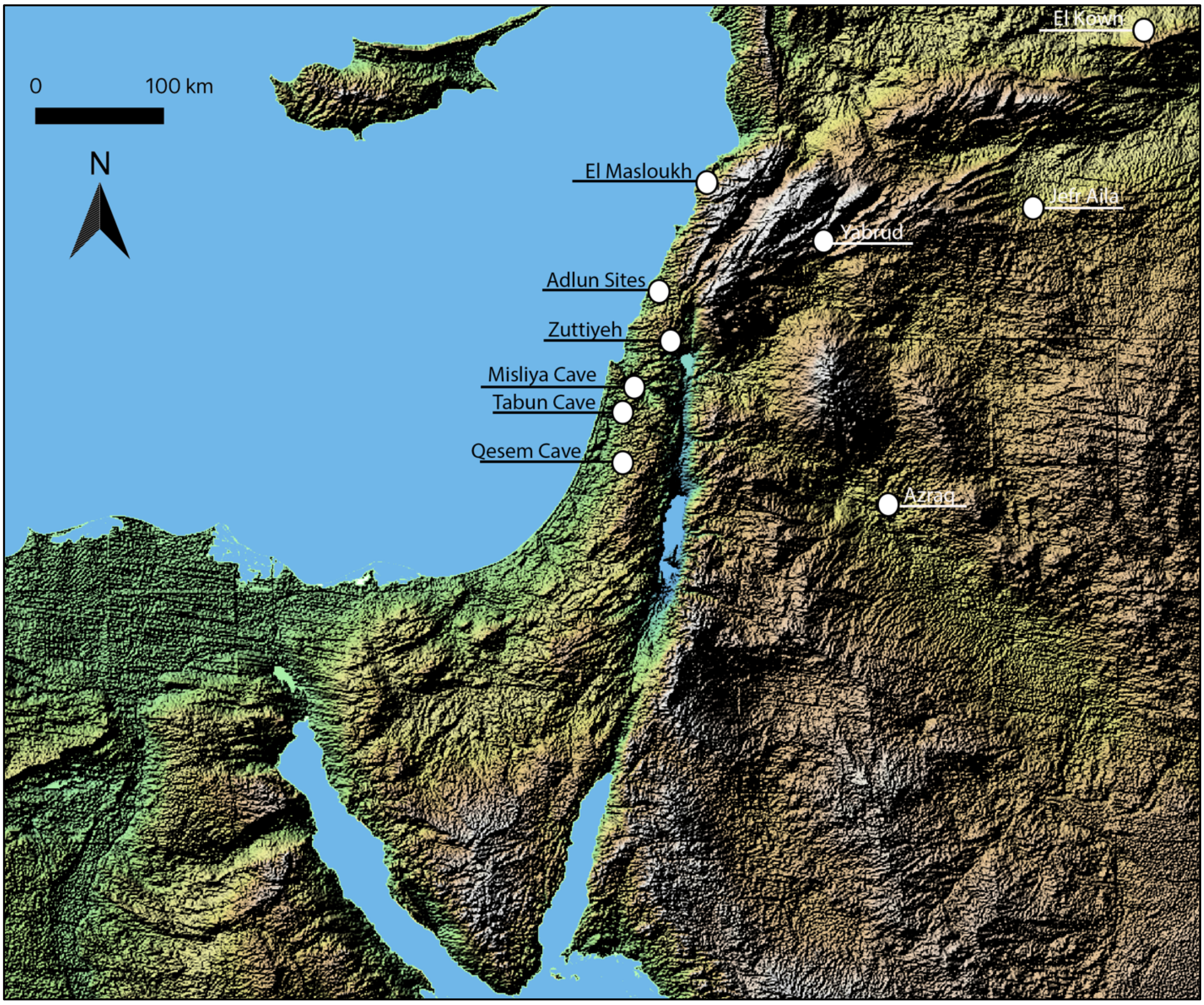

Figure 1. Distribution of Acheulo Yabrudian sites

I.2 Yabrudian Scrapers Production Strategies

Overall, the very high number of scrapers found in Yabrudian assemblages suggests the existence of technological organization and especially predetermined reduction strategies at least by 400,000 years ago (Shimelmitz et al. 2014; Shimelmitz, Barkai, and Gopher 2011). Although a detailed analysis of Yabrudian scraper blank technology is still missing for the majority of the known Acheulo Yabrudian contexts, as pointed out by Shimelmitz et al. (2014) and by Bourguignon (1997) a common reduction sequence can be suggested. To this matter, Shimelmitz and colleagues (2014) defined in detail the steps of the *chaine operatoire* associated with the production of scrapers at Tabun Cave (Israel). In the absence of a detailed technological study of other Acheulo-Yabrudian scraper assemblages (Qesem Cave included), the study of the Tabun Cave assemblage will serve as a base for presenting scrapers technology in this chapter. Analysing the scraper assemblages from three layers of Tabun

Cave (Beds J82BS, J83B1 and R63), a calculated and planned production emerges, even though not exhibiting the same complexity of later Levallois productions (Shimelmitz et al. 2014).

Regarding the production of scrapers, the majority of the implements from Tabun Cave are made on primary blanks, indicating a specific strategy of blank selection (Shimelmitz et al. 2014). Overall, at Tabun Cave and also at Qesem Cave (see chapter IV) patinated blanks were not usually selected for scrapers' production. A common characteristic observed on most of the Yabrudian scrapers is the high amount of cortex retained over the dorsal surface of the exploited blanks (Shimelmitz et al. 2014). This aspect, as suggested by Shimelmitz and colleagues and also by use-wear analysis (see Zupancich et al. 2015) indicates the preference of blanks more suitable for a freehand manipulation of the scrapers. Moreover, regarding blank morphology, generally, the largest specimens were selected to produce scrapers (Shimelmitz et al. 2014).

Regarding the production of scrapers, prime nodules were preferred, and hard hammers were utilised as suggested by the usual thick striking platforms characterising the blanks (Shimelmitz et al. 2014). Given the high frequency of scrapers made on cortical and lateral items, it seems clear that the production of blanks devoted to Yabrudian scrapers focused on the exploitation of both the internal mass and the outer surface of the nodule (Shimelmitz et al. 2014).

In terms of stages of reduction, a first step involves the removal of large cortical flakes which have two aims: to create scraper blanks and to shape the core for further production (Shimelmitz et al. 2014). The preferred area from which these first removals were detached corresponds to the broadest surface of the nodule following the concept of *debitage facial*. During this first stage of production, at least two completely cortical flakes were removed from the core, a first one forming the primary striking platform, and a second one leading to the creation of a *debitage* surface (Shimelmitz et al. 2014). Most of the primary element (PE) flakes exhibit laterally originating dorsal scars which indicate that during the detachments of successive flakes, the striking platform moved around the perimeter of core's broader surface (Shimelmitz et al. 2014).

To be able to produce large blanks which lead to the exploitation of a considerable amount of the core's surface areas, the debitage surface needs to be flat. As underlined by Shimelmitz and colleagues (2014) to remove such large blanks is essential to maintain a hierarchy between the core's surfaces, with the upper one used for production and the lower one as a striking platform, resulting in a core characterised by two surfaces with a plane of intersection between them (Shimelmitz et al. 2014).

Following this first phase of blank production, the second stage of reduction focuses on the exploitation of the lateral and central edges of the core surface. These were obtained by striking the inner portion of the surface (Shimelmitz et al. 2014). Contrary to what is observed in Amudian blade production, where the manufacture of overpassing blanks is intentional, in the case of scraper's blank production, this behaviour is not recorded, as indicated by the majority of flat or convex ventral surfaces characterising Yabrudian scrapers. This aspect may coincide with the use of the scrapers in scraping activities, in which a convex or at least flat ventral surface allows better contact between the tool and the worked substance (see Lemorini et al. 2015), contrary to a concave one.

On the other hand, hinged terminating scars are commonly exploited in the production of Yabrudian scrapers. As suggested by Shimelmitz et al. (2014) and again, according to the evidence of prehension wear found on Acheulo Yabrudian Quina scrapers (Zupancich et al. 2015) this aspect may indicate an intentional choice for creating blanks with morphological characteristics suitable for a hand-held manipulation of the tools. The production of hinged terminating blanks involves the continuous rotation of the striking platform location, a solution which will allow cleaning away the hinges related to previous removals (Shimelmitz et al. 2014). To this matter, in the case of Yabrudian scrapers blank production at Tabun Cave, the rotation was performed clockwise as indicated by the left orientation of all the lateral items (Shimelmitz et al. 2014). Regarding core manipulation during blank production, it is probable that to maximise the production of cortical blanks, this was frequently flipped, with the sequential (as opposed to a simultaneous) working of the surfaces (Shimelmitz et al.

2014). Finally, the main characteristics of Yabrudian assemblage are the high frequency of retouched implements. In the case of scrapers, Quina retouch is the most commonly recorded edge retouch type. Overall, although the information concerning the production of Yabrudian scrapers is meagre, several points can be highlighted. Within these, the most relevant is the existence of a certain degree of planning and predetermination characterising the production of Yabrudian scraper blanks. Such predetermination can be viewed as evidence of both high cognitive capabilities and complex mobility patterns hinting towards calculated strategies of resource exploitation and thus a good knowledge of the surrounding environment.

It is important to highlight the fact that similar patterns of predetermination are present in the reduction strategies concerning Quina scrapers in Western Europe. As pointed out by Meignen et al. (2009) and as it will be further discussed in this chapter, both Levantine Yabrudian scraper production and that of the Middle Palaeolithic Western European Quina exhibit a low degree of blank pre-shaping. On the contrary, the edge of the tool is highly retouched to achieve the desired tool shape (Shimelmitz et al. 2014), a characteristic not identified in the Levallois production of both the Levant and Western Europe.

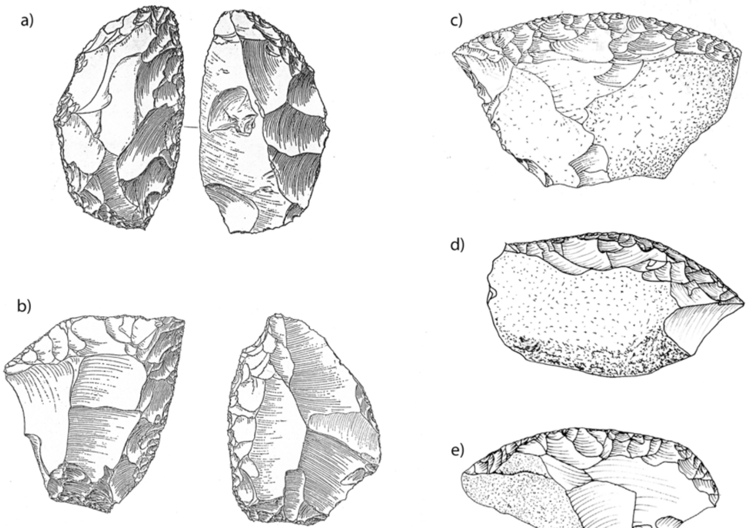

Figure 2. Examples of Yabrudian scrapers coming from. a,b) Yabrud I (from Rust 1950); c) Oumm et Tlell (from Rust 1950); d) Tabun Cave Level E (from Shimelmitz et al. 2014); e) Mislya Cave (from Zaidner & Weinstein-Evron 2016).

I.3 The European Quina Mousterian

To define a specific lithic industry dominated by *"thick transversal and convex scrapers"*, first found at the site of La Quina in the Charente region of South West France, Bordes and Bourgon (1951) introduced the term *Charentien*. At first, given the assemblage characteristics, the Charentien was described as a cultural entity differing from the Mousterian. However, following the discovery and analysis of other similar contexts, Bourgon (1957) started to refer to the Charentien as a specific aspect of the Middle Palaeolithic Mousterian: namely the Quina Mousterian. One of the particular features observable on Quina contexts is the very high percentage of scrapers within the assemblage composition. Along with this, Bordes (1981) included among the main characteristics of Quina contexts:

- absence of bifaces
- low presence of Levallois implements
- presence of a particular kind of scraper, namely **Quina scraper**, characterised by a specific scaled-stepped (*ècailleuse scalariforme*) edge retouch.

Since the first description of the Charentien made by Bordes and Bourgon in 1951, numerous works - e.g. (Bourguignon 1997; Turq 200, 1985; Dibble 1985) - focused on the analysis of Quina Mousterian contexts, strengthening its definition as specific *facies* of the European Middle Palaeolithic. Of particular importance regarding this matter are the works of L. Bourguingnon (1997) and A. Turq (1989, 1992) on the technological strategies adopted in the production of Quina implements. Through the analysis of the knapping sequence and fracture patterns observed within Quina lithic assemblages, Bourguignon (1997) and Turq (2000) described in details the variations in Quina core reduction strategies. They underline a specific logic of volumetric production aimed at the creation of thick flakes, with large striking platforms and a substantial amount of cortex over their dorsal surface. From a palaeoanthropological perspective, most of the available evidence came from France, where, so far, only Neanderthal remains have been found in association with Quina contexts. These include among the others: La Quina, la Chapelle aux Saints, Combe Grenal, Marillac, Pech de l'Aze. Neanderthal remains have also been found in other European Quina contexts such as Cova Negra (Spain). This continuous and specific association of Neanderthal groups and European Quina Mousterian evidence allows defining this phenomenon as one particular technological entity (Bourguignon 1997).

I.3.1 Palaeoenvironment and Chronology

From a paleoenvironmental perspective, in France, the Quina Mousterian is associated with a cold environment with steppe-like vegetation dominated by reindeer, bison and horses (Bourguignon 1997; Discamps, Jaubert, and Bachellerie 2011; Castel et al. 2017). However, in other areas where Quina Mousterian evidence have been recorded, for instance in Spain and Italy, the paleoenvironmental setting seems to be slightly different (Bourguignon 1997; Peresani 2012; Jéquier et al. 2015; Baena et al. 2012). These areas were somewhat warmer and more temperate in climate and thus associate with faunal assemblages dominated by roe deer and wild boar (Bourguignon 1997; Baena et al. 2012). Concerning the chronology of the Quina Mousterian in Western Europe, the wealthiest amount of information comes from South Western France contexts. Recently, new dates were obtained from the site of La Quina Amont (Frouin et al. 2017). Through the application of different Thermoluminescence (TL) based techniques as well as OSL, IR-IRSL and IRSL, Frouin and colleagues (2017) were able to provide new dates regarding the human occupation at the site, which they claim to have spanned for at least 20,0000 years. The Quina occupation levels at the site are dated from the end of MIS 4 to the beginning of MIS 3. The new dates obtained by Frouin et al. (2017) along with the dating of other relevant Quina Mousterian contexts allow defining the time-span of this techno complex, with its earliest evidence dated to MIS 4 (ca 75.000 years ago) and its latest one dated to MIS 3 (40-38.000 years ago).

I.3.2 Geographical Distribution

Quina complexes have been identified in Western and Central European regions as well as in the Near East, indicating a very large spatial distribution. Most of the Quina contexts so far recorded are located in France. In particular, its South-Western area exhibits the highest density of Quina sites with the Charente and Aquitaine regions being the richer areas in terms of Quina evidence. Other French parts in which Quina Mousterian contexts have been identified include the eastern area of the Languedoc region and the eastern regions of the Massif Central area. On the other hand, Quina evidence is absent in the north of France, and in the Paris basin (Bourguignon 1997; Lebègue and Meignen 2014; Claud et al. 2012). Other than France, a conspicuous amount of Quina Mousterian contexts have been identified in Spain. Most of the data recorded come from the North (Basque Country and Cantabria), East (Cataluña) and the Mediterranean area of the Iberian Peninsula (Bourguinon 1997; Baena et al. 2012) (Fig. 3).

Moving towards Central and East Europe, several Quina contexts have been identified in North-East and Central Italy, Greece and the Balkan region (Bourguignon 1997; Jéquier et al. 2015; Mihailovic 2014).

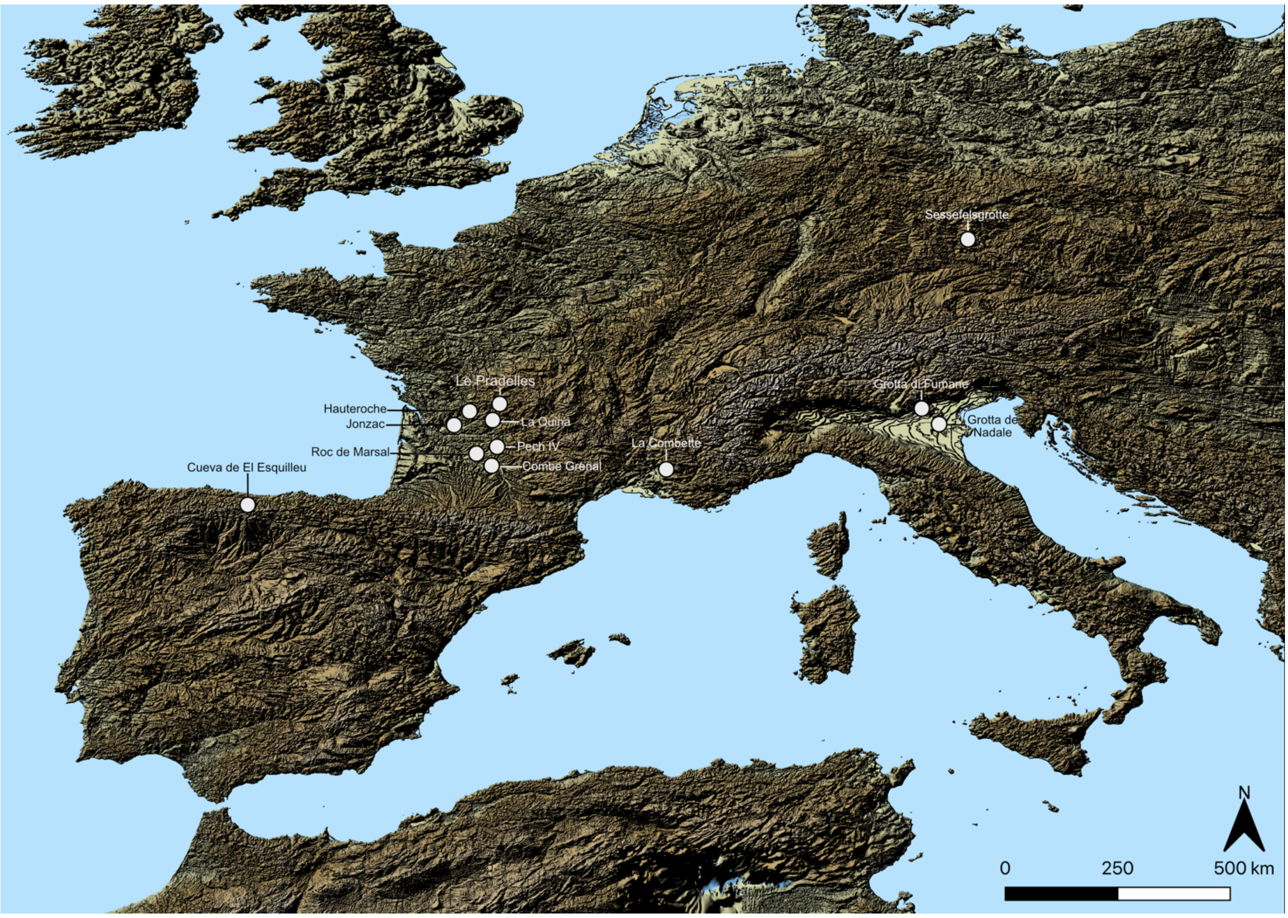

Figure 3. Map showing the localisation of the most representative Quina contexts in Western Europe

I.3.4 Quina Scraper Production Strategies

Quina core reduction strategies often referred to as “Clactonian”, are aimed at the production of blanks characterised by specific morphological features. The obtained flakes are large and thick, featuring an asymmetrical cross-section and a decent amount of cortex often retained over their dorsal surface (Bourguignon 1997; Lemorini et al. 2016; Turq 2000, 1985; Adams and Blades 2009; Hiscock and Clarkson 2015). The regularity in the production of blanks with such specific features indicates the existence of different systems of core reduction, which, as demonstrated by the works of Bourguignon (1997) and Turq (2000), changed based on the raw material morphology. Analysing the actions, the pattern of fractures, hammerstone selection and use, Bourguignon (1997) suggests that Quina core reduction *“obeys a specific logic of volumetric production”* (Hiscock et al. 2009 pp. 236) leading to products resembling Clactonian systems of core reduction (Ashton 1998; 2000), trifacial systems (Boëda 1991, 2013) and *systéme par surface de débitage alternée (SSDA)* (Forestier 2009).

The works of Turq (1988, 1989,1992, 2000) focusing on the variation of Quina core reduction identified at the French site of Roc de Marsal highlighted the existence of three primary strategies (Fig.4), namely:

- *"tranche de saucisson"*
- "*cortical backed strategy"*
- *"covering strategy"*

The **tranche de saucisson or "salami-slicing"** strategy consists of the application of a series of powerful blows at the centre of the natural surface of the block, to remove a series of parallel flakes which, progressively truncate one end of the nodule. The flakes thus obtained are large and thick with cortical striking platforms and steep cortical edges.

The **cortical backed strategy** involves the application of blows on the nodule's natural surface, not on its centre but towards one of the margins of the block. The resulting flakes are large, thick, with an asymmetrical cross-section and one steep cortical edge.

The **covering strategy** involves the "stripping" of the cortex from the platform and the core surface removing large flakes along the nodule length and across its end. This primary step is followed by blows applied down the ridges originated by the junction of cortical and flaked surfaces. The flakes obtained are large and thick, most of the times asymmetrical, with a cortical margin and a typical "conchoidal platform".

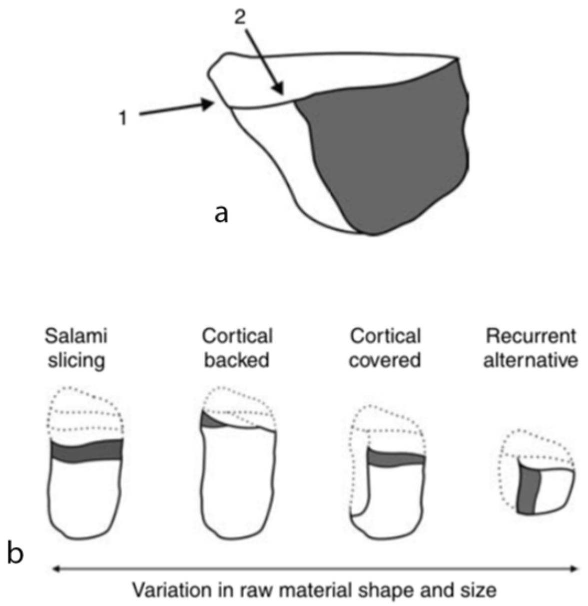

Figure 4. Quina reduction strategies proposed by Turq. Following Turq (2000).

A fourth reduction strategy has been identified by Bourguignon (1997). It consists of the alternate detaching of flakes from two or three platforms. Such a system is particularly suited for equidimensional blocks, which allow maintaining a similar core morphology during the whole reduction process. The obtained flakes are large and thick with cortex retained on one lateral margin or their distal area. Two approaches have been identified within Quina industries in the production of large flake blanks:

- Kombewa technique: striking the proximal end of the flake to remove a blank exhibiting the bulb of the original flake on its dorsal surface. Generally, the flakes obtained are asymmetrical in their longitudinal rather than their transversal cross-section. Turq (1989) highlighted the preference of this strategy over the others at the site of Combe Grenal, where an irregular morphology characterised the exploited raw material.
- Notching of a scraper edges: Such an approach leads to the production of flakes with a very sharp unretouched edge and a prehensive area corresponding to the old edge of the exploited Quina scraper (Bourguignon 1997; Zupancich et al. 2015; Lemorini et al. 2016).

According to Bourguignon and colleagues (2004) these strategies represent an example of *"ramification"*. In a ramified production system, there are not only multiple strategies of production but also recursion of operations at several stages of the production history or of the tool life cycle. Thus, blanks used to produce tools come from cores, and tools themselves become cores at a certain point of their life cycle.

Overall, Quina reduction strategies were highly efficient, according to Turq (1992), given the fact that Quina productions yielded at least between twice or six times more suitable blanks than the Levallois technique. Indeed, in Quina production strategies, there are no intensive phases of core preparation to allow successive removals of blanks (Turq 1985; Hiscock et al. 2009). Furthermore, another relevant aspect is the very high frequency, within Quina assemblages, of retouched items, indicating a high rate of core mass transformed into tool mass.

I.3.5 The Quina Retouch

Quina lithic assemblages are dominated by retouched implements, mostly single-edged scrapers, exhibiting a specific type of scalar stepped edge by a retouch defined as "*écailleuse scalariforme*" (Bordes 1961; Bourguignon 1997; Turq 2000) (Fig. 5). Such retouch is obtained by blows applied on the ventral surface of the tool, which results in regular invasive scars characterised by a hinge termination. Shorter, later scars with a step termination are superimposed to these creating the typical pattern made of "lines of retouch" characterising a Quina scraper's edge profile (Bourguignon 1997; Adams and Blades 2009; Pagli 2009) (Fig.6).

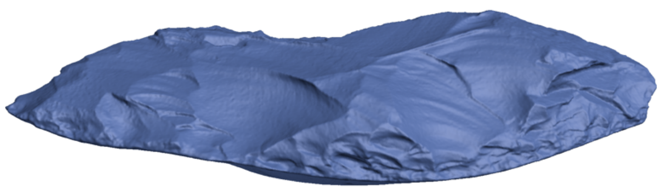

Figure 5. Example of Quina Retouch

Numerous works have focused on the Quina retouch, the first of which was proposed by Bordes (1961), who suggested a direct percussion using a soft hammer. Bordes (1961) highlighted the high efficiency of hammerstones made of organic material (e.g. wood, antler, bone). Moreover, he also suggested the use of a specific portion of the hammerstone, the inner one, to produce this particular retouch.

Bordes' definition lacks a specific aspect concerning the production of Quina retouch: the description of the sequence of gestures involved in obtaining the typical "lines" of retouch characterising Quina scrapers. M. Lenoir (1973), other than proposing the exploitation of hard hammers for the production of Quina retouch, has been the first to suggest the existence of a *"cycle d'aménagement"* comprising different stages of retouch characterising the life cycle of a Quina scraper (Bourguignon 1997).

To this matter, the works of Boëda and Vincent (1990) and Bourguignon (1997, 2001) are of paramount importance as they provide a detailed description of the gestures involved in the production and management of a Quina scraper edge along with an analysis of the use of both soft and hard hammerstones. From these studies, it emerged that both types of hammerstones are extremely suitable in the production and *aménagement* of Quina edges. Little differences have been identified in the edge delineation, which comes out neater and more regular when a soft hammerstone is used. On the other hand, a harder hammerstone is much more durable than a softer one (bone), which tends to fracture and break much more frequently (Bourguignon 1997).

Going into more details with her experimental work, Bourguinon (2001) describes the hammerstones mechanical properties and the gestures involved in the production and maintenance of a Quina scraper edge, suggesting three different gestures involved in the creation of a scaled-steppe retouch:

1) Curved Trajectory. An ample half-circle movement applied during the first stages of the retouch production to produce convex and flat detachments. A soft hammerstone (wood, animal material and soft stone) may be used.
2) Rectilinear Trajectory: Consists of almost horizontal movement perpendicular to the striking platform which results in the production of “encoche-like” detachments. Hammerstone made of soft and hard stone may be employed.
3) Shifting Trajectory: A movement combining two trajectories. A first curved movement followed, after the impact, by a retracting one going towards the knapper and leading to the production of concave detachments. Both soft and hard hammerstone may be used.

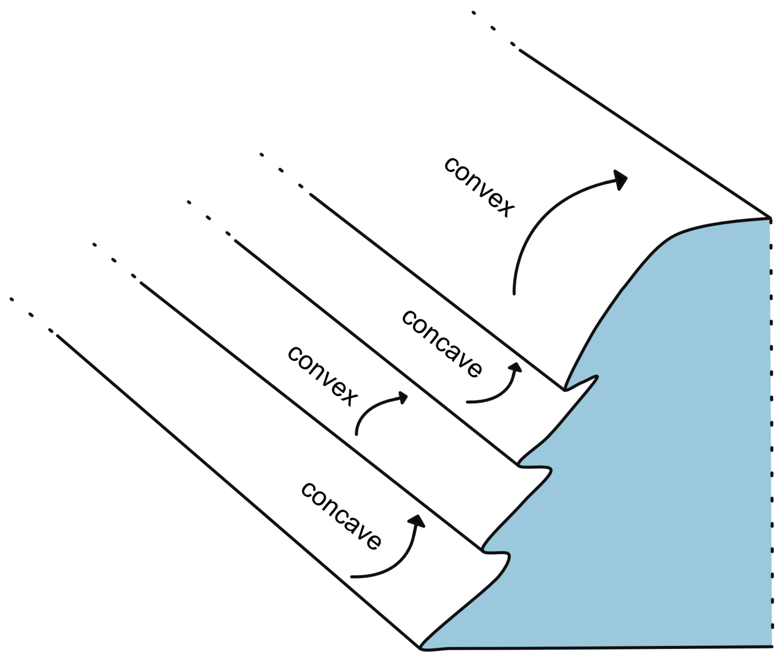

Figure 6. The succession of convexities and concavities characterising a Quina edge

According to Bourguignon (2001), each of the described movements corresponds not only to a specific stage of Quina retouch manufacturing but also to by-products (removals) (Fig. 7) exhibiting distinct morphological features (Tab. 2). In this regard, several use-wear studies (Claud et al. 2012) suggested that, in the case of detachment type 3, 4 and 5, these may be exploited as tools.

	Convex Detachments	Concave Detachments	Clactonian Detachments
Type	0 and 3	1 and 2	4 and 5
Profile	Convex	Concave	Convex
Previous Detachments	No (0) - Yes (3)	No (1) - Yes (2)	Yes
Stage of Quina Retouch	Initial (0) - Advanced (3)	Initial	Advanced
Hammerstone	Soft	Soft or Soft Stone	Hard
Dimension	Large	Small	Large

Table 2. Features of Quina retouch and resharpening flakes as described by Bourguignon (2001)

Figure 7. Reaffutage Classification after Bourguignon (1997, 2001)

I.3.6 The Use of Quina Scrapers

From a techno-morpho functional point of view, the high functional potentials of Quina scrapers has been stressed by numerous authors (e.g. Bourguignon 1997; Turq 2000; Hisckock et al. 2009). However, only several studies focused on the use of Quina scrapers through the application use wear and residues analysis. According to Lemorini (2000), the Quina implements from the site of La Combette (France) were mostly used to process hide through scraping along with wood and animal materials processing. Hardy (2004) analysed the use of Quina implements at the French site of La Quina, where he found the majority of analysed specimens to be used in a variety of activities involving wood, bone/antler and animal material processing. Residues, in particular concerning plants, were also identified and interpreted as soft wood (*gymnosperm*) (Hardy 2004). Finally, the use of Quina scrapers from the site of Chez-Pinaud was analysed by Claud and colleagues (2012) with very interesting results. The majority of activities performed involved longitudinal motions performed to process soft or medium-soft materials. Transversal activities were performed as well on both fresh and dry hide. Moreover, percussion activities have been identified as well and interpreted as both organic and mineral processing (Claud et al. 2012). All of the studies mentioned above allow to speculate regarding a multifunctional character of Quina scrapers, which were used to process hide at different stages - fresh and dry - through scraping activities, but also to work animal and vegetal materials mostly through longitudinal motions.

Chapter II - Research Methods

The methodological approach adopted in this research allowed to investigate in details various aspects related to the function of Quina and demi-Quina scrapers associated with the Levantine Acheulo Yabrudian and the Western European Middle Palaeolithic. The technological analysis of the lithic assemblages subject of this research is performed through the application of a techno-morpho functional approach. The use of the studied tools was investigated through use-wear analysis, through the application of both low and high-power approaches. Both use and prehension/hafting wear were taken into consideration, providing a detailed picture of the use of these specific tools. Furthermore, given the excellent preservation of the scraper assemblage of Qesem Cave, residues analysis has been performed as well. To this end, micro Fourier Transform-Infra Red spectroscopy (Micro FT-IR) was applied to identify preserved organic and inorganic residues to provide further insights related to the use of these tools at the site.

II.1 The Techno Morpho Functional Approach

Quina and demi-Quina scrapers are often characterised by long life cycles characterised by numerous edge re-sharpening episodes which may sometimes coincide with a change of use of the tool (Bourguignon 1997; Lemorini et al. 2016; Pagli 2009). For this reason, it is essential to analyse in details the techno morphological characteristics of both the portion of the tool in contact with the processed material and its prehensive area, as proposed by the techno morpho-functional analysis (Lepot 1993; Bourguignon 1997). This approach relies on the concept that a tool is to be intended as a transmission medium of energy and between the user and the processed material, allowing to satisfy the needs of the former through the transformation of the latter. According to the concept proposed by Lepot (1993), the tool becomes a system composed by a set of technological functional units (henceforth referred as TFU), which allow the tool to be useful during its use. A TFU is a specific area of the object characterised by distinct and homogeneous functional capabilities (Donnart 2010; Eric Boëda 2013; Bourguignon 1997). Lepot (1993) identifies three types of techno functional units:

1) Transformative techno functional unit (***UTF de contact transformatif***)

2) Prehensive techno functional unit (***UTF de contact préhensif***)

3) Energy receptive techno functional unit (***UTF réceptif de l'énergie***)

- *Transformative Techno Functional Unit*: corresponds to the **active part of the tool, which is in direct contact with the worked material.**
- *Prehensive Techno Functional Unit*: **corresponds to the area of the tool dedicated to its prehension or hafting.**
- *Energy Receptive Techno Functional Unit*: is the **portion of the tool which receives the energy transmitted by the user.**

As pointed out by Soriano (2001) and Boëda (2001), the third type of TFU can be confused with the former prehensive TFU, in particular in the case of objects used freehand. In this case, to avoid confusion, the two TFUs can be merged and referred to as the prehensive/receptive TFU. A given object is composed at least by a couple of TFUs, a transformative and a prehensive/receptive one. Generally, a couple of TFUs are created during the early phases of production of the tool; it is not unusual that several successive TFUs can be produced during the tool's life cycle (e.g. edge re-sharpening) and may superimpose the previously existing ones (Boëda 2001; Soriano 2001). The application of this allows analysing in detail each of the technological features characterising a tool and provide relevant insights related to its intended use.

II.1.2 The application of a Techno Morpho Functional Approach to the study of Quina and demi-Quina scrapers

The techno-morphological features of the Quina and demi-Quina scrapers that are the subject of this research have been analysed through a techno morpho-functional approach. In this way, it was possible to obtain detailed data related to the technological choices leading to the modelling of both the potential active and prehensive areas of the tools (Lemorini et al. 2016). Each of the Quina and demi-Quina Scrapers composing the studied assemblages have been assigned to one of five groups (Fig. 8), three Quina and two demi-Quina, proposed by Bourguignon (1997) and defined as follows:

• <u>Group I</u>. Includes Quina and demi-Quina scrapers characterised by the presence of Clactonian notches or other kinds of detachments on one or both their faces, which modify the overall morphology of the tool's active area (Bourguignon 1997; Lemorini et al. 2016). The aims of these detachments serve to alter the scraper's edge morphology creating a new TFU (transformative or prehensive) with new techno-functional characteristics, or indicate the turning of the scraper into a core (Bourguignon 1997; Lemorini et al. 2016).

• <u>Group II</u>. The Quina scrapers in this group are characterised by multiple long cycles of scalar stepped retouch over their whole active area. These tools exhibit a series of complete Quina retouch cycles on their edge, retaining an entire Quina retouching sequence (Bourguignon 1997; Lemorini et al. 2016).

• <u>Group III</u>. Quina scrapers characterised by short or single scalar stepped retouch cycle are included in this group. These tools exhibit at least one complete Quina retouch cycle on their entire active area (Bourguignon 1997; Lemorini et al. 2016).

• <u>Group IV</u>. This group includes the first type of demi-Quina scrapers, mostly made on thinner blanks when compared to the Quina scrapers. These are characterised by a lightly stepped retouch on their edge/s. The scalar stepped Quina retouch is not present on the entire edge, but only on the area corresponding to the thicker portion of the blank (Bourguignon 1997; Lemorini et al. 2016).

• Group V. This group includes the second type of demi-Quina scrapers. As in the case of group IV, these tools are made on thin blanks. However, they are characterised by a more scalar retouch than the former along with a heavier retouch of their edge (Bourguignon 1997; Lemorini et al. 2016).

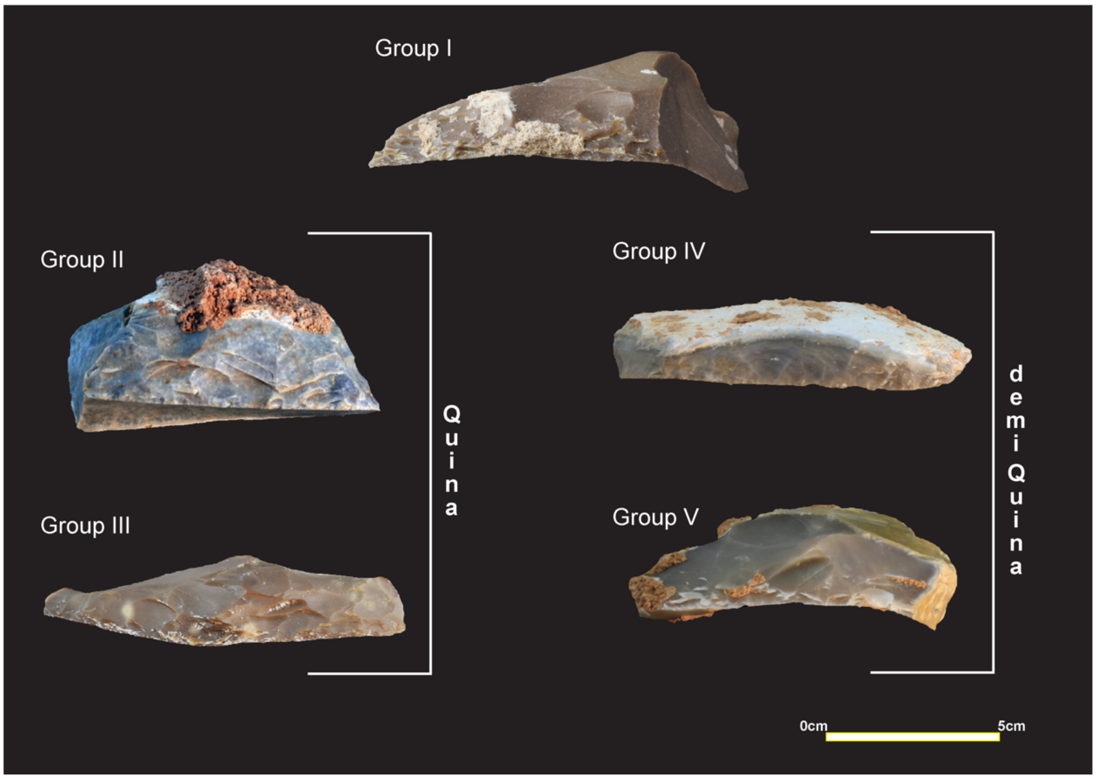

Figure 8. Quina and demi-Quina groups from Qesem Cave, as defined by Bourguignon (1997)

II.1.3 Techno-morphological description of the active areas of Quina and demi-Quina scrapers.

The transformative TFU, corresponding to the active edge of the tools analysed in this research, have been analysed in detail given their relevance in the investigation of the life cycles of Quina and demi-Quina scrapers. The techno morphological analysis of the active areas of Quina and demi-Quina scrapers starts with the description of the edge delineation in plan, its delineation in section and its cross-section **(Tab.3).**

Edge Morphological Analysis

Delineation in plan	Straight; Convex; Concave; Irregular
Delineation in section (profile)	Straight; Convex; Concave; Irregular
Cross-section	Straight-Straight, Straight-Convex, Straight-Concave, Convex-Convex, Concave-Concave, Convex-Concave

Table 3. Edge descriptive features

The retouch affecting the edge of the tool is described based on its morphology, position, extent, delineation and localisation on the tool's edge according to the variables proposed by Inizan et al. (1995) as can be seen in table 4.

Edge Retouch Analysis	
Morphology	Parallel; Sub-Parallel; Scaled; Stepped; Scale-Stepped
Delineation	Rectilinear; Concave; Convex; Irregular
Extent	Along the edge' Invasive; Covering
Localisation	Entire edge; Proximal; Mesial; Ventral
Position	Direct; Inverse; Alternate; Bifacial; Crossed

Table 4. Edge retouch descriptive features

Given the peculiar morphology of a Quina scraper's edge, the use of a goniometer to measure the edge angle appeared inconvenient. Indeed, the overall high thickness of the edge affects its measuring, resulting in an altered edge angle value, not related to the actual portion of the edge that comes in contact with the worked material. To overcome this issue, the measure of the edge angle of Quina and demi-Quina scrapers required the application of a specific measuring technique proposed by Dibble and Bernard (1980) and referred by the authors as the "calliper method"(Dibble and Bernard 1980). Through this method, it is possible to compute the edge angle, starting from a thickness measurement taken at a known distance from the edge[1]. Knowing the thickness and the constant value of the distance from the edge, the edge angle value is calculated through the application of a trigonometric equation as follows:

$$\theta = 2\left[\mathrm{Tan}^{-1}\left(\frac{.5T}{D}\right)\right]$$

θ refers to the unknown edge angle, while **D** is the known constant distance between the edge and the point in which the thickness (**T**) is measured (Dibble and Bernard 1980). Through this method, it is possible to obtain the measure of the exact portion of the edge coming in contact with the worked material during the use of the tool.

II.2 Use Wear Analysis

During the early 19th century hypotheses related to the use of ancient tools were based on the ethnographic comparison with the tools used by preindustrial human groups (e.g. Nilsson 1840; Vaughan 1983). At the beginning of the 20th century, traceology as a discipline was introduced thanks to the pioneering work of S.A. Semenov, who was the first to develop a discipline based upon the microscopic analysis of use traces on ancient artefacts. Semenov's work was the first of its kind, centred on the application of systematic experiments and the comparison at high magnification of experimental and archaeological wear. Such an approach allowed for the first time to investigate the activities performed and the materials worked by ancient artefacts. A boost in the development of use-wear analysis happened after the English translation of Semenov's masterpiece "Prehistoric Technology" in 1964, which allowed the discipline to spread and develop through Western Europe and the United States. In 1974 Tringham and colleagues introduced the Low-Power Approach based on the observation of the sample at low magnifications (up to 80x) utilising a stereo microscope. The type of wear identifiable through this approach is defined as edge damage or macro wear. It comprises flaking, micro flaking and edge rounding, which allow determining the motion of use and the hardness of the worked material (Tringham et al. 1974; Odell 1981; Van Gijn 2010). Parallel to Tringham's approach, Lawrence Keeley (1980) introduced the High-Power Approach, which is based on the analysis of the sample at high magnifications (ranging between 100-500x), using a metallographic microscope. The application of a High-Power Approach permits to identify micro-wear, as polish, abrasions and micro striations, allowing to obtain detailed information regarding the activities and the worked material (Van Gijn 2010). Moreover, the adoption of Scanning Electron Microscope (SEM) capable of magnification up to 5000X in use wear-related studies, lead use-wear analysts to achieve a further level of detail in the study of ancient artefacts use. In particular, regarding the analysis of highly reflective materials, materials with a coarse and non-homogeneous surface, and the identification of preserved organic and inorganic residues (Ollé and Vergès 2008, 2014; Ollé et al. 2016; Pedergnana and Ollé 2017; Conte et al. 2015; Lombard and Wadley 2007).

II.2.1 Use Wear Description and Interpretation

To identify and interpret both the edge damage and microwear affecting the artefacts analysed in this research, both Low and High-Power Approaches were applied. A preliminary evaluation of the state of preservation of the materials, along with the analysis of the edge damage affecting the artefacts was performed through the use of a Zeiss Discovery V20 in reflected light conditions, equipped with 10X oculars and a 1X objective, providing a zoom range from 0.75 up to 7.5X. Microwear instead were identified and described using a Zeiss AxioScope A1 metallographic microscope in reflected light conditions equipped with 10X ocular and 10X, 20X and 50X objectives, allowing a magnification range of 100X up to 500X. Microphotographs of edge damage and microwear were taken utilising a Zeiss Axiocam 305 colour. The analysis of artefacts made of high reflective non-flint raw materials (quartzite) was performed with the aid of a Hitachi TM3000-Tabletop Scanning Electron Microscope equipped with a SWIFT ED3000 EDS Probe. When a direct observation of the samples was not possible due to the absence of a metallographic microscope in the collections housing structures, as in the case of the scrapers from Roc de Marsal and Cueva de El Esquilleu, high-resolution silicone casts of the edges were made utilising Provil Novo® Light Fast (Banks and Kay 2003; Pedergnana and Ollé 2017).

II.2.1.2 Edge Damage Analysis

Wear defined as edge damage or macro wear consists of edge scarring and edge rounding **(Fig. 10b)** (Tringham et al. 1974; Odell 1981; Hayden 1979). The morphology of the scars generated by use provides significant clues related to the hardness of the worked material (Van Gijn 2010). The two morphological features characterising use-derived scars are their initial and terminal parts (i.e.

initiation and termination). The description of these two features is based on the variables (HoHo Classification) proposed in 1979 during the Burnaby Conference in Canada (Hayden 1979) **(Tab. 5)**. Other relevant features concerning edge damage are their orientation and localisation over the tool's edge, which provide information concerning the motion of use (Tringham et al. 1974) **(Tab. 5)**. Other characteristics include their distribution and dimensions, useful in the overall functional interpretation of the artefacts. On the other hand, edge rounding is defined based on its degree, which is defined as high, medium or low.

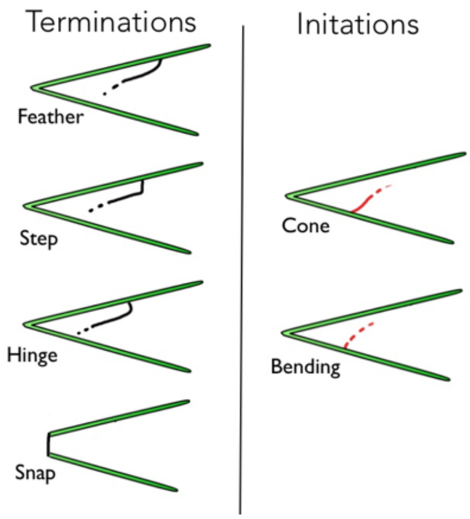

Figure 9.Terminations and Initiations morphologies (modified from the HoHo Classification and Nomenclature Committee Report).

II.2.1.3 Micro Wear Analysis

Polish, abrasion, striations and micro rounding are defined as microwear. The morphological features characterising these micro wears allows describing in detail the worked material and the activity performed with the tool (Keeley 1980; Van Gijn 2010; Vaughan 1985).

Polish

"*Polish refers to an altered zone on a stone tool which is visible as a shiner or rougher area in comparison with the surrounding surface*" (Rots 2010 pp. 32) (Fig.10a). The formation and development of polish is an issue still discussed and addressed in use-wear studies

(Anderson-Gerfaud 1981; Mansur Franchomme 1983; Mansur-Franchomme 1983; Unger - Hamilton 1984; Vaughan 1985; Plisson and Mauger 1988; Fullagar 1990; Hurcombe 1992; Yamada 1993; Christensen et al. 1998; Lerner et al. 2007). Several models have been proposed to explain polish formation. Andreson-Gerfaud in 1981 was one of the first to investigate the issue, defining polish development as essentially a tribological phenomenon (abrasion). Anderson-Gerfaud (1981), as already acknowledged by Del Bene (1979), noted the formation of silica gel on the tool's surface during its use defining this latter as the leading cause of polish formation. Several other hypotheses concerning polish development have been proposed since the silica gel theory. Levi-Sala (1993,1996) argue that surface asperities are removed during use and lead to the polishing of the flint surface. A depositional model has been proposed by Christensen (1998), which through the use of SEM and energy dispersed X-ray spectrometer she was able to record the accumulation of worked materials particles within the spaces present on the flint surface during tool use. Polish formation and development are still an open issue, and so far, a definitive explanation has not been given yet. However, it is clear that during its use flint is subject to a combination of both depositional factors and mechanical abrasions, which determine the formation of polish (Fullagar L.K. 1990; Mansur-Franchomme 1983; Hurcombe 1992). Polish is described according to several morphological characteristics, which vary based on the worked substance (Keeley 1980; Vaughan 1985; Van Gijn 2010) (Tab.5). Texture and topography represent two main features of use-related polish and are strictly related to the worked material. Polish linkage refers to the portion of surface micro-topography affected by polishing, providing useful insights on its development. Polish localisation is used to indicate on which of the tool's surface polish developed. At the same time, its extension and distribution are related to the invasiveness of the polish towards the inner edge area (extension) and its continuity along the tool's edge (distribution). Finally, polish orientation over the edge provides, as in the case of edge damage, relevant insights related to the activity performed.

Striations

Striations or striae can be defined as linear features developing over the tool's surface (del Bene and Halley 1971; Rots 2010). The development of this kind of wear over the tool's surface can occur due to material particles acting as an abrasive agent between the tool and the worked substance (Keeley 1980; Tringham et al. 1974; Semenov 1970). Such particles may derive from the worked material, the tool itself or the surrounding environment (e.g. soil particles). However, as underlined by Del Bene (1979) striations can also be produced by adhesive wear, though the transferral of material particles from one surface to another and vice versa. Striations may occur isolated or multiple and provide insights in particular regarding the activity performed (Rots 2005; Van Gijn 2010). Striae are described based on their location on the tool's surface and their orientation according to the edge axis. The morphological features characterising striations are their morphology, their bottom, their depth and their width **(Tab. 5)**.

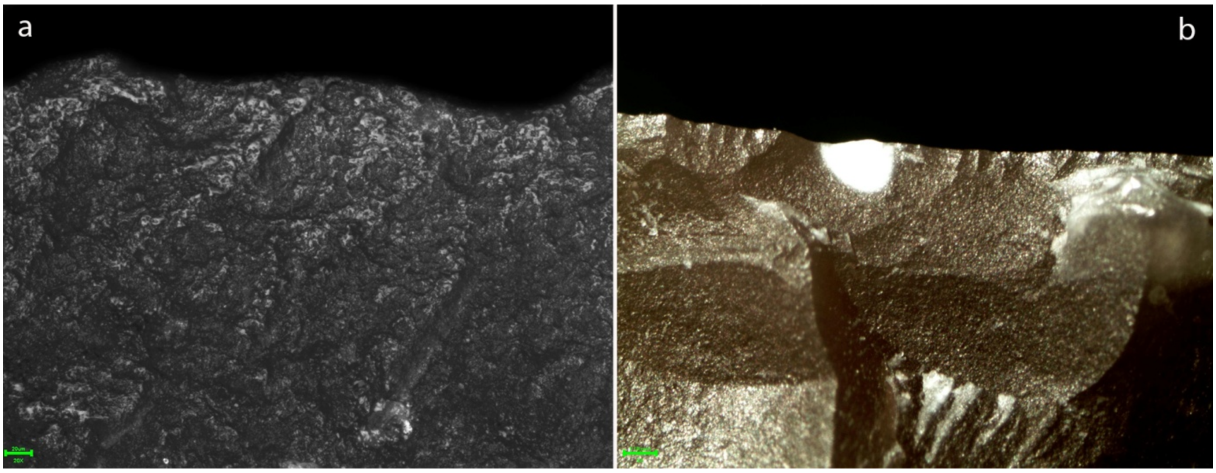

Figure 10. Example of use related polish and edge damage developed on flint. White dashed lines indicate the polished area of the edge. Red arrows indicate the edge damaged developed by use over the working edge.

Edge Scarring Morphological Features	
Initiation	*Cone; Bending; Indeterminable*
Termination	*Feather; Step; Hinge; Snap; Half-Moon*

Orientation	*Transversal; Oblique Bidirectional; Oblique Unidirectional; Mixed*
Localisation	Dorsal; Ventral; Dorsal More; Ventral More; Dorsal and Ventral
Distribution	Close Regular; Close Irregular; Wide Regular; Wide Irregular; Overlapping
Dimension	Small; Large
Polish Morphological Features	
Texture	*Smooth; Rough; Rough tend. to Smooth*
Topography	*Flat; Domed; Reticulated; Granular; Melted snow; Cratered; Pitted*
Linkage	*Open; Half tight; Tight; Compact*
Localisation	*Dorsal; Ventral; Dorsal and Ventral*
Extension	*Outer edge; Edge; Inner Surface*
Distribution	*Continuous; Discontinuous; Spot like*
Orientation	*Transversal ; Oblique unidirectional; Oblique bidirectional; Mixed*
Striations Morphological Features	
Location	*Dorsal; Ventral; Dorsal and Ventral*
Orientation	*Transversal ; Oblique unidirectional; Oblique bidirectional; Mixed*
Morphology	*Long; Short; Comet tails*
Bottom	*Polished; Matt; Corrugated; Grooved*
Depth	*Deep; Shallow*
Width	*Large; Narrow*

Table 5. Variables and descriptions utilised to define use wear features on tools made on flint.

II.2.1.4 Prehension and Hafting Wear

The investigation of wear generated by tool prehension and hafting has always been a problematic issue. Indeed, apart for specific cases use-wear analysts focused their attention on the analysis of the hypothesised working edge/s of ancient tools (Stordeur 1987). In general, scepticism surrounded the interpretative potentials of wear derived from hafting or prehension. In particular, traces generated by prehension or tool manipulation were defined as too poorly developed to be considered of any interpretative potential (Rots 2010). Given such overall neglect towards this kind of wear, only a few works focused on the matter. Prehension traces received much more attention from Low-Power analysts, which provide a detailed description of these latters (Tringham et al. 1974; Odell and Odell-Vereecken 1980), given the fact that the observation at lower magnification allows to realize better the relation undergoing within the identified wear and the analysed tool (Rots 2010). On the other hand, High-Power analysts (Keeley 1980) just referred to polished spots bearing morphological characteristics similar to the polish identified on the tool's working edge (Rots 2010). As in the case of prehension wear, even hafting traces have been considered as too poorly developed to provide substantial interpretative insights. The main reason leading to general neglect of hafting related wear was the assumption that an object should not have moved from its haft (Keeley 1980). Nonetheless, this belief did not prevent sporadic mentions and interpretations of hafting wear in several works. However, in most of the cases, hypothesis were provided without proper dedicated experimental frameworks (Rots 2010). Experiments focusing on hafting were limited and sporadic (Odell 1981; Odell and Odell-Vereecken 1980; Clemente-Conte, Boëda and Farias-Gluchy 2017). In general, the interpretation of specific wear as hafting-related was based on its unusual distribution on the tool, not conforming to the expected use pattern (Rots 2010). Moreover, the attention to hafting-related wear was given mainly to type of objects, bearing a high "hafting potential" as for examples microliths (Lombard and Pargeter 2008), Levallois points (Shea 1990; Boëda et al. 1999), scrapers (Beyries 1987; Plisson 1982; Keeley 1982) and harvesting tools (Unger - Hamilton 1984; Anderson-Gerfaud 1981). However, this did not prevent an inclusion OF this specific kind of wear within the use-wear standard. In recent years the study of hafting and prehension traces became an integral part of the use-wear analysis, in particular thanks to extensive work of Veerle Rots who provided the first comprehensive analysis of prehension and hafting wear (Rots 2013; Rots, Van Peer, and Vermeersch 2011; Rots 2010; Rots et al. 2006).

Prehension Wear

The traces generated by a hand-held use of a tool are intended as prehension wear. This kind of wear is caused by the contact between the object and the hand of the user (Fig.11) (Rots et al. 2006; Rots 2010). Polish is the primary type of wear associated with prehension and is formed by removed particles of worked materials which, from the hand of the user come in contact with the tool. For this reason, the morphological features of prehension polish mimic, in most of the cases, the characteristics of the polish affecting the active area of the tool (Rots 2010). As noted by Rots (2010), more abrasive worked materials lead to a higher degree of prehension-related polish. Generally, a tool used free-hand is characterised by prehension polish on its non-active edge, and the bulb area; the inner surface of the tool is usually not affected (Rots 2010). As for polish originating from use, even prehension-related polish is described based on its texture and, when possible, its topography. Other descriptive characters include localisation, distribution and brightness (for details refer to **Tab. 7)**. Even if not as frequent as polish, scarring may develop as well on a tool used handheld and consisting of small scars exhibiting a feather termination and a close regular distribution (Rots 2010). Prehension-related scars are described based on their morphology, distribution and pattern (Rots 2010) (for details refer to **Tab 7)**.

Hafting Wear

Traces associated with hafting are strictly related to the type of hafting and on the haft material (Fig.11) (Rots 2010). A hafting arrangement is described based on haft type, hafting method and tool placement (Rots 2010) **(Tab. 6)**. Haft types vary from male, female and juxtaposed hafts (Stordeur 1987; Rots 2010). A hafting method can be direct and indirect, while the tool placement varies according to the position of the tool on the haft (Rots 2010).

Haft Type	Description
Juxtaposed	The tool is placed next to the handle
Male	The tool is inserted in the haft
Female	A haft is inserted in the tool

Hafting Method	Description
Direct	The tool is directly in contact with the haft
Indirect	An intermediate material is placed between the tool and the haft

Tool Placement	Description
Terminal	The tool is placed at the end of a straight haft
Lateral	The tool is placed at the side of the haft
Latero-Distal	The tool is placed at the end of a bent haft

Table 6. Variables utilised in the description of haft type, hafting methods and tool placement.

Wear deriving from hafting consists of polish, scarring and bright spots. Traces deriving from hafting can be generated both during the hafting process and tool use, with these latter resulting much more developed (Rots 2010). Hafting-derived polish affects the areas of the tool that is more in contact with the haft (e.g. surface ridges) and develops mostly over the haft limit areas (Rots 2005). Moreover, the morphological features of hafting polish are strictly associated with the haft material (Rots 2010). As for polish generated by use or prehension, also hafting polish is described based on its texture and topography, along with its localisation and brightness. Scarring can also develop on a hafted tool. Generally, scars related to hafting are bigger than the ones that may be generated by prehension or use (Rots 2005). Hafting scars are described based on their morphology, distribution and pattern (Rots 2010) (**Tab. 7**). A further type of wear that can affect hafted tools are bright spots (Rots 2005). These latter are generally associated with scarring and originate from the intense friction within the tool and detached flint particles entrapped in the haft (Rots 2010; Rots et al. 2006). Bright spots are described based on their presence/absence and their location (**Tab.7**). Hafting may also lead to the development of striations. These latter are not as frequent as the previously described wear (polish, scarring and bright spots). However, when present they usually mark the haft limit (Rots 2005,2010). Hafting derived striations are described based on their morphology, localisation, orientation, width, depth and bottom (**Tab.7**).

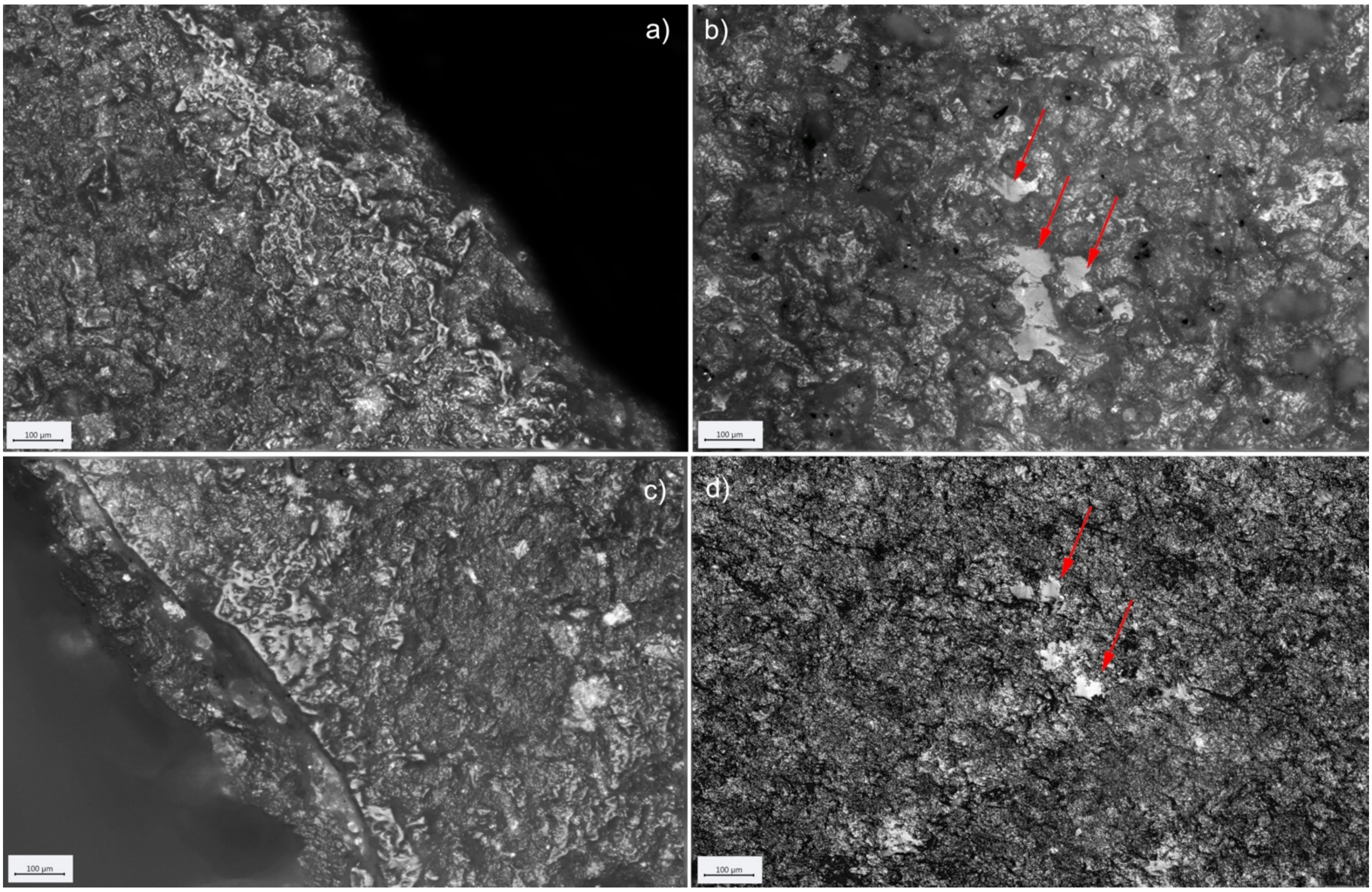

Figure 11. Example of polish (a) and bright spots (b, d) generated by hafting and polish caused by prehension (c).

	Prehension Wear
	Scarring
Morphology	Scalar; Trapezoidal; Triangular; Rectangular; Sliced; Balloon; Elongated; Oblique; Narrow into wide
Distribution	Even and Run-together; Uneven and Run-together; Even and Wide; Uneven and Wide; Distinct Patches; Distinct Patches Wide in between
Pattern	Well defined line; Large scars with small scars inside; Skewed saw pattern; Inverse skewed saw pattern; Largest scars at centre; Largest scars at the extremities
	Polish
Texture	*Rough; Rough tend. Smooth; Smooth*
Brightness	*Low; Medium; High*
Distribution	*Patches; Continuous*

	Hafting Wear
	Scarring
Morphology	Scalar; Trapezoidal; Triangular; Rectangular; Sliced; Balloon; Elongated; Oblique; Narrow into wide
Distribution	Even and Run-together; Uneven and Run-together; Even and Wide; Uneven and Wide; Distinct Patches; Distinct Patches Wide in between
Pattern	Well defined line; Large scars with small scars inside; Skewed saw pattern; Inverse skewed saw pattern; Largest scars at centre; Largest scars at the extremities
	Polish
Texture	Rough; Rough tend. Smooth; Smooth
Brightness	Low; Medium; High
Distribution	Patches; Continuous
	Bright Spots
Presence/Absence	Yes; No
Localisation	Inner Dorsal Surface; Inner Ventral Surface; Edges; Bulb
	Striations
Localisation	Dorsal; Ventral; Dorsal and Ventral
Morphology	Transversal ; Oblique unidirectional; Oblique bidirectional; Mixed
Orientation	Long; Short; Comet tails
Width	Polished; Matt; Corrugated; Grooved
Depth	Deep; Shallow
Bottom	Large; Narrow

Table 7. Variables and descriptions utilised to define prehension and hafting wear features on flint tools.

II.3 Use Wear Analysis on Non-Flint Raw Materials

Functional analysis of non-flint raw materials is still problematic and not yet sufficiently developed despite their high exploitation by prehistoric groups and their resistance to post-depositional alteration (Knutsson 1988). Several studies (Igreja 2009) on the matter have underlined the difficulties related in the microscopic analysis of coarse materials such as quartz, quartzite and basalt. The high reflectivity of such materials represents the main problem affecting their microscopic examination. However, despite these difficulties, several methodological frameworks devoted to the analysis of non-flint raw materials have been developed (Sussman 1985; Pedergnana and Ollé 2017; Pedergnana et al. 2016). As stated above, the high reflectivity of these materials represents one of the main issues needed to be overcome by researchers interested in the functional analysis of non-flint raw materials. This issue has led to the adoption of microscopes not based on reflected light observation as Scanning Electron Microscopes (SEM) (Ollé and Vergès 2014, 2008) and Laser Scanning Confocal Microscopes (LSCM) (Evans and Donahue 2008; Stemp, Macdonald, and Gleason 2019) along with the development of several moulding techniques (e.g. using bi-component silicones and resins), allowing to obtain high detailed casts of the tool's edge that can be observed through a metallographic microscope in reflected light (Bienenfeld 1995; Banks and Kay 2003; Igreja 2009; Lemorini et al. 2014)

II.3.1 Edge Damage Analysis

As in the case of flint, also quartz and quartzite can be subject to edge scarring generated by use. There are no main differences within the morphological features of the edge damage on flint and quartzose materials. However, it is worth to note that the identification of diagnostic edge damage on these latter results to be much more difficult in comparison to flint given its less frequency and small dimensions (Conte et al. 2015; Ollé and Vergès 2014; Pedergnana and Ollé 2017). Indeed, given their composition, during use, the edges of tools made on quartz or quartzite tend to round rather than fracture (Leipus and Mansur 2007).

II.3.2 Micro Wear Analysis

As in the case of flint, surface alterations, in the form of corrosions, striation and polish can be generated by use on quartzose materials as well (Conte et al. 2015; Pedergnana and Ollé 2017) (See **table 5** for details on the descriptive variables of each kind of microwear).

Corrosions

This kind of wear, as described by Conte et al. (2015) is the result of the "loss, disappearance or solution" of part of the original quartz crystal surface (Conte et al. 2015 pp. 70). Corrosions are described based on their extent (isolated or continuous) over the crystal's surface and can be identified through an Optical Light Microscopes (OLM) (Conte et al. 2015). Isolated corrosions develop mainly over the inner areas of the crystal surfaces and can be defined as pecked or large extraction based on their dimensions, with the former being the smallest (Conte et al. 2015) **(Fig 12a)**. On the other hand, continuous corrosions affect the edges of the crystals and are a direct consequence of the destruction of the original quartz surface.

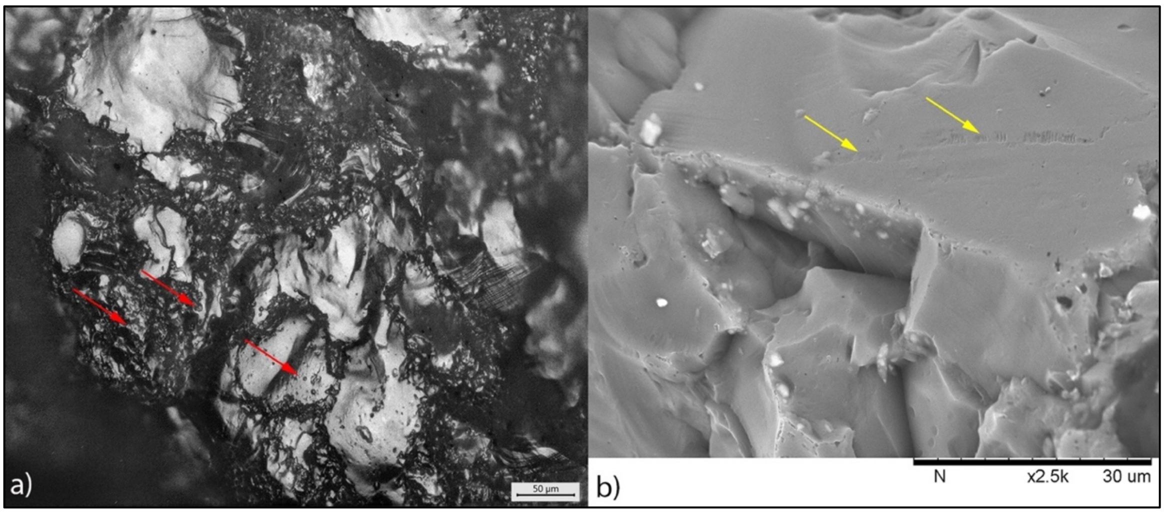

Figure 12. Example of use-wear affecting a quartz surface on an experimental quartzite scraper. a) OLM image showing polishing and corrosion affecting the crystals and matrix. b) furrows affecting the surface of the crystals.

Polish

As in the case of flint, polish may also develop on quartzite and is the result of plastic deformation of the surface due to abrasive processes (Pedergnana and Ollé 2017; Ollé et al. 2016; Ollé and Vergès 2014). However, there are not as many detailed descriptions of its features. One of the main issues concerning the development of polish on non-flint rocks, like quartzite, is its low rate of development, even after prolonged tool uses, due to very irregular topography characterising these materials and the continuing detachment of material (Pedergnana and Ollé 2017). As recorded in several sequential experiments focused on the development of polish on quartzose materials, depending on the processed material, the activity performed and its duration, polish starts to develop affecting the highest parts of the crystal's micro-topography leading to a progressive flattening of the surface (Pedergnana and Ollé 2017). Both OLM and SEM can be used to observe and describe the morphological features of polish developed on quartzose rocks. In both cases, the main features to be recorded on polished areas on quartzite are roughness (or texture) and topography, which vary depending on the worked materials (Pedergnana and Ollé 2017) **(Tab. 8)**.

Linear features

This kind of wear, observable through OLM and SEM, can affect both the original surface and the polished areas of a given tool, and represent one of the most reliable indicators of the motion in which an object was used (Pedergnana and Ollé 2017; Semenov 1970). Linear features are generated by the scratching of the rock surface by extraneous particles (e.g. worked material particles or soil particles) or by fragments detached from the tool itself (Semenov 1970; Sussman 1985; Mansur Franchomme 1983; Pedergnana and Ollé 2017). Kamminga (1979) made a distinction between striations (sleeks) and furrows (linear grooves), which is yet maintained with slight terminological differences. As stated by several researchers, striations (sleeks) are not very frequent on quartzose materials, often developing over polished areas and appearing as short and narrow (Leipus and Mansur 2007;

Sussman 1985; Knutsson 1988; Pedergnana and Ollé 2017). Furrows are instead described as linear features characterised by a rough bottom forming partial *hertzian* cones of percussion over the surface (Sussman 1985). Overall, both sleeks and furrows are described based on their location on the tool's surface and their orientation according to the edge axis **(Tab. 8)**. When present, the morphological features characterising striations (sleeks) are described as well and comprise their morphology, their bottom, their depth and their width (**Tab. 8**).

Edge Scarring Morphological Features (OLM & SEM)	
Initiation	*Cone; Bending; Indeterminable*
Termination	*Feather; Step; Hinge; Snap; Half-Moon*
Orientation	*Transversal; Oblique Bidirectional; Oblique Unidirectional; Mixed*
Localisation	Dorsal; Ventral; Dorsal More; Ventral More; Dorsal and Ventral
Distribution	Close Regular; Close Irregular; Wide Regular; Wide Irregular; Overlapping
Dimension	Small; Large
Polish Morphological Features (OLM)	
Texture	*Smooth; Rough; Rough tend. to Smooth*
Topography	*Flat; Domed; Reticulated; Granular; Melted snow; Cratered; Pitted*
Localisation	*Dorsal; Ventral; Dorsal and Ventral*
Orientation	*Transversal; Oblique unidirectional; Oblique bidirectional; Mixed*
Corrosions (OLM)	
Extent	*Isolated; Continuous*
Edge Rounding (SEM)	
Degree	*Low; Medium; High*
Striations (Sleeks) and Furrows Morphological Features (OLM & SEM)	
Location	*Dorsal; Ventral; Dorsal and Ventral*
Orientation	*Transversal; Oblique unidirectional; Oblique bidirectional; Mixed*
Morphology	*Long; Short; Comet tails*
Bottom	*Polished; Matt; Corrugated; Grooved*
Depth	*Deep; Shallow*
Width	*Large; Narrow*

Table 8. Variables and descriptions utilised to define use wear features on tools made on non-flint raw materials, in this specific case on quartz and quartzite.

II.4 *Residues analysis*

While the analysis of residues on ancient tools is not new in the field of studies concerning the function of prehistoric tools, the combination of integrated techniques and the creation of an experimental residues collection developed in recent years (Nunziante-Cesaro and Lemorini 2014; Nunziante Cesaro and Lemorini 2011). In the last few years, numerous researchers focused on the identification and interpretation of organic and inorganic residues preserved over ancient stone tools (Zupancich et al. 2016; Solodenko et al. 2015; Nunziante Cesaro and Lemorini 2011; Lombard and Wadley 2007; Hayes, Cnuts, and Rots 2018; Hayes and Rots 2018; Pedergnana et al. 2016; Rots et al. 2013). P. Anderson (1980) has been one of the pioneers in residues analysis, identifying different types of organic residues as vegetal, antler and bone through the study of artefacts using a Scanning Electron Microscope. Also, the pioneering work of Loy (1983, 1998) on the identification of blood residues provided relevant methodological insights to the discipline. More recently, the works of Nunziante-Cesaro and Lemorini (2011, 2014) and Wadley and Lombard (2007) allowed to refine the methodology, in particular regarding the identification and interpretation of plant and animal-related organic residues. Moreover, Fullagar and colleagues (2006) carried out extensive work, focusing, in particular, on the mechanical extraction of preserved residues and their imaging. Within the techniques developed in the field of residues analysis there are: Fourier Transform Infrared Spectroscopy, UV Luminescence, Histological Staining, Biochemical Tests, Absorbance Spectroscopy, Enzymatic Testing, Gas Chromatography coupled Mass Spectroscopy, DNA and Amino Acid Sequencing and Immunological Testing (Veall and Matheson 2014). However, despite the number of possible techniques, the field of residues analysis presents some limitations and pitfalls. As stated by several authors (Monnier 2018; Monnier, Ladwig, and Porter 2012; Nunziante-Cesaro and Lemorini 2014), the main issue concerning residues analysis is the contamination of the sample, which can occur due to its depositional environment, handling and curation of the tools and exposure to modern sources as well as the preservation of the residues, which can experience degradation due to the characteristics of its depositional environment (Nunziante-Cesaro and Lemorini 2014). A further issue in residues analysis is represented by the limitations of light microscopy, which, however, has been compensated when possible (sample dimensions) through the use of Scanning Electron Microscopes. As stated by Veall and Matheson (2014), the application of several of the techniques mentioned above allows overcoming possible misinterpretations originate by the application of a single technique. Moreover, as underlined by Nunziante-Cesaro and Lemorini (2014), the combination of use wear and residues analyses is essential to define an identified residue as use-related and avoid any misinterpretation.

II.4.1Micro FT-IR Spectroscopy

Infrared (IR) Spectroscopy has been applied for several decades in archaeology (Karkanas et al. 2000; Weiner 2010). However, the implementation of Micro FT-IR or FTIRM in the study of ancient stone tool use is recent and was first proposed by Nunziante-Cesaro and Lemorini (2014). Since its first application, this non-destructive analysis, based on the gathering spectral data directly from the object's surface, in reflectance mode, without any sample preparation or alteration has been applied in numerous works providing new and relevant insights about the use of ancient stone tools. As an example, Monnier and colleagues (2013) identified bitumen residues on several stone tools coming from the site of Hummal (Syria), bone mineral residues and adipocere have been identified on Acheulean stone tools coming from the site of Revadim (Israel) (Solodenko et al. 2015), and mineral bone residues have been found on several stone tools at Qesem Cave (Israel) (Zupancich et al. 2016). Within the framework of this research, the IR spectra of the stone tools were collected using a Bruker Optic Alpha-R portable interferometer with an external reflectance head covering a circular area of about 5 mm of diameter. The investigated spectral range was 7500-375 cm-1 with a resolution of 4 cm-1, and 250 scans or more were performed. Six points were analysed per each tool (**Fig. 13**): • Inner Dorsal Surface (IDS) • Inner Ventral Surface (IVS) • Outer Edge Dorsal Surface (OEDS) • Outer Edge Ventral Surface (OEVS) • Inner Edge Dorsal Surface (IEDS) • Inner Edge Ventral Surface (IEVS)

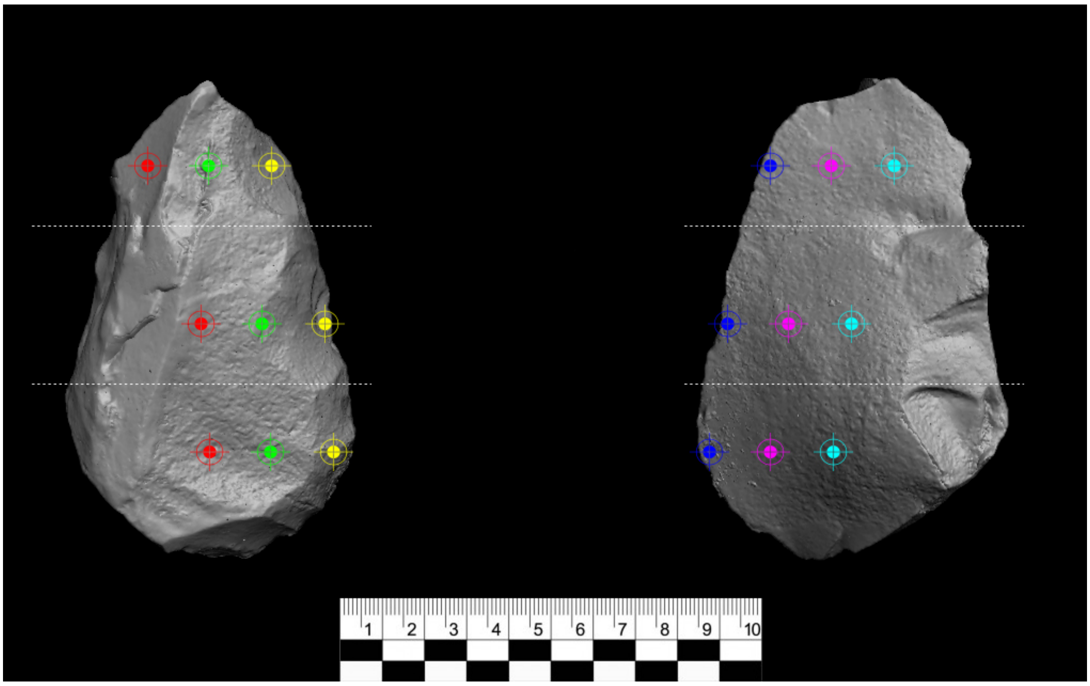

Figure 13. Micro FT-IR sampling points: IDS (red symbol), IEDS (green symbol), OEDS (yellow symbol), OEVS (blue symbol), IEVS (pink symbol) and IVS (light blue symbol).

The tools were analysed both before and after washing. The resulting spectra were then compared between each other to avoid any misinterpretation of the identified residue (i.e. residues associated with the sediment and not to the actual use of the tool). Moreover, the sediment present underneath the tools, when sampled, was spectroscopically examined using the Diffuse Reflectance InfraRed Spectroscopy (DRIFT) module. Minimal amounts of the samples have been dispersed in potassium bromide (KBr, FT-IR grade of purity, Fluka) in excess, at different concentrations (sample\KBr:1\100 to sample\KBr:1\1000) and examined cumulating 250 scans or more in the same spectral range and resolution adopted for Micro FT-IR analysis.

II.5 Sample treatment and data collection

The standard washing procedure of the archaeological specimens consisted in:

1) Washing under rinsing hot water with soap to remove soil deposits. 2) 15 minutes bath in an ultrasonic tank in deionised water.

The cleaning procedure for the experimental replicas consisted in: 1) washing under rinsing hot water with soap 2) 15 minutes chemical bath starting with a dilute 3% acetic acid (CH_3COOH). 3) 15 minutes bath in dilute 3% sodium hydroxide ($NaOH$). 4) 10 minutes ultrasonic bath in deionised water with a 2% neutral phosphate detergent. 5) 10 minutes ultrasonic bath in deionised water.

II.5.1Data collection

A dedicated database for each of the studied contexts was designed using Filemaker Pro Advance 15® to record information related both to the techno-morphological features and the use-wear (**Fig. 14)** characterising the analysed specimen. The information pertaining to each of the experiments performed in this research were recorded as well in a dedicated database designed using the same software. Pictures of the archaeological specimens and the experimental replicas were taken using a Canon EOS100d camera equipped with a Canon Compact-Macro Lens EF-50mm 1:2.5. Photos of the use-wear identified on both the archaeological and experimental scrapers were captured through an Olympus SC100 camera.

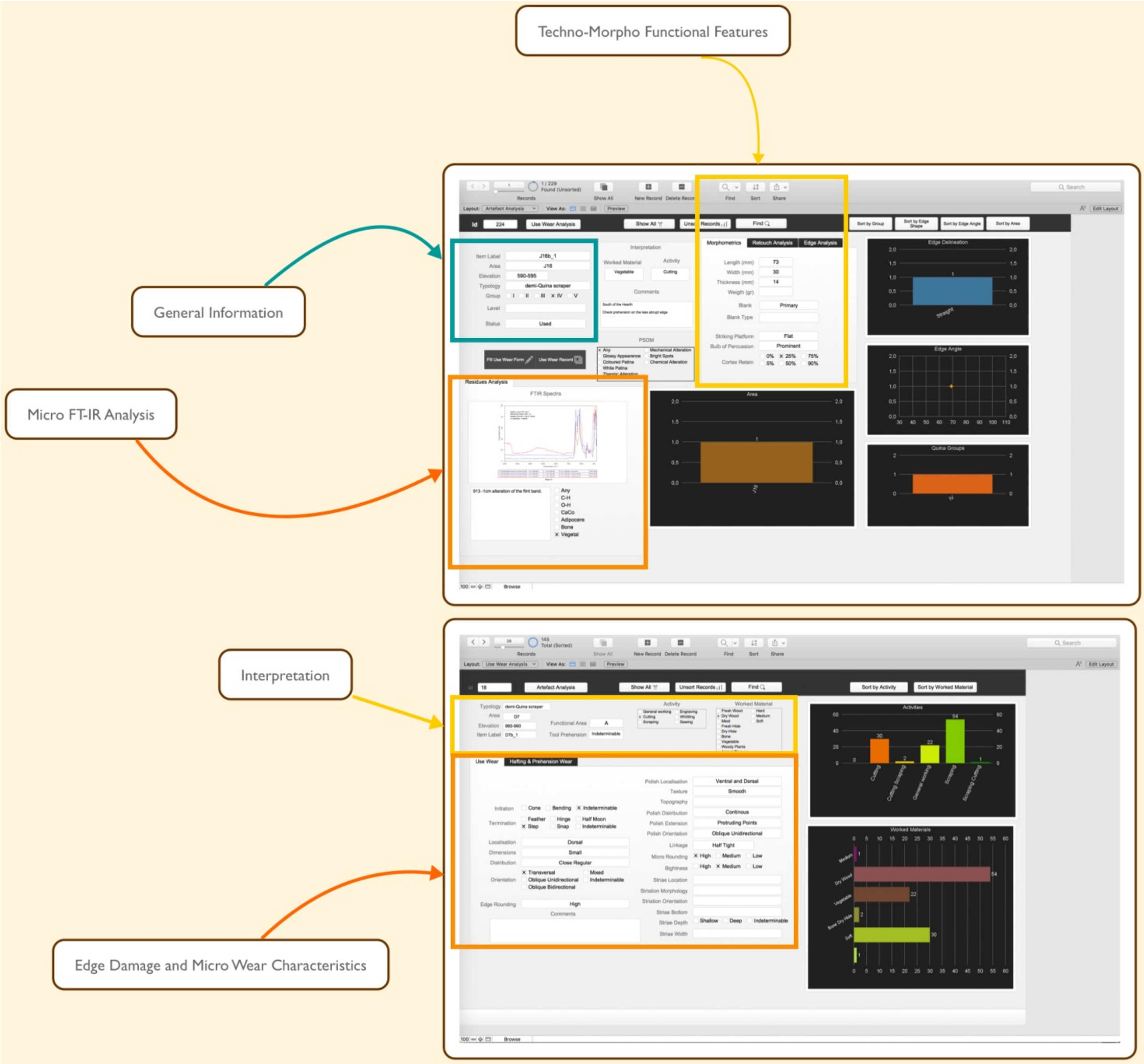

Figure 14. Example of the relational database designed for the recording of both technological and use-wear data

Chapter III - The Experimental Framework

A dedicated experimental framework has been designed to identify and interpret use related wear affecting the archaeological Quina assemblages presented in this work. This allowed creating a use-wear comparison collection comprising traces generated by different kinds of worked materials and activities as well as various handling modes.

Monitoring the development of use wear, its morphological features and distribution patterns over the tool's edge and surfaces on experimental replicas has been essential to correctly interpret the use of Quina scraper assemblages subject of this research. Expert flintknappers made both flint and quartzite replicas of Quina and demi-Quina scrapers. Flint coming from the outcrops localised near Qesem Cave (Israel) was used by Dr Laurence Bourguignon to produce both Quina and demi-Quina scrapers (Fig 15. The replicas were made utilising both hard and soft hammerstones. The formers were used primarily during the first stage of reduction (i.e. blank production). Soft hammers, made of schist and bone, were instead used during the retouching phase to produce the sequence of convexities and concavities typical of the Quina retouch. A different approach was adopted in the production of Quina and demi-Quina scrapers made of quartzite and produced by Prof. Javier Baena. Given the hardness of the raw material coming from the *Habarrio* outcrop (Spain), both during the stages of blank production and retouch, the knapper preferred the use of a hard hammerstone.

Overall, the design and performance of a dedicated experimental framework are essential to investigate thoroughly the use of Quina and demi-Quina scrapers within the archaeological contexts presented in this study. Utilising modern Quina and demi-Quina scraper replicas in different kinds of activities and on various substances allowed to provide data concerning:

1. To test the efficiency of Quina and demi-Quina scrapers in the processing of different types of matters including vegetal and animal materials and various activities including transversal and longitudinal motions.

2. Highlight, from a functional perspective, the potentials and limits of Quina and demi-Quina scrapers, which can be given by their morphological characteristics.
3. Investigate different handling and hafting expedients and their impact on the efficiency of Quina and demi-Quina scrapers.
4. Create a dedicated and comprehensive use wear reference collection devoted to Quina and demi-Quina scrapers made both of flint and quartzite.

Figure 15. Production of Quina and demi-Quina scraper replicas. a) blank production; b) retouch using a soft stone retoucher (schist); c) retouching using a bone retoucher; c) the schist retoucher after its use.

A preliminary observation of a sample of Quina and demi-Quina scrapers coming from Qesem Cave (n. 35) allowed the definition of an initial set of experimental activities (Fig. 16). These included the processing of animal materials, in particular hide, and vegetal substances (e.g. wood and woody plants) to be worked through transversal and longitudinal motions. During this first stage of experimentation, the tools were used free-hand and, in two cases, wrapped in animal or vegetal materials. The second set of experiments focused on the use of Quina and demi-Quina scrapers in activities concerning the processing of hide at different states (semi-dry, dry and treated with ash and minerals), bone (fresh and dry), woody plants, and underground storage organs (USOs). Moreover, during this latter experimental phase, different kinds of hafting techniques were tested as well. A third and final experimental phase focused on the development of use-wear on non-flint raw materials, precisely quartzite. As in the previous experimental stages, Quina and demi-Quina scraper replicas made of quartzite were used to process animal material (hide), wood, woody plants and bone.

Along with the tool's morphometric features, during each of the experimental activities performed, a variety of parameters were monitored, as shown in table 9.

During each of the experiments performed, different aspects directly related to the development of use wear and its characteristics were recorded. The surface (ventral or dorsal) which came in contact with the material, along with the working angle, was recorded. Tool handling (freehand or hafted) and its impact with the efficiency of the tool in a given task wee considered as well. Finally, the state of the worked material (e.g. dry or fresh) represented an important variable as it is directly related to the morphological characteristics of use wear. Both edge damage (micro-scarring and edge rounding) and microwear (micro polish, striations and abrasions) were observed and recorded applying both Low and High-Power approaches (for details refer to Chapter II).

Contact Surface	Contact Angle (degrees)
Worked Material	State of the Worked Material
Activity	Tool Handling
Working Time (min)	Efficiency

Table 9. Experimental variables recorded during each experiment.

Figure 16. Phases of the experimental trials performed within this research framework and comprising the processing throughout different activities of a-b) hide; c) soft animal materials and bone; d-e) vegetal materials.

III. 1 Hide Processing

A total of 10 experiments have been performed focusing on hide working (Tab. 10). These involved the processing of hide at different stages, from fresh (experiments #3, 4, 17,18,19, 20 and 30) to dry (experiments #21, 22 and 31), these latter cases involving the use of ash and ochre. Both Quina (n.6) and demi-Quina (n.4) scraper replicas have been used, made of flint (experiments #3,4,17,18,19 and 20) and quartzite (experiments # 30 and 31). The tools have been handled freehand (n.4), wrapped in vegetal material (n.1) and hafted (n.5). When used freehand the contact between hand and tool was direct, without any intermediate substance, while when used wrapped, a batch of *Amphelodesmos mauritanicus* was knotted around the object. In the case of hafted tools, two typologies of haft expedients have been adopted. Juxtaposed (n.1) and split (n.3) hafts were used with the tool secured to the wood haft using vegetal and leather bindings, exception made for one case (experiments #20) where the object was secured to the haft using only leather strips.

Fresh wild boar (*Sus scrofa*) hide was processed utilising Quina scrapers (experiments # 3 and 4). One of the tools (experiment #3) was used wrapped in vegetal binding, while experiment #4 was handled free hand. Both tools resulted highly efficient during the whole activity, which was performed for 60 minutes using each experiment. While utilised, the tools came in contact with the hide at ca. 55°. The gesture performed during scraping was not perfectly transversal but included a certain amount of curvature. Moreover, during the removal of big portions of *sub-cutis,* a more oblique and faster movement was adopted. As aforementioned, both the tools resulted highly efficient, the only difference relies on the fact that during its use, the handling of experiment #4 started to be more difficult due to the fat residues spreading over the tool's surface and making it slippery. This issue was not recorded with experiment #3, given the highly efficient grip provided by the vegetal binding.

Experiments #17, 18, 19 and 20 were used to process fresh sheep hide (*Ovis aries*). All of the used objects, Quina (n.1) and demi-Quina (n. 3) scrapers were hafted in wooden hafts. The use of haft leads to a straighter transversal trajectory if compared to the one related to freehand manipulation of the tool. It allowed to ample the area of the hide to be worked, given the extension provided by the haft (mean length 15 cm), but at the same time, it resulted in a more *"fixed"* motion which made it difficult to process certain areas of the hide as the angles.

As already experienced with the first set of Quina and demi-Quina replicas, the tool's resulted highly efficient during the entire working time (120 minutes). However, some hafts resulted more efficient than others. In most of the cases, during their use, the objects fell off their haft and need to be re-inserted. This issue occurred especially with the thicker implements (mean thickness 20mm) than with thinner ones (mean thickness <12mm). The angle of contact between the tool and the hide was higher (mean 70° and maximum 90°) than the one recorded when the scrapers were handled free hand.

The third set of experiments was dedicated to the processing of drying hide covered with ash. The choice leading to the use of Quina and demi-Quina scrapers work a hide covered in ash is given the great preservation properties of this substance (Hakbijl, 2002 and reference therein) which might have been exploited by the Qesem inhabitants. One Quina and demi-Quina scrapers (experiments # 21 and 22) were used for the purpose. Differently from the previous set of experiment, where the hide was fixed horizontally on the ground, the hide was placed vertically and stretched over a wooden structure. This solution was adopted to test a possible variation in use wear features, in particular its orientation, which, if identified within the archaeological sample, may suggest the working of hide adopting different placement strategies. The tools were used freehand, and the hide was processed through transversal movements. The contact angle between the tool and the hide ranged between 55° and 60°. Both the tools resulted highly efficient throughout the entire experiment duration (60 minutes). Furthermore, ash, other than being a useful preserving substance, enhanced the removal of the remaining *sub-cutis* tissues and lead to a thorough cleaning and softening of the hide.

The last experiment devoted to hide processing was performed utilising two Quina scrapers (experiments # 30 and 31) made of Quartzite. Experiment # 30 was used to scrape fresh sheep (*Ovis aries*) hide which was then covered with ochre and subsequently processed utilising experiment # 31. During both the experimental stages the sheep hide was placed on the ground. Both the objects worked extremely well with their edges resulting highly efficient after 60 minutes of use during which the tools came in contact with the worked substance at approximately 65°. Of relevance is the fact that, in contrast with what was experienced during the use of scrapers made of flint (experiments #4), Quartzite, given its coarseness, provided a firm grip on the tool also during fresh hide processing.

Experiment #	Raw Material	Type of Scraper	State of Worked Material	Hide Placement	Activity	Duration (min)	Contact Angle (°)	Handling	Efficiency
3	Flint	Quina	Fresh	Floor	Scraping	60	60	Wrapped (Vegetal)	High
4	Flint	Quina	Fresh	Floor	Scraping	60	45	Free Hand	High
17	Flint	Quina	Fresh	Floor	Scraping	120	70	Hafted (Juxtaposed)	High
18	Flint	½ Quina	Fresh	Floor	Scraping	120	60	Hafted (Split)	High
19	Flint	½ Quina	Fresh	Floor	Scraping	20	65	Hafted (Split)	Medium
20	Flint	½ Quina	Fresh	Floor	Scraping	120	90	Hafted (Split)	High
21	Flint	Quina	Drying with Ash	Frame	Scraping	60	75	Free Hand	High
22	Flint	½ Quina	Drying with Ash	Frame	Scraping	60	80	Free Hand	High
30	Quartzite	Quina	Fresh	Floor	Scraping	60	65	Free Hand	Very High
31	Quartzite	Quina	Drying with Ochre	Frame	Scraping	110	70	Free Hand	High

Table 10. Details of the experimental trials devoted to the processing of hide

III.1.2 Use wear: Active Area

Fresh Hide

At low magnifications, both microchipping and edge rounding are visible on the experimental replicas used to process fresh hide through scraping.

Small scars characterised by *feather* and *step* terminations developed over the tool's edge dorsal surface. In several instances, it was possible to determine the initiation of the scars which appears as *cone*. The scars exhibit a *close regular* distribution over the edge and feature a transversal orientation. Overall a medium to a high degree of edge rounding has been recorded in all the utilised experimental tools. The analysis of the tools at high magnifications allowed to trace the development of a band of polish continuously running over the ventral surface of the tool's edge. The polish texture is smooth, and its topography is domed. A high degree of micro rounding was also identified. As in the case of edge damage, the polish orientation is transversal. To this matter, a slight difference was noticed when comparing the polish developed over objects used freehand and hafted ones. In the case of the tools used freehand to scrape hide, it is possible to see a certain amount of obliqueness in polish orientation, which is not recorded on the ones developed on hafted tools.

Dry Hide (covered with Ash)

Several differences were observed regarding the wear generated by the processing of dry hide covered with ash. Edge damage consisted in large *step* fractures, along with several snaps of the edge. Fractures run *close regular* along the edge, exhibiting a *transversal* orientation. Overall, the edge results highly rounded. Polish developed over the ventral surface of the tools affected the protruding point of the microsurface, leaving the lower areas nearly unmodified. Polish exhibits a *smooth* texture and a topography varying from *domed* to *flat* in certain areas. Moreover, the distribution of the polish band is *discontinuous* along the edge and is associate to a high degree of micro surface rounding.

Striae are visible over the ventral surface as well. These are short, shallow and narrow. Their bottom is polished, and their orientation is transversal.

III.1.3 Use Wear: Passive Area

For hide processing, different kinds of prehension and hafting were adopted.

When using the tool freehand (experiments # 4, 21 and 22) polish developed over the ventral surface of the scraper, in particular over the bulb area. The developed polish is *smooth* with a medium degree of brightness, and its usually associated with a medium degree of ridge rounding. Any bright spot or scarring was observed.

Wrapping the tool in vegetal bindings (e.g. experiment #3) leads to the development of both microchipping and polish. These latter affected mostly the edges of the tool, both on the dorsal and ventral surfaces, while its inner area appears unmodified. Large *balloon scars*, with smaller specimens inside, are visible over the edge of experiment #3. The same area of the tool suffered the development of *smooth* polish over both the ridges and lower portion of the surface.

In the case of hafted tools, bright spots, scarring and polish were recorded. Medium-sized *bright spot* developed over the bulb area of the scrapers ventral surface along with scalar scars appearing even and running together in a well-defined line. Moreover, *smooth* polish associated with a medium to a high degree of surface ridge rounding was recorded as well. Slight differences were observed according to the kind of hafting adopted. In the case of split hafts (n.3) polish affected in a similar way, both the ventral and dorsal surface of the scraper. Instead, in the case of juxtaposed hafts (n.1), polish was identified only on the ventral surface of the objects.

III.1.4 Quartzite Items

Regarding the quartzite specimen utilised to work fresh hide both the matrix and crystals are affected by use wear. Observing the sample using an Optical Light Microscope (OLM) it is possible to appreciate the rounding on the crystal's edges and the development of polish over the matrix and the outer portion of the crystals. As in the case of flint, the polish texture is *smooth*, with a *domed* topography. At magnification ranging between 500x and 1000x, using an SEM, the crystals' edge results highly rounded and almost loses its original morphology while being embedded within the quartzite matrix.

If compared to the one related to fresh hide polish, the degree of modification generated by the processing of dry hide with ochre results more substantial. Observing the specimen using an OLM, the crystals result to be modified in particular over their edge. These are heavily rounded and, in some cases, completely obliterated by use. In many instances, the surface of the crystals results modified as well by the development of small corroded areas. The matrix instead is affected by the development of a smooth domed polish, which appears as flat over its most developed areas.

At higher magnification (600-2500x) using an SEM, the high degree of modification of the crystals is even more evident. Moreover, it is possible to observe in detail the corrosions of the crystals, which in several cases leads to the detachment of the crystal and the exposure of the underlying matrix.

III.2 Wood Working

Twelve (12) experiments have been performed focusing on woodworking, through both debarking by scraping and cutting activities. The experimental replicas (#5, 6, 9, 10, 11,12, 13,14,15,16, 28 and 29), including both Quina (n.6) and demi-Quina (n.6) scrapers, have been used to process both fresh

and dry wood. The tools have always been used freehand; exception made for experiment #5, which was wrapped in leather.
As aforementioned, the activities performed included both transversal (debarking) and longitudinal (cutting) gesture finalised to create points and hafts. Experiments # 5, 6, 10, 11, 12, 13 and 28 have been used to create pointed sticks. The processed woods included Mediterranean species as fresh branches of *Prunus armeniaca* (experiment #6) and dry branches of *Quercus ilex* (experiments # 5, 10, 11, 12 and 28) and *Olea europaea* (experiment # 13). Both Quina and demi-Quina resulted very efficient during the debarking phase, where the tools came in contact with the wood at an angle of ca. 60°. The edges of the tool's were functional during the whole experiments, which lasted from a minimum of 50 to a maximum of 120 minutes. Handling the tools freehand resulted in a firm grasping of the object, which instead was not experienced with experiment #5. In this latter case, the leather wrapping fell off the tool in numerous occasion not allowing a proper grasping of the object and resulting in frequent interruptions to adjust the wrapping.
The second stage of wood processing focused on cutting the previously debarked branches to create two kinds of hafts: split and juxtaposed. The experimental replicas utilised (experiments # 5,6,9,13,15 and 16) included both Quina and demi-Quina scrapers. During the first phases of the experiment, all the tools resulted efficient, and cutting was performed through longitudinal motions with the tool placed at 90° over the worked material. However, during a more advanced stage of the experiment, where the cut reached a depth of approximately 3,5 – 4 cm a decay in the efficiency of the tool was experienced, in particular regarding Quina scrapers. Indeed, especially during the production of split hafts, the tool remained stuck within the split walls, resulting in the active area not being in contact anymore with the wood. This issue was not experienced with demi-Quina scrapers, made on thinner blanks, which instead lead to the production of splits ranging between 6 and 8 cm in depth ideally suited for the insertion of a Quina or demi-Quina scrapers in the haft. On the other hand, both Quina and demi-Quina scrapers were very useful in the production of the "sockets" characterising juxtaposed haft which did not involve the creation of deep cuts.

Freehand prehension of the tool granted a firm and precise grasp of the object for the whole experiments which lasted between 50 and 60 minutes. Again, as experienced during the debarking phase, or even worst, the wrapping of experiment #5 with leather was inefficient leading to frequent replacing of the wrap over the tool.

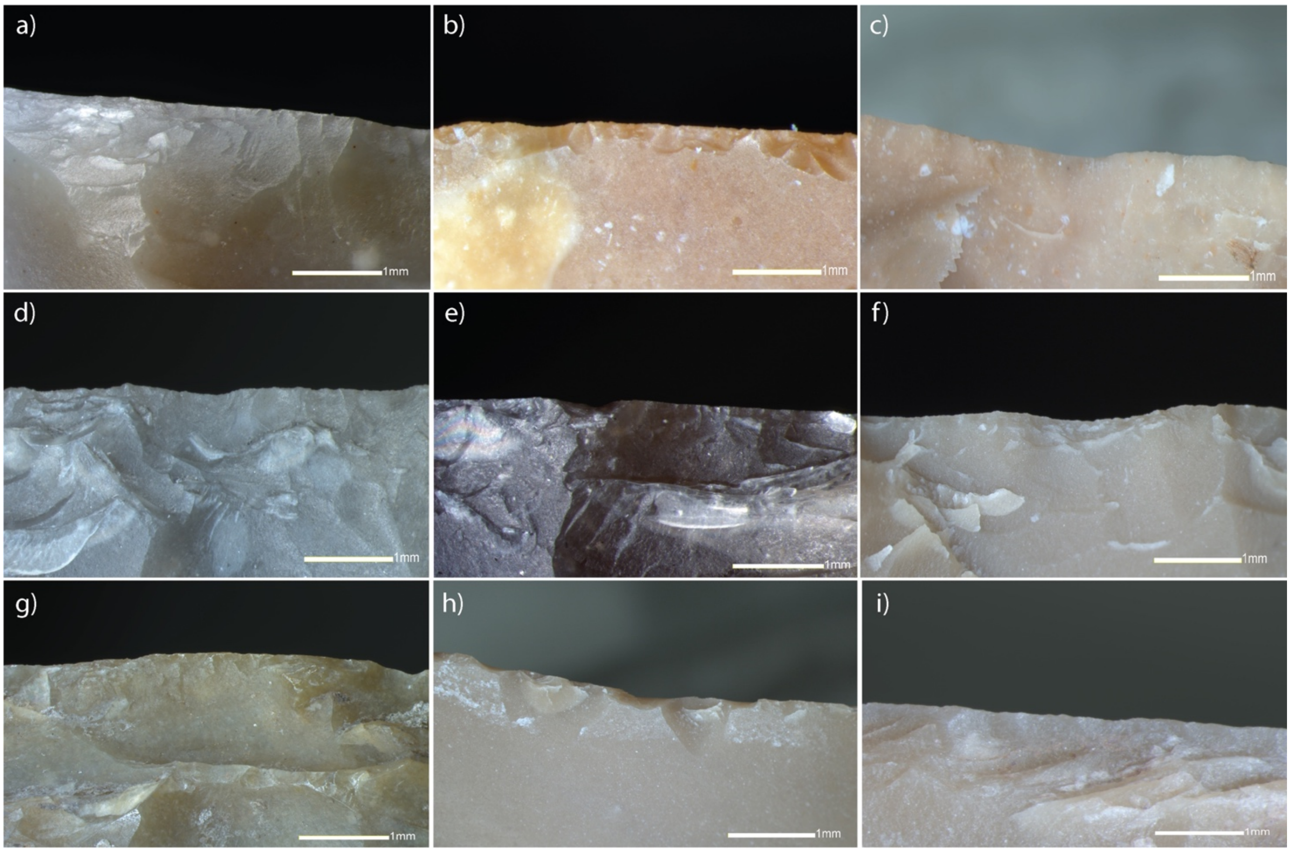

Figure 17. Edge damage developed over the Quina and demi-Quina scraper replicas and associated to a) fresh hide scraping; b) removing meat from bine; c) wood scraping; d) dry hide scraping; e) bone scraping; f) woody plant cutting; g) scraping drying hide with ash; h) bone cutting; i) woody plants de-fibering

Experiment #	Raw Material	Type of Scraper	State of Worked Material	Activity	Duration (min)	Contact Angle (°)	Handling	Efficiency
5	Flint	½ Quina	Dry	Scraping and Cutting	50	60 (Scraping) 90 (Cutting)	Wrapped (Leather)	Medium
6	Flint	½ Quina	Fresh	Scraping and Cutting	50	45 (Scraping) 90 (Cutting)	Free Hand	Very High
9	Flint	Quina	Dry Soaked in Water	Scraping	75	45	Free Hand	High
10	Flint	Quina	Dry Soaked in Water	Scraping	90	90	Free Hand	High
11	Flint	Quina	Dry Soaked in Water	Scraping	20	45	Free Hand	Medium
12	Flint	Quina	Dry Soaked in Water	Scraping	30	80	Free Hand	High
13	Flint	½ Quina	Dry Soaked in Water	Cutting	120	90	Free Hand	Very High
14	Flint	½ Quina	Dry Soaked in Water	Scraping	55	90	Free Hand	High
15	Flint	½ Quina	Dry Soaked in Water	Cutting	120	80	Free Hand	High
16	Flint	½ Quina	Dry Soaked in Water	Cutting	60	90	Free Hand	High
28	Quartzite	Quina	Dry	Scraping	60	60	Free Hand	High
29	Quartzite	Quina	Dry	Cutting	45	90	Free Hand	Medium

Table 11. Details of the experimental trials devoted to the processing of wood

III.2.1 Use Wear: Active Area

Wood scraping (de-barking)

Small scars bearing, in most of the cases, *step* terminations are visible, sometimes related to *feather* terminating ones. The initial portion of the scar is generally cone, even though in several instances was not determinable. The scars developed over the dorsal surface, with a close regular distribution and a transversal orientation. Edge rounding is recorded as medium to high in most of the utilised experimental replicas with heavier rounding characterising the tools used to process dry wood.

At higher magnifications, a continuous band of polish was observed over the edge of the tool ventral surface. Its texture is smooth with a reticulated topography, which appears flat in its more developed portion over the outer area of the edge, and a transversal orientation. Polish linkage is tight, and surface micro rounding is very high.

Wood cutting

Small *feather* and *step* scars developed over the edge of the tools utilised to cut through the wood (fresh and dry). Their initiation is cone, and they are visible over both the ventral and dorsal surface of the scraper's edge. Edge scarring is *close regularly* distributed along the edge and exhibit an *oblique bi-directional* orientation. Edge rounding is high. At higher magnification, a band of smooth reticulated polish is visible mostly over the edge's ventral surface. The polish orientation is oblique, and its linkage is half-tight along with a high degree of surface micro rounding.

III. 2.2 Use Wear: Passive Area

Wear generated by tool prehension during wood cutting and scraping developed over the ventral surface of the tool, affecting mostly the surface ridges which appear as moderately rounded. The developed polish exhibits a smooth topography and is characterised by a medium to a high degree of brightness. Any scar or bright spots are present over the tool's prehensive area.

III.2.3 Quartzite Items

Experiment #28 exhibits microwear over both the matrix and the crystals. Observing the specimen using an OLM, it is possible to see the high rounding suffered by the crystals, especially over their edges. Occasionally a corrugation of the crystal's surface is present as well. Another use pattern observed on the crystals is the crushing of the crystal's edge. This may be intended as a primary stage of the crystal's modification happening before its rounding. Observing experiment #28 at magnification ranging in between 500x and 1.500x using the SEM, allowed to analyse in detail the rounding of the crystal's edge and the crushing affecting these latter. The surface of the crystal's appeared overall not affected by use-wear exception made for the presence of few small *furrow* striations.

Wear generated by the cutting of dry wood developed over both the ventral and dorsal surface of experiment #29. At magnifications ranging between 200 and 500x it both polish and striations are visible. Smooth domed and flat polish affects mostly the protruding areas of the matrix, while the crystals' surface is affected by pointed striations. These latter are short and run parallel to the tool's edge. Corrosions of the crystal's surface are visible as well. Using the SEM, parallel furrow striations are visible along with the rounding and microchipping of the crystals' edges.

III. 3 Vegetal Processing

Experimental activities dedicated to vegetal materials focused on a variety of substances ranging from siliceous and woody plants, aquatic plants and USOs. A total of 8 experiments (experiments # 1, 2, 23, 27, 33, 32, 36 and 37) were carried outperforming a range of activities including cutting, debarking and de-fibering which included both transversal and longitudinal motions.

Experiment # 1, a demi-Quina scraper made of flint, was used to cut a moderately siliceous plant (*Amphelodesmos mauritanicus*). This species of plant is yet commonly used within populations of the Mediterranean basin, to produce ropes or basketry elements (Adovasio 2016; Soffer et al. 2000). The tool was used to perform back and forth cutting motions, with both the dorsal and ventral surfaces of the edge in contact with the worked substance. The tool was handled with bare hands, and both its gripping and efficiency were high during the entire experiment duration (ca. 60 minutes). Woody plants, as *Pistacia lentiscus* and *Mirtus communis*, are as well renowned for their use in basketry activities. Experiments #2, 23, 32 and 37 were used to process woody plants in both cutting and de-barking activities. In the case of experiments # 23 and 33, the two activities were carried out subsequently, exploiting two different portions of the experimental replica's edge. This allowed isolating the wear generated by de-barking from the one developed through cutting. Experiments # 32 and 37 were instead used singularly for de-barking (experiment #37) and cutting (experiment # 32). All of the four experimental replicas resulted in highly efficient when used to remove bark and de-fibre. Each of the activities lasted between 30 and 60 minutes, with the tools being in contact with the processed material at angles ranging between 70° and 90°, and any sign of the decay of the edge was experienced. On the contrary of what experienced in wood processing, both Quina and demi-Quina scrapers worked well during the cutting of woody and aquatic plants which was performed through single fast strokes. This enhanced efficiency can be associated to the fact that the processed branches are much thinner and softer than the ones worked during the experiments devoted to wood cutting.

The processing of woody plants also included the use of one Quina scrapers made of quartzite (experiments # 32). The tool was used for debarking and cutting branches of *Mirtus communis.* The tool worked efficiently overall (experiment duration 80 minutes), yet as experienced with the flint Quina and demi-Quina replicas, a higher efficiency was recorded during the debarking phase. Throughout the experiment, the scraper was handled with bare hands, and the gripping felt comfortable during both the scraping and cutting steps.

Moreover, woody plants associated with a water environment, such as willow (*Salix*) were worked well. Utilising a portion of the edge of experiments # 23 and 33 not exploited during the previous experimental phases cutting and de-fibering activities were carried out. Experiment #33 was used to cut willow branches, which were then de-fibered utilising experiment #23. Yet both the experiment resulted very efficient in particular experiment #23, which performed extremely well, allowing to easily de-fibre the branch. Combined the two activities lasted for 120 minutes, with the tool being in contact at an angle of 80° during branch cutting and at a lower angle (ca. 60°) when used for de-fibering. One Quina scraper made of quartzite was utilised as well to de-fibre *Salix* branches. The tool was used for 60 minutes and came in contact with the worked material at ca. 50°. The tool worked very well, allowing a fast and precise separation of the woody fibres. Also, the handling of the tool by bare hands resulted comfortable, providing a firm grip during the entire experiment.

Finally, experiment #27 has been used to process USOs. Tubers of *Typha latyfolia* were roasted before being processed covering them with hot ash. The tool was used to remove the outer skin of the tubers. Fast transversal motions were performed with the tool being in contact with the processed material at an angle of 50°. The entire experiment lasted 40 minutes, during which 500gr of tubers were processed. The tool resulted very efficient, allowing a straightforward removal of the roasted tuber skin. The tool was handled with bare hands, and the grip was firm during the entire process.

Experiment #	Raw Material	Type of Scraper	Plant Species	State of Worked Material	Activity	Duration (min)	Contact Angle (°)	Handling	Efficiency
1	Flint	½ Quina	Siliceous Plant (*Amphelodesmos mauritanicus*)	Fresh	Cutting	60	90	Free Hand	High
2	Flint	½ Quina	Woody Plant (*Pistacia lentiscus*)	Fresh	Scraping and Cutting	30	90	Free Hand	Medium
23	Flint	Quina	Woody Plant (*Mirtus communis*)	Fresh	Cutting and De-Fibering	120	45 (Defibring) 90 (Cutting)	Free Hand	High
27	Flint	Quina	Tubers (*Typha latyfolia*)	Roasted	Scraping	40	50	Free Hand	High
32	Quartzite	Quina	Woody plant (*Salix*)	Fresh	Scraping and Cutting	80	45 (Scraping) 90 (Cutting)	Free Hand	Medium
33	Flint	Quina	Woody plant (*Salix*)	Fresh	Scraping	30	60	Free Hand	High
36	Quartzite	½ Quina	Woody Plant (*Salix*)	Fresh	De-Fibering	60	50	Free Hand	Very High
37	Flint	Quina	Woody Plant (*Salix*)	Fresh	De-Fibering	58	56	Free Hand	High

Table 12. Details of the experimental trials devoted to the processing of plants and USOs

III. 3. 1 Use Wear: Active Area

Cutting Siliceous plants

Edge damage developed through the processing of siliceous plants consisted of small feather and step terminating scars, with an indeterminable initiation, running close regular over the tool's dorsal edge surface. Their orientation is oblique bidirectional and is associated with a high degree of edge rounding. At higher magnifications, a discontinuous band of polish has been identified on the ventral surface of experiment #1. This affects the outer edge portion and its higher points and is characterised by a smooth texture and a flat topography. Polish orientation is longitudinal, and its linkage appears tight. Furthermore, the degree of micro rounding affecting the surface is high.

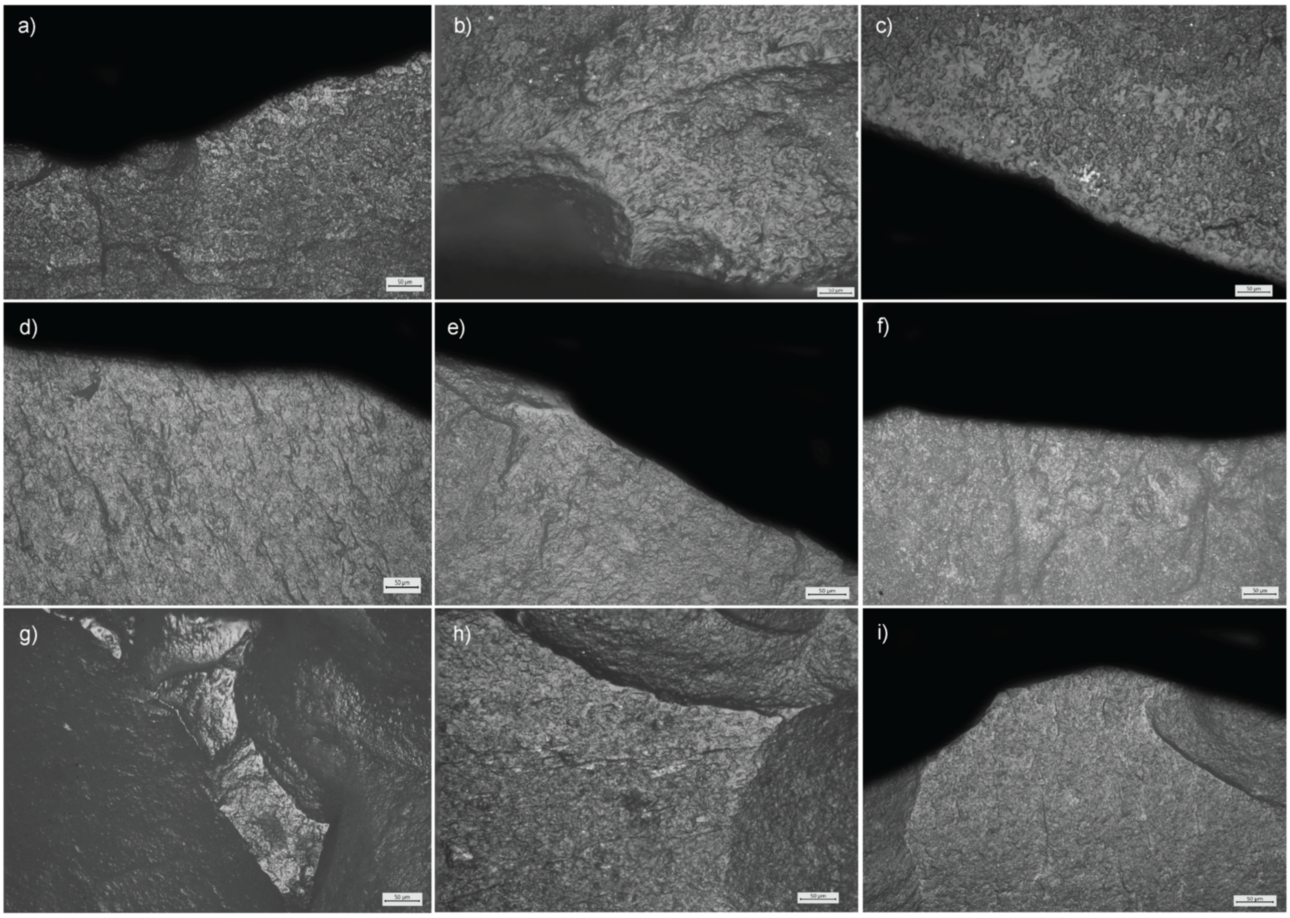

Figure 18. Microwear developed over the Quina and demi-Quina scraper replicas and associated to a) fresh hide scraping; b) removing meat from bone; c) fresh wood scraping; d) dry hide scraping; e) bone cutting; f) dry wood scraping;g) scraping dry hide covered with ash; h) cutting soft animal materials; i) scraping woody plants. All pictures are taken at 200x.

Cutting Woody Plants

Edge scarring caused by woody plants cutting appears in the form of small step scar, with cone initiations, developing over both the ventral and dorsal surface of the tool. Their distribution over the tool's edge is close regular, while their orientation is oblique unidirectional. The edge suffered a high degree of rounding. Polish generated from woody plant cutting affects the outer portion of the tool's edge, in particular its ventral surface. The band of polish is continuous along the edge, exhibits a smooth texture and a domed topography. Its orientation is oblique unidirectional, the linkage compact and is associated with a high degree of surface micro rounding.

De-fibering Woody Plants

Edge damage generated by woody plants de-fibering consists of small feather terminating scars with an indeterminable initial portion. Scars run close regular over the edge dorsal surface and exhibit a transversal orientation. Associated to the scars is a medium degree of edge rounding. Microwear developed to woody plants de-fibering is represented by smooth domed polish, running continuously over the ventral surface of the tool's edge. Polish orientation is transversal, its linkage compact and is associated with a high degree of surface micro rounding. Moreover, short transversal striae are visible as well. These latter are located over the ventral surface and are shallow and narrow exhibiting a polished bottom.

Tuber Processing

Small step terminating scars developed over the tool's edge during tuber processing. Micro scarring affected both the dorsal and ventral surfaces of the edge, with this latter being the more affected. Edge damage orientation is transversal, and their distribution is close regular. Edge rounding is high. Polish generated by tuber processing is characterised by a texture which can be defined as rough tending towards smooth over its more developed spots. Polish topography is domed, and its distribution over the tool's edge is continuous. Polish orientation is transversal; its linkage is tight and is associated with a high degree of surface micro rounding.

III.3.2 Use Wear: Passive Area

All of the experiments used in vegetal processing have been handled with bare hands. Only in one case, during the processing of *Amphelodesmos mauritanicus*, gloves were worn given the sharpness of the plants' fibres. For this reason, it was not possible to record the traces of prehension relate to the cutting of siliceous plants.

Regarding woody plants and tuber processing as in the case of the traces observed over the scrapers' active areas, differences were identified concerning the wear generated by tool handling.

On the experimental replicas used to process woody plants, performing cutting and de-fibering activities, (experiments #2,23,32 and 37) any bright spot or scarring related to prehension was observed. However, in particular, over the bulb area, a smooth polish was identified. This latter affected mostly the protruding areas of the surface and is related to a high degree of ridge rounding.

Regarding tuber processing, the bulb area of experiment #27 was affected by traces generated by handling. Small bright spots are present, which were not observed on the scrapers used to work woody plants. These latter are caused the higher degree of friction due to both the ash and the soil residues present over the worked tubers. Bright spots are associated with a well-developed rough polish, which is very bright and exhibits some smoother areas corresponding to the surface protruding points. As observed on the scrapers utilised in woody plant processing any kind of scarring related to prehension is recorded.

III.3.3 Quartzite Items

Microwear deriving from the cutting of woody plants affected both the matrix and the surface of the crystals. A smooth polish with a reticulated and flat topography developed over the matrix, embedding also the crystal's edges, which resulted more crushed than rounded. Moreover, corroded areas are visible over the surface of the crystals; any diagnostic striation was identified. Using the SEM, few parallel furrow striations are visible over the crystals' surface, along with a low to medium degree of rounding of the crystals' edges

The de-fibering of woody plants lead to the development of a rough to smooth polish, with a domed and reticulated topography, over the matrix. The crystals surface results profoundly affected by use as visible from the large corroded areas. Moreover, the crystal's edges are highly rounded, and sometimes fractures are visible as well. At higher magnifications using the SEM, a medium degree of the crystals edge rounding is visible.

III.4 Bone Working

Experiments #7,8,24,25,26,34,35 and 36 have been used to process bone. The activities performed included both the scraping cutting and scraping of the bone, which were carried out utilising scrapers made of both flint and quartzite were utilised during the experiments.

Bone scraping was performed using Quina (experiment #7, 34 and 36) and demi-Quina (experiment #8 and 35) scraper replicas. Fresh bone was processed utilising experiments #7 and 8 while experiments # 34 and 35 were used to process bone in a dry state.

The experimental trials lasted for a total of 176 minutes, during which the tools were used to remove the *periosteum* and create a pointed item. A slight variation in tool efficiency was experienced regarding the kind of utilised scrapers. Indeed, Quina scrapers worked better, and also experienced a slower edge decay, while demi-Quina scrapers tended to lose efficiency much faster. On the other hand, the thinner edges characterising demi-Quina scrapers allowed a thorough removal of the meat residues attached on fresh bones.

The contact angle between the tool and the bone surface varied between 60° and 50°. During all the experimental trials, the tools were handled with bare hands, and the grip resulted firm and comfortable during the entire duration of the experiments.

Bone cutting was performed utilising four demi-Quina scrapers made of flint (experiments # 8, 24, 25, and 26) and one Quina scraper made of Quartzite (experiment #36). Two kinds of cutting were performed. On the one hand, experiments #8 and 36 were used to produced deep cuts on the bone surface finalized to the breaking of this latter, while on the other hand experiments #24, 25 and 26 were used to create shallower incisions on the bone surface. While the experimental replicas used to produce shallow incisions resulted very efficient, the tools utilised to cut through bone were less useful. This variation within tool efficiency is given by the fact that the Quina scraper (experiment #36) given its thickness did not allow to produce a deep enough cut, while the demi-Quina scraper's edge suffered a fast and high degree of rounding which affected its efficiency.

The contact angle between the scrapers and the bone varied between 85° (experiments #7,8, 25 and 26) and 75° (experiment # 24 and 36). During each of the experiments devoted to bone cutting the tools were handled with bare hands and tool gripping was very good and comfortable during the entire experiment duration.

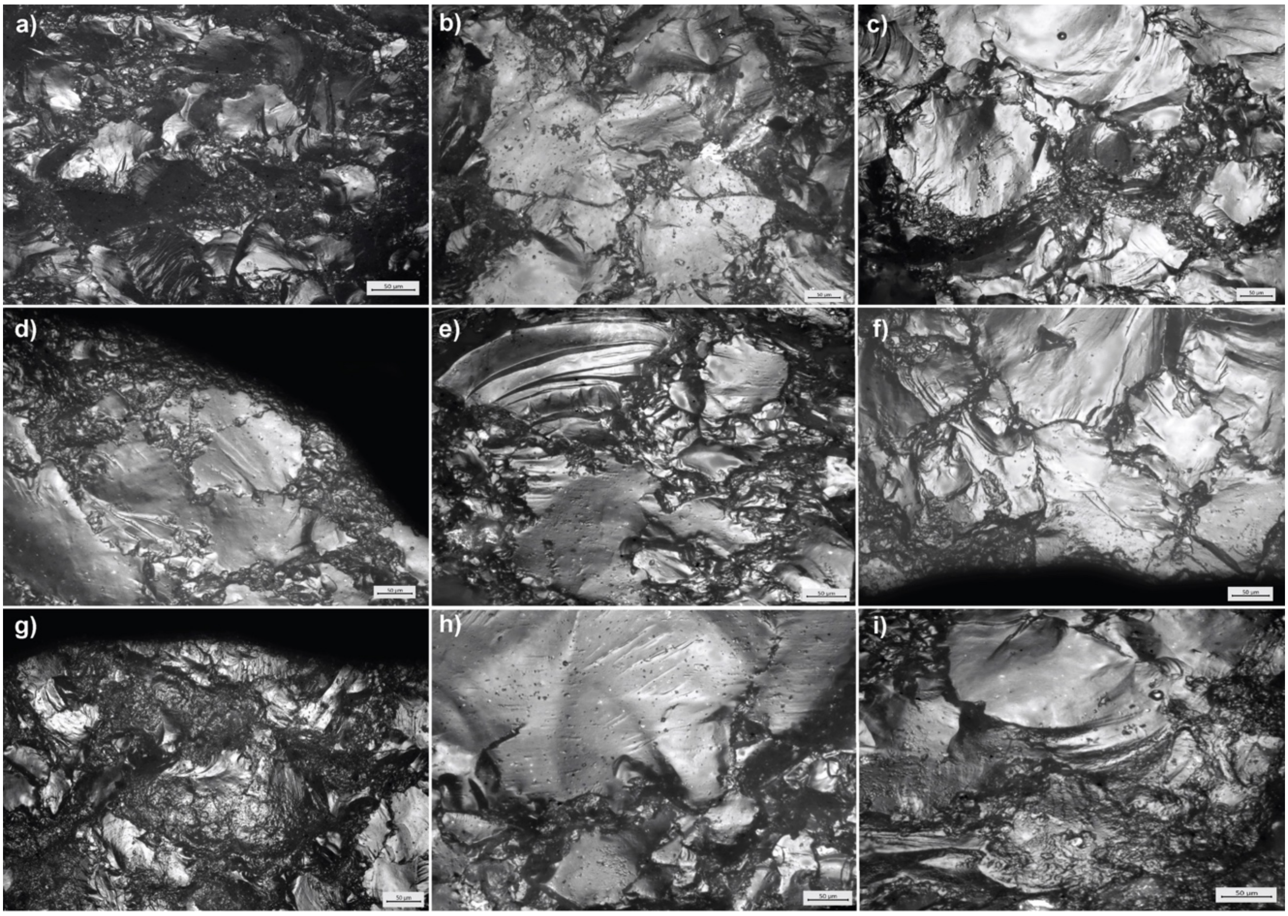

Figure 19. Microwear developed over the Quina and demi-Quina scraper replicas made on Quartzite and associated to a) fresh hide scraping; b) bone cutting; c) woody plants scraping; d) scraping tanned dry hide; e) fresh wood scraping; f) woody plants cutting; g) bone scraping; h) dry wood cutting; i) de fibre woody plants. All Pictures are taken at 400x.

Experiment #	Raw Material	Type of Scraper	State of Worked Material	Activity	Duration (min)	Contact Angle (°)	Handling	Efficiency
7	Flint	Quina	Fresh	Scraping	50	60	Free Hand	High
8	Flint	½ Quina	Fresh	Scraping and Cutting (Deep Incision)	30 (15' per activity)	65 (Scraping) 90 (Cutting)	Free Hand	Medium
24	Flint	½ Quina	Fresh	Cutting (Shallow Incision)	3	75	Free Hand	High
25	Flint	½ Quina	Dry	Cutting (Shallow Incision)	2	85	Free Hand	High
26	Flint	½ Quina	Fresh	Cutting (Shallow Incision)	3	85	Free Hand	High
34	Flint	Quina	Fresh	Scraping	50	60	Free Hand	High
35	Flint	½ Quina	Dry	Scraping	10	50	Free Hand	Medium
36	Quartzite	Quina	Dry	Scraping and Cutting (Deep Incision)	5 (Scraping) 15 (Cutting)	60 (Scraping) 90 (Cutting)	Free Hand	Medium

Table 13. Details of the experimental trials devoted to the processing of bone

III.4.1 Use Wear Analysis: Active Area

Bone Scraping

Bone scraping leads to the development of small step scars over the dorsal surface of experiments #7,8, 34 and 35. The scars exhibit a wide regular distribution along with a transversal orientation. Overall, the edge rounding degree is medium, some areas of the edge (centre) being more rounded. Microwear developed from bone scraping consists of a continuous band of smooth domed polish, which appears flatter over its more developed portions. Polish affects the ventral surface of the tool's edge; its linkage is tight, and the surface micro rounding is very high. A slight difference, concerning the polish topography, was recorded between the scraping of dry and fresh bone. Indeed, in the case of dry bone polish, topography appeared flatter if compared to the one associated with the processing of fresh bone.

Bone Cutting

Small step scars with a cone initiation are visible over the edge dorsal surface of experiments #24, 25 and 26. Scars are close regularly distributed and exhibit an oblique bidirectional orientation. Edge rounding is very high. The small amount of time needed to produce the superficial cuts over the bone surface did not allow proper development of microwear. Only in one case (experiment #26), microwear was observed. Polish affected the outer portion of the edge, on both its ventral and dorsal surfaces. It appears as a continuous band, bearing a smooth texture and a domed topography. Polish orientation is oblique, its linkage id compact and the surface micro rounding is high.

The fact that microwear was identified only on one of the items can be explained by the finer-grained flint of which experiment #26 is made.

Edge snapping and large step scars are visible over the dorsal surface used to create deep cuts over the bones. These feature an oblique bidirectional orientation and are associated with a high degree of edge rounding. The microwear observed on experiment #8 consists of a smooth domed polish, affecting mostly the outer portion of the edge on its ventral surface. Polish distribution is continuous along the edge, with an oblique bi-directional orientation and a tight linkage. Moreover, surface micro rounding is very high.

III.4.2 Use Wear Analysis: Passive Area

All of the Quina and demi-Quina scraper replicas used to process bone through cutting and scraping have been handled with bare hands. Prehension traces were identified over the ventral surface of the tools, over the bulb area. Patches of rough polish are visible, associated with a medium degree of ridge rounding. However, over the higher portion of the tool's surface, a polish with a smoother topography is visible as well. Such a difference in polish topography is simply given by the fact that these latter represent the areas of the surface more in contact with the hand during tool use. No bright spots have been identified, and also any difference is noted between tool's that have worked bone in a fresh or dry state.

III. 4. 3 Quartzite Items

Bone scraping leads to the modification of both the surface matrix and the crystals. A well-developed smooth domed polish developed over the matrix, embedding also the crystals' edges. These latter results heavily rounded and in some cases are entirely obliterated. On the other hand, the crystal's surface does not exhibit any diagnostic modification. Under the SEM, several areas where crystals detached are visible along with a medium to high rounding of the edge of the crystals.

Under the OLM, it is possible to observe how bone cutting affected more the crystals than the matrix. The latter suffered the development of a smooth flat polish solely over its higher points. On the other hand, the edges of the crystals are heavily rounded. Furthermore, the crystals' surface is characterised by the presence of medium-sized corroded areas which in some cases bear an elongated morphology. At higher magnifications using the SEM, the crystals' edge and surface are characterised by a high degree of rounding.

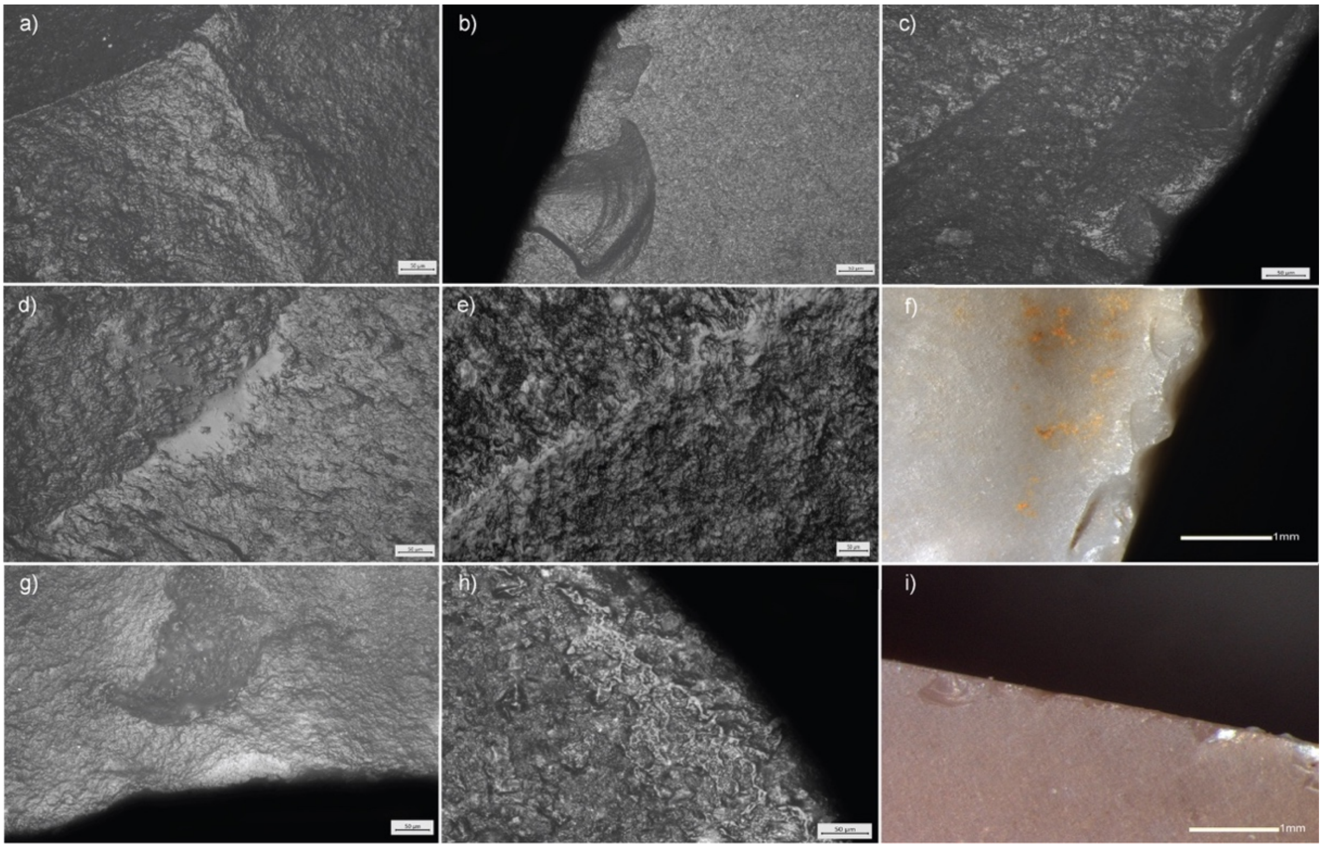

Figure 20. Edge damage and microwear associated with prehension (a, b, d, g, i) and hafting (c, e, f, h). a) prehension polish associate to the processing of hide; b) prehension micro-scarring and polish associated to the processing of wood; c) micro-scarring and polish associated to hafting; d) prehension polish associated to the working of bone; e) polish associated to a wood haft; f) micro-scarring associated to hafting; g) prehension polish associated to the processing of animal materials; h) polish associated to hafting; i) micro-scarring associated to prehension.

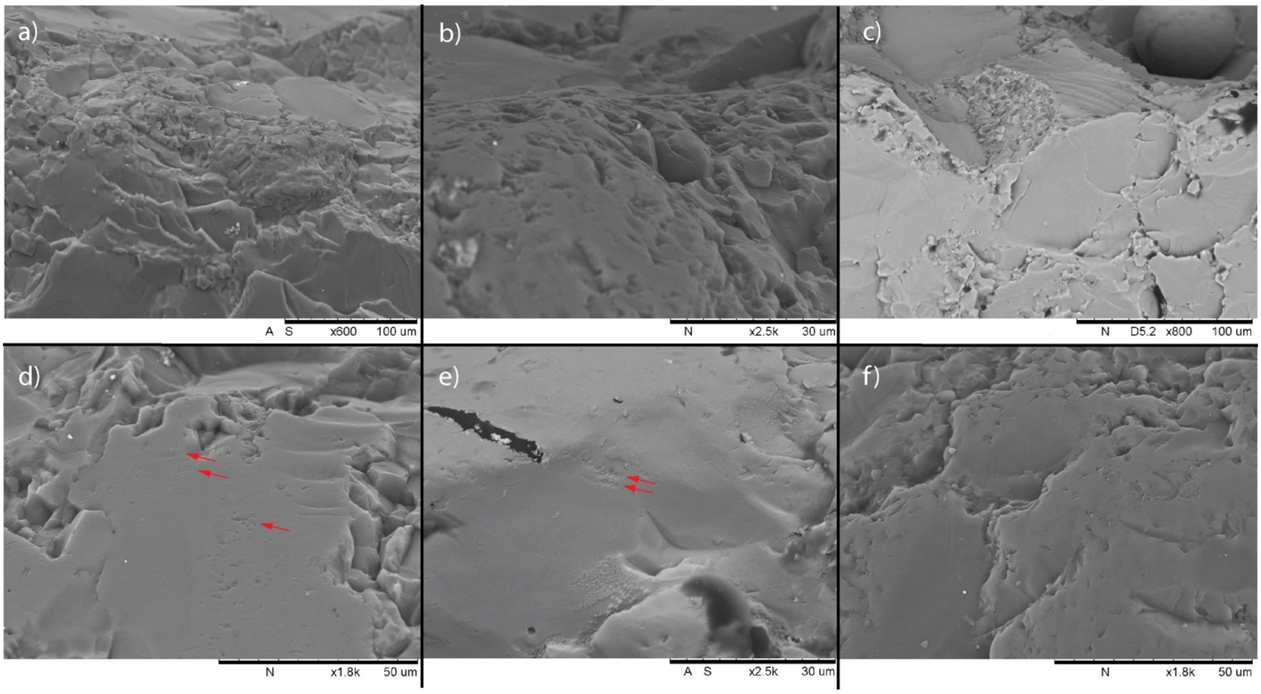

Figure 21. Experimental wear developed over the Quartzite Quina and demi-Quina scrapers replicas observed under the SEM and associated to a) fresh hide scraping; b) scraping dry hide treated with ochre; c) scraping fresh wood; d) cutting dry wood; e) processing woody plants; f) bone processing.

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Chapter IV - Results

Qesem Cave

Discovered in the year 2000 and located 12 km east of Tel Aviv, Qesem Cave is the southernmost context associated with the Acheulo Yabrudian cultural complex recorded so far in the region (Fig. 22). Systematic excavation at the site started in 2001and yielded an impressive amount of evidence related to a set of new behaviours, manifested in the production and use of stone tools, subsistence economy, and site organisation. In particular, the data recorded so far throughout the sequence of Qesem cave suggests the habitual use of fire, well-educated and specific raw materials selection and acquisition, systematic blade production, the production and exploitation of recycled items, the production and use of Quina and demi-Quina scrapers, along with indications of group hunting, specialised carcass processing strategies and meat sharing habits. All of this significantly contributed to a better understanding of the cultural dynamics ongoing during the Acheulo-Yabrudian and the behavioural traits characterising Levantine *hominin* groups occupying the site during the Late Lower Palaeolithic.

IV. 1 Geomorphological, Chronological and Environmental Setting

Qesem Cave is a filled karstic chamber, part of a larger karstic system associated with the Turonian limestone of the B'ina Formation, which is one of the richest-most formations in Israel in terms of cave presence (Frumkin et al. 2009). The cave, consisting in a chamber of a size of 21 x 19 m^2 with a height of at least 11 m., developed as an independent phreatic cave before the Samaria Hills reached their present position. The cave was closed, not permitting human occupation until the Middle Pleistocene when an opening developed due to erosion processes (Frumkin et al. 2009; Maul et al. 2011). The geomorphologic analyses conducted by Frumkin and colleagues (2009) indicate a combination of natural and anthropogenic sediment filling the cave, the latter being mainly flint, bone and firewood that was burned and turned into ash. The geological processes that Qesem Cave underwent during the Middle Pleistocene included subsidence, erosion and fracturing, along with the deposition of various materials. Approximately 200,000 years ago, these continuous phenomena ceased due to the roof cave collapse and denudation (Frumkin et al. 2009).

The whole stratigraphic sequence of Qesem Cave is over 11 m. high, while bedrock had not been reached yet. The sequence has been divided into a Lower and Upper part (Barkai and Gopher 2011; Gopher et al. 2005; Gopher and Barkai 2017). The Lower part, approximately 6 metres thick, is characterised by sediments with a clastic content and gravel and was deposited in a moment when the cave was more closed (Karkanas et al. 2007; Barkai and Gopher 2013; Gopher and Barkai 2017). The Upper part instead is constituted by cemented sediments with a high ash component and was deposited in a moment when the cave was more open, as suggested by the numerous calcified rootlets found within the sediments (Karkanas et al. 2007).

From a palaeoenvironmental point of view, the type of climate during the human occupation of Qesem cave would have been Mediterranean with the majority of precipitations during the winter, followed by dry summers (Sánchez-Marco et al. 2016). In more detail, studies focusing on micromammal and bird remains and the rich microfaunal assemblages recovered at the site suggest the presence of a heterogeneous environment constituted by a mosaic of open, shrubland and Mediterranean woodland habitat(Sánchez-Marco et al. 2016; Maul et al. 2011; Maul et al. 2016; Smith et al. 2013). Within the biotopes characterising the neighbouring areas of Qesem cave, woodlands are indicated by the presence of birds (e.g. *Otus scops*) and micromammal species associated with forested areas. Moreover, bushlands and open lands with the presence of bodies of water are suggested as well by birds (e.g. *Cygnus cygnus, Francolinus francolinus* and *Crex crex)* and micromammals (*Chameleo*) associated to aquatic environments (e.g. springs, swamps, lagoons) (Sanchez-Marco et al. 2015; Maul et al. 2011, 2016).

Figure 22. Location of Qesem Cave

First dating of the site was carried out in 2003 using U-Th dating (Barkai et al. 2003). The dates retrieved ranged between 382.000 and 207.000 years ago representing the earliest evidence of the Acheulo Yabrudian Cultural Complex in the region. An intensive U-Th series of dates from many of the Cave's parts was published later (Gopher et al. 2010) followed by a series of TL and ESR dates (Mercier et al. 2013) generally setting the human occupations at Qesem cave between MIS 11 and MIS7, from 420,000 to 200,000 years ago. More recently Falguerès et al. (2015) produced a new series of combined ESR/U-series dating on both animal materials (teeth), burnt flint and speleothems originating from three main areas of the site, namely the *Hearth*, the *Shelf* and the *Southern Area* showing a similar range. This chronological dataset from Qesem cave would indicate a range ending somewhat sometime ca. 420,000 years for the Lower Palaeolithic Acheulean in the Levant and a range starting slightly earlier than 200,000 years ago for the Mousterian (Falguères et al. 2016; Gopher et al. 2010)

IV.2 Archaeozoological setting

Overall the composition of the faunal assemblage of Qesem cave is characterised by a low degree of variation with the exclusive presence of Palearctic species (Blasco et al. 2014; Stiner, Gopher, and Barkai 2011). The archaeozoological record is dominated by fallow deer (*Dama mesopotamica*), while red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), aurochs (*Bos*), horses (*Equus ferus*), wild ass (*Equus idruntinus*) and wild boards (*Sus scrofa*) are present in lower proportions (Blasco et al. 2014).

Analysis of the faunal remains recovered at the site indicates large game hunting, aimed at adult individuals, of which, only selected body parts were brought to the site to be processed (Stiner et al. 2011; Blasco et al. 2014). Moreover, the analysis of cut-marks and bone surfaces provide information regarding the range of activities concerning the processing of carcasses performed in the cave and including butchering, roasting and marrow extraction (Stiner et al. 2011). Evidence of the use of bones for non-nutritional purposes, such as bone retouchers and sawing marks on bone surfaces have been recorded as well (Zupancich et al. 2016; Blasco et al. 2015; Rosell et al. 2015).

As mentioned above, fallow deer is the most exploited animal at the site. Age analysis shows a predominance of adult specimens (Stiner et al. 2011; Blasco et al. 2014). Such a high presence within the archaeozoological assemblage suggests devoted predation towards this type of prey, possibly indicating the development of cooperative hunting techniques among the Qesem inhabitants (Stiner et al. 2009; Blasco et al. 2014). Given the data provided by the analysis of immature mandibles and maxillae, Blasco and colleagues (2014) were able to hypothesise continuous occupation of the site going on from late summer through autumn, even though episodes of sporadic occupation of the cave during the rest of the year cannot be excluded (Stiner et al. 2011).

Furthermore, the detailed analysis of cut marks and percussion marks, along with the study of body parts, provided essential insights on *vis a vis* butchering processes occurring at the site. The low number of cranial fragments indicate that parts of the animal were processed directly on the kill site (Blasco et al. 2014). The disarticulation and de-fleshing activities were among the butchering activities performed at the site, suggesting the primary and immediate access to the carcass by the Qesem inhabitants (Blasco et al. 2014). Moreover, a specific pattern (crossed marks) within the cut marks on fallow deer limb bones indicates that the carcass was processed by people of different skill and probably in different moments (Stiner et al. 2009: Blasco et al. 2014). Furthermore, the analysis of the bone burnt surfaces allowed to assume the performing of various processes strictly related to fire, such as exposing of meat to heat for roasting, cooking, cleaning activities, the preparation of bones for marrow extraction or the use of bone as fuel (Blasco et al. 2014, 2016 and references therein).

Finally, along with the exploitation of fallow deer, red deer and other ungulate species, animals such as tortoises were exploited at the site as well. Through the analysis of cut marks, percussion marks and burning distribution patterns observed on bones, carapace and plastron fragments, Blasco and colleagues (2016) were able to highlight specific elements characterising the exploitation of these animals. The patterns observed indicate that in earlier layers, as in the shelf area, tortoise bones are characterised by cutmarks and rare burning traces, suggesting that the animals were mostly processed, probably with stone tools, without being roasted. On the contrary, in the more recent layers as the hearth area, burnt tortoise bones are more frequent, mainly associated to the carapace of the animal, while cutmarks are less represented suggesting that the animals were roasted and subsequently opened by active or passive percussion (Blasco et al. 2016; Barkai et al. 2017).

IV. 3 Palaeoanthropological setting

Overall, data concerning Middle Pleistocene *hominin* remains from southwestern Asian contexts are scarce. In the Levant, these are related to archaic members of the genus *Homo* and include skull fragments from Hazorea, teeth from the site of Ubeidya and Tabun cave (Layer E), a partial skull from Zuttiyeh and a femoral diaphysis from Gesher BenotYa'aqov (Hershkovitz et al. 2016; Grün et al. 2018 and references therein). At Qesem cave 13 teeth were found including four deciduous and nine permanent specimens, but no postcranial bones were recovered so far (Hershkovitz et al. 2016; Fornai et al. 2015; Weber et al. 2016). The analyses performed on the Qesem cave dental sample do not allow a definite association of the cave inhabitants to a specific hominin taxon. The Qesem teeth exhibit unique, primitive features along with characteristics related both with Neanderthals and AMH

(Anatomically Modern Humans) (Hershkovitz et al. 2011, 2016; Weber et al. 2016; Fornai et al. 2016). Such a mixture of morphology allowed specialists to propose two general scenarios:

a) is the possibility that a different hominin, with any association to H. erectus, Neanderthal or AMH, has occupied the cave during the Middle Pleistocene, a hypothesis which may be supported by the shape/morphology of the Qesem mandibular premolars and molars which resembles the Neanderthal (Weber et al. 2016; Hershkovitz et al. 2011, 2016).

b) the contribution of the Qesem cave hominins to the development of early modern human populations in the Levant supported by the size of the Qesem premolars, which is more modern-like. Unfortunately, with the data available to date, it is not possible to provide an accurate attribution to a specific hominin species for the Qesem teeth. Indeed, as stressed out also by recent analysis (Hershkovitz et al. 2016; Weber et al. 2016; Fornai et al. 2016), the Qesem teeth exhibit a mixture of traits which may be attributed to Neanderthals, AMH or a yet unknown hominin species.

IV.3 The Lithic Assemblage: an Overview

The Acheulo Yabrudian Cultural-Complex is composed by three main industries, namely the Amudian, dominated by blade production, the Yabrudian, characterised by Quina and demi Quina scrapers and the Acheulo Yabrudian dominated by bifaces and scrapers. At Qesem Cave both Amudian and Yabrudian are present within the lithic assemblage so far recovered. Nevertheless, several bifaces have been recovered at the site.

Throughout the sequence of the cave, the Amudian industry is dominant. It is characterised by the systematic production of blades and shaped blades along with Natural Backed Knives (NBKs) (Gopher and Barkai 2013). Through the technological analysis carried out by Shimelmitz and colleagues (2011, 2016), two main knapping trajectories have been identified within the production of blades at Qesem Cave. The first is characterised by the exploitation of flat flint slabs, cores maintain a similar shape throughout the entire production sequence, the combined production of blades, Primary Element Blades (PE Blades) and NBKs (Shimelmitz, Barkai, and Gopher 2011). The second trajectory is based on the exploitation of wider flint nodules and a significant change in the morphology of the cores along the reduction sequence of producing blades, PE Blades, NBKs and flakes (Shimelmitz et al. 2011).

Overall, the two identified trajectories share similar patterns, including:

- The exploitation of the natural morphology of the raw material with no decortication or pre-shaping.
- Use of powerful continuous blows through the entire length of the knapping surface.
- The control of core convexities through the removal of overpassing laminar items.
- The combined production of blades (and PE blades) and NBKs throughout a single knapping sequence

A dedicated use-wear analysis was performed on a blade sample from Square K10 at the site (Lemorini et al. 2006). The high degree of preservation of the materials allowed for a thorough interpretation of their use. Wear patterns identified on these tools demonstrated their use for processing animal matters (e.g. meat, hide) mostly through longitudinal motions, in association with butchering and de-fleshing activities, while few tools were used to treat herbaceous and woody plants (Lemorini et al. 2006). An interesting pattern emerging from this study is that overall, a low degree of rounding was observed on blade's edges, indicating a brief use and suggesting a high availability of flint at the site or in its vicinity (Lemorini et al. 2006).

Quina and demi-Quina scrapers represent the main feature of the Yabrudian levels of the cave[1]. Overall, as observed in other AYCC contexts (e.g. Tabun Cave), the Yabrudian levels of Qesem cave are characterised by a high frequency of scrapers, not observed in the Amudian layers, along with a low frequency of blades. Moreover, contrary to the complete *chaine operatoire* of Amudian blades

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[1] Being the subject of this study, more details concerning the technology and use of Quina and demi-Quina scrapers will be discussed later in this chapter.

found at the cave, significant parts of the *chaine operatoire* of Quina scrapers were not detected at Qesem Cave, indicating that the complete scrapers or scraper blanks were brought to the site (Barkai and Gopher 2013; Gopher and Barkai 2017). As hypothesised by Gopher and Barkai (2017) and by other scholars involved in the study of Acheulo Yabrudian contexts (e.g. Zaidner and Weinstein-Evron 2016; Shimelmitz et al. 2014), the presence of small percentages of blades within the Yabrudian assemblages and the few Quina and demi Quina scrapers found in the Amudian assemblages suggest that the two were "*parts of a single industrial complex produced by a single group of hominins*" (Gopher and Barkai 2017, pp. 206).

A relevant aspect characterising both the Yabrudian and the Amudian of Qesem cave is recycling of flint items. Several studies have been carried out and work is ongoing, focusing on recycling (Parush, Gopher and Barkai 2015; Gopher et al. 2016; Assaf et al. 2015; Venditti et al. 2019).

The technological analysis of the recycling assemblage shows specific technological trajectories devoted to the production of flakes and blades through recycling old, discarded 'parent flakes – 'cores on flakes'.

Overall, recycling products may constitute up to 10% of the entire lithic assemblage recovered at Qesem cave.

In their detailed analysis of the recycling assemblage at the site, Parush and colleagues (2015) identified five flint recycling modes:

- <u>The exploitation of bifaces as cores</u>. In several cases, old patinated bifaces have been exploited as blade cores.
- <u>Large patinated flakes exploited as blanks to produce side scrapers</u>.
- <u>Side scrapers used as cores to produce flakes</u>. Flakes were detached after the production of the scrapers. Generally, flakes were detached from the ventral surface of the scraper. It is worth mentioning that, especially when there are no apparent differences in surface patina,

this behaviour may not indicate the recycling of the scrapers as a 'core on flake'. Still, it may reflect the need to thin the scraper to enhance its manipulation or placement into a handle.

- The use of discarded cores. Blanks are produced using old cores that were once abandoned and characterised by patinated surfaces.
- Production of small flakes and blades from parent flakes or blades. This recycling trajectory involves the exploitation of both old patinated and unpatinated parent.

Use wear analysis was performed on recycled 'parent flakes – cores on flakes' and recycling products to assess their function. A preliminary study on a sample of recycled implements was conducted by Lemorini and colleagues (2015) while recently use wear and residues analyses have been applied to a larger sample in the framework of a PhD research (Venditti 2017). From the studies performed so far, it emerged that recycled items were used mostly to perform cutting activities (Lemorini et al. 2015). Most of the analysed items were exploited in the processing of animal materials such as meat and fresh hide (Lemorini et al. 2015; Venditti 2019). Traces associated with bone processing have been found as well along with wear related to the processing of vegetal (e.g. woody plants).

Finally, another relevant aspect of the lithic assemblage of Qesem cave is the presence of spheroids/polyhedrons. So far, 30 shaped stone balls have been found at the site, the vast majority of them within two Amudian horizons in the southwestern area of the cave, while they are absent in Yabrudian levels (Gopher and Barkai 2017; Ran Barkai and Gopher 2016). In several cases, the spheroids have been found in concentrations of less than two square metres (Ran Barkai and Gopher 2016). The majority of the spheroids are made of limestone, while only one is made of flint. This is of significance given the fact that these tools are the only example of limestone exploitation at the site. Regarding the use of spheroids at Qesem cave, functional analysis involving experimental activities are still ongoing. However, given the absence of limestone flakes in the cave, their use as cores can be discarded (Barkai and Gopher 2016). Through the analysis of the traces identified on several specimens, it is plausible to assume their use in specific activities. So far, the study of use-wear and residues suggests that these tools were utilised to break bone for marrow extraction. If this is the case, the spheroid assemblage of Qesem cave may indicate yet another element of space and task division at the site (Barkai and Gopher 2016).

Figure 23. Example of the stone tools characterising the Qesem cave lithic assemblage. a) Amudian blades; b) NBK; c) recycled items; d) spheroids/polyhedrons.

The entire lithic assemblage of Qesem cave that consists of hundreds of thousands lithic items is made on flint with few items made of limestone (spheroids) and basalt. In the last three years, a detailed study devoted to raw material sourcing has been performed and is yet ongoing. The preliminary results of this study have highlighted relevant aspects concerning the selection and provisioning of flint at the site (Wilson et al. 2015). Among the identified flint types (over 80), the most exploited one at Qesem cave is a striped flint which is found in the form of slabs (Wilson et al. 2015). Within the potential source locations, thirteen have been identified within a radius of 5 km from the site, all of which are Turonian outcrops or secondary deposits of Turonian origin (Wilson et al. 2015).

Within the assemblages analysed so far, blades are the most represented tool types made of Turonian flint. Such behaviour may be explained by the fact that this type of flint comes in the form of thin slabs, which are highly suitable in blade technology, supporting their high frequency in the Qesem cave Amudian contexts (Wilson et al. 2015).

Moreover, within the identified raw material types, ten types differ from the local Turonian and have been associated with the Campanian Mishash Formation located 15 km. south of Qesem cave (Wilson et al. 2015). The presence of flint coming from such far sources may point towards a well-planned exploitation strategy focused on this specific type of flint, also indicating the wide movement range characterising the Qesem cave hominins (Wilson et al. 2015).

The above results are confirmed by earlier studies, based on measuring the in situ cosmogenic^{10}Be in flint items from the cave and out of the cave, indicating the exploitation of both surface and subsurface flint sources (Boaretto et al. 2009; Verri et al. 2005).^{10}Be concentration varies according to the depth at which flint is buried, with more significant concentrations characterising surface (exposed) flints. At Qesem cave, handaxes and scrapers exhibit low levels of ^{10}Be, while blades are characterised by high^{10}Be concentrations (Boaretto et al. 2009). This pattern suggests that, given their quality, the nodules utilised to produce handaxes and scrapers were most probably quarried from primary underground sources (or from sources that were exposed to the elements for a very short time). This indirectly suggests a high knowledge of the resources available in the environment by the Qesem *hominins*.

Furthermore, the exploitation of high-quality quarried flint in several cases coming from distant sources (>15 km) (Agam & Zupancich in press) for the production of specific tools as Quina scrapers highlights the important role played by these objects at Qesem Cave.

IV.4 The Quina and demi-Quina Scraper assemblage from Qesem Cave

A total of 214 Quina and demi-Quina scraper constitute the selected sample that is the subject of this research. All of the artefacts analysed in this study come from four excavation seasons carried out at Qesem Cave from 2013 to 2016. The items were directly collected from the excavation with a sample of the sediments in which they were embedded, to minimise contamination and enhance the possibilities of identifying preserved organic and inorganic residues. The tools come from each of the four main areas of the cave (Tab. 24), namely: The Shelf, the Deep Shelf, the Hearth and the South of the Hearth Area, which are described below.

The Shelf: The Yabrudian assemblage Below the Shelf, more than 300,000 years old, spreads over squares D-G/9-12, at elevations of 520 to 700 cm below datum and is composed of a mixture of soft and hard brown sediments (Gopher et al. 2016; Parush et al. 2016; Falguères et al. 2016). At the top of this layer is soft, lighter-coloured sediment, which was almost sterile. This layer dips from northeast to southwest and from south to north. The assemblage has been studied in detail and also provides evidence of systematic lithic recycling (Parush 2014; Parush et al. 2015, 2016). The entire lithic assemblage consists of 10.947 artefacts (*débitage* and shaped items: 4.292), with 1.291 artefacts per $1m^3$ (Gopher et al. 2016).

Deep Shelf – Unit I: This is the oldest assemblage excavated at Qesem Cave so far. It is localised at the northernmost part of the cave, under the rock shelf, and includes squares C-E/6-8 at elevations of between 800 and 1130 cm below datum. The sediments of this layer are dark-brown, moist, with small (up to 10 cm in diameter) and medium (up to 20 cm in diameter) rocks (Y. Parush, personal communication). The entire lithic assemblage is composed of 7.287 artefacts (*débitage* and shaped items: 3.373), with a density of 1.751 artefacts per $1m^3$.

The Hearth: This context represents a series of superimposed, centrally located hearths which were repetitively used as a focus for human activities, starting at least as early as ca. 300,000 years ago (Falguères et al. 2016). The assemblage includes most of the $4m^2$ of the hearth (I-J/12-13). Some of the sub-squares included in this assemblage (I/12a; J/12b; I/13a) do not fully belong to the hearth, while some parts of squares I/14 and J/14, which do belong to the hearth, are not included in this unit, but, instead, were included in the area south of the hearth. These affiliations are the result of them not being separated during fieldwork. The faunal remains from this context were previously analysed and published by Blasco et al. (2014, 2016). The entire lithic assemblage consists of 10.599 artefacts (*débitage* and shaped items: 3.323), with 6.144 artefacts per 1m^3 (Gopher et al. 2016).

South of Hearth: This assemblage comes from squares I-K/14-15, at elevations of between 545 and 600 cm below datum. This assemblage includes the southern edge of the hearth, in addition to the squares just to the south of it and has dark-brown sediments. This area is characterised by the presence of large flat rocks in some parts (Shahack-Gross et al. 2014). This assemblage is the closest to the hearth, which was at similar elevations (Gopher et al. 2016). The faunal remains from this context were analysed and published in Blasco et al. (2016a). The entire lithic assemblage consists of 8.252 artefacts (*débitage*, and shaped items: 2.884), with 3,751 artefacts per 1m^3 (Gopher et al. 2016).

The spatial distribution of Quina and demi-Quina scrapers in the cave (see below), show that the majority of Quina and demi-Quina scrapers come from the Shelf and Deep Shelf areas, with a lower frequency characterising the Hearth and the Southern Areas.

	Quina	**1/2 Quina**
Deep Shelf		
n	26	40
%	31%	32%
Shelf		
n.	14	39
%	17%	31%
Hearth		
n.	0	15
%	0%	12%
South of the Hearth		
n.	2	3
%	2%	2%
Not Assigned		
n.	42	27
%	50%	22%
Total	**84**	**124**

Figure 24. Distribution of Quina and demi-Quina scrapers across the areas of Qesem Cave

IV.4.1 Assemblage composition and Raw Material Selection

Within the analysed scraper's sample demi-Quina scrapers (58.9%) are more frequent than Quina ones (41.1 %). Sorting the scrapers and assigning them to Techno Morpho Functional Groups (TMFG) was performed according to the variables proposed by Bourguignon (1997). Details of each of the TMFGs are described in Chapter II. Quina scrapers (TMFG II and III) are mostly represented by implements of the TMFG III (n=43) than TMFG II (n=26) category, indicating that the majority of the Quina scrapers exhibit a single complete Quina retouch cycle (Bourguignon 1997; Lemorini et al. 2016). Long cycles of Quina retouch indicating several stages of retouch and rejuvenation (TMFG II) have been identified on 26 of the analysed Quina scrapers.

Demi-Quina scrapers, which are nearly exclusively made on thinner blanks when compared to the ones exploited for Quina scrapers and are represented mostly by objects falling within the TMFG IV (n=80). These are characterised by a lightly stepped Quina retouch not affecting the entire available edge surface but located over its thicker portions. On the other hand, 47 demi-Quina scrapers fall into TMFG V, characterised by a more scalar retouch than that observed in TMFG IV also affecting a broader edge area.

The studied sample includes 7.5 % scrapers that are assigned to TMFG I, which represents the category of tools characterised by Clactonian notches or detachments, suggesting their re-use as cores. It is worth mentioning that most of the tools, 14 out of 16, falling into this TMFG are Quina scrapers. This can be explained by the fact that the overall thickness of the blanks exploited in the production of Quina scrapers (mean thickness 18.9 mm) is significantly higher than the one characterising the blanks used to produce demi-Quina ones (mean thickness 15.2 mm), making them more suitable for their use as cores for flake detachment (Fig. 25).

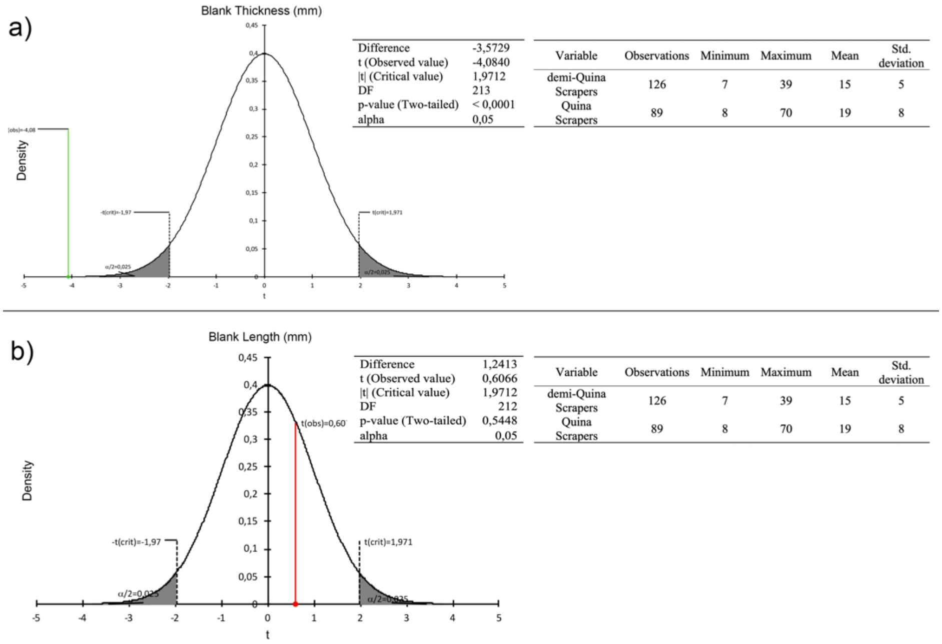


Figure 25. Two Sample t-test showing run on blank thickness (a) and length (b) of Quina and demi-Quina scrapers. Thickness results to be a statistically significant feature (p<0,0001) within the two scraper types.

The majority of Quina and demi-Quina scrapers composing the analysed sample are made on primary blanks (87.3%), while only a small proportion (12.6 %) is made on patinated ones. It is worth underlining that within the tools made exploiting old patinated blanks demi-Quina scrapers are the most represented (64.2%). Regarding the morphology of the exploited blanks, both Quina and demi-Quina scrapers are made on flakes, with one single implement out of the entire assemblage made on a blade-like blank. The blank section is asymmetrical in most of the cases, with its thicker portion corresponding to the prehensive Techno Functional Unit of the scraper. The amount of cortex retained over the surface of the blanks is low, with most of the artefacts exhibiting values between 0 and 10% of retained cortex, suggesting the preferred use of secondary and tertiary flakes in the production of Quina and demi-Quina scrapers. This assumption is further supported by the fact that any of the analysed scrapers exhibit removals over their dorsal surface, which may suggest an intentional removal of cortex on primary flakes. Overall, this evidence underlines the fact that, at Qesem Cave, more attention was given to the edge of the tool rather than to the surface of the blank.

When identifiable, the predominant striking platform is flat, with several specimens of scrapers exhibiting a cortical butt. This pattern reflects an overall low effort dedicated to the preparation of the striking platform during blank production. As suggested by the prominent bulbs of percussion characterising both Quina and demi-Quina scrapers unearthed at Qesem cave, a hard hammerstone, most likely of stone, was used during the first stage of scraper production.

On the contrary, as suggested by the several bone retouchers found at Qesem cave (Rosell et al. 2015), and by the experimental reproduction of Quina and demi-Quina scraper replicas, softer hammerstones are better suited and have been possibly used along with bone retouchers to create the typical scaled stepped retouch characterising the edge of Quina implements. In the majority of the cases, the retouch affecting the edge of the scraper has a direct position (i.e. on the dorsal surface), exception made for very few implements (n=6) exhibiting an inverse retouch. The retouch delineation is always rectilinear, and in most of the cases (n=139), its extent over the edge is invasive. Within the Qesem Cave Quina scraper assemblage, a clear pattern emerges regarding the morphology of the edges. Almost 3/4 (72%) of the scrapers, including both Quina and demi-Quina, feature a straight edge delineation, whereas a convex delineation is observed on 16.5% of the artefacts only. This pattern is of great relevance, as it indicates a clear preference in edge morphology in the Qesem scrapers, which is not the case in the later European Quina scrapers (Bourguignon 1997). The functional meanings of these data will be discussed in detail later in this work.

The profile of the edges, in both Quina and demi-Quina scrapers is mostly straight, with few implements exhibiting concave, convex or irregular profiles. Edge cross-section is straight-straight (n=161) in most of the artefacts, with several specimens exhibiting Concave-Straight (n=19) and Straight-Convex (n=20) edge cross-sections. If from a morphological point of view, any major difference is present between Quina and demi-Quina scrapers at Qesem cave, variations concerning edge angle do exist. Indeed, Quina scrapers exhibit an average edge angle of 69.9° while the mean edge angle value for demi-Quina scrapers is 55.7°. This pattern, as will be discussed later in this chapter, is strictly related to the range of activities performed by each of the two types of scrapers reflecting different functional needs of the Qesem inhabitants.

demi-Quina Scrapers

	Length (mm)	Width (mm)	Thickness (mm)	Weight (gr)	Cortex %	Edge Angle
Mean	60.3	40.0	15.3	314.7	31.3	55.7
Min	32	14	7	13.0	0	28.0
Max	94	76	39	1336.0	90	89.0
St. Dev.	12.9	12.2	5.3	264.8	34.1	11.9
Tot.	**126**					

Quina Scrapers

	Length (mm)	Width (mm)	Thickness (mm)	Weight (gr)	Cortex %	Edge Angle
Mean	59.1	44.5	19.0	366.2	25.0	69.3
Min	22	12	10	6.0	0	43.0
Max	100	91	70	1196.0	90	90.0
St. Dev.	17.0	16.8	7.5	294.4	29.9	13.5
Tot.	**88**					

Table 14. Main morphometric features of the analysed Quina and demi-Quina assemblage from Qesem Cave

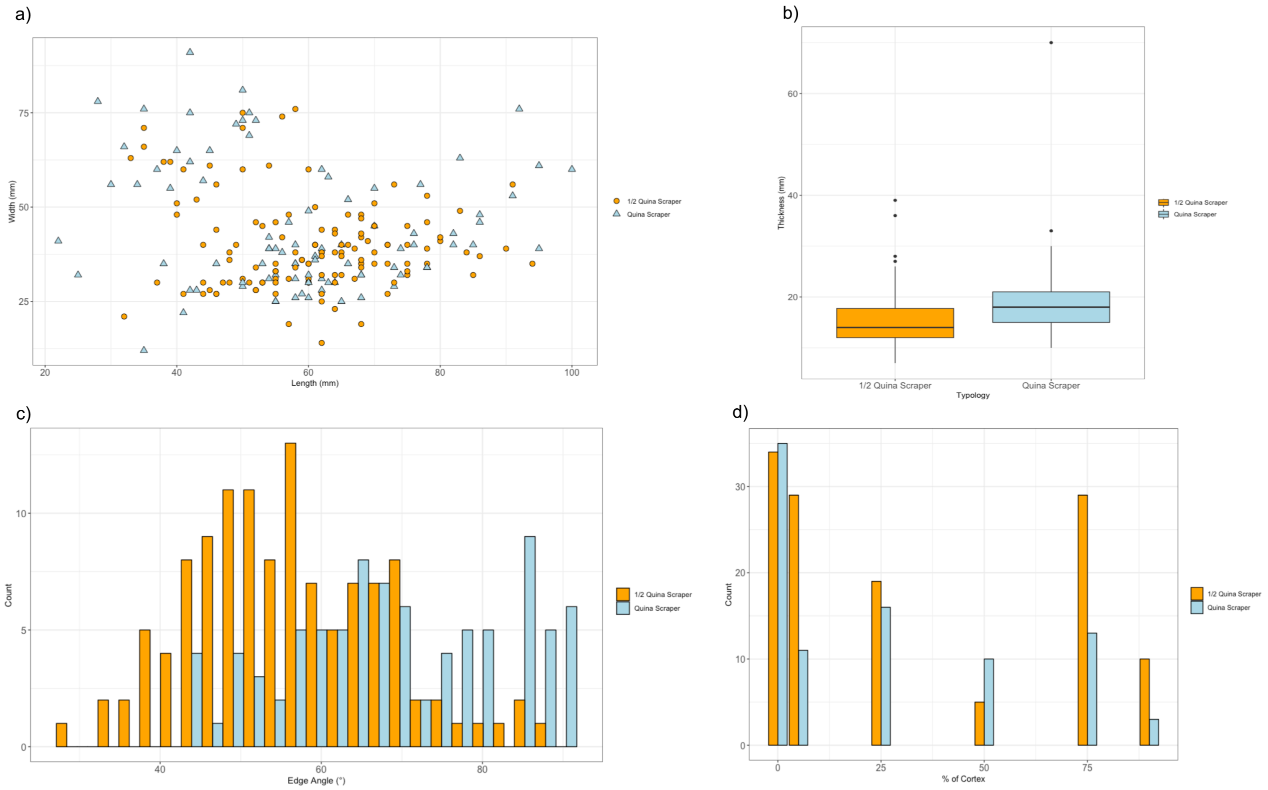


Figure 26. a) length by width comparison; b) blank thickness comparison; c) edge angle comparison; d) amount of cortex retain over the blank surface

The scrapers coming from Qesem Cave and subject of this work (n=214) at the site are made of flint.

A preliminary analysis of the raw material of scrapers in the studied sample was performed based on visual traits allowing associating each object to a flint type (Wilson et al. 2016; Agam & Zupancich submitted). As previously stated, most of the lithics at Qesem cave are made on flint originating from sources not far from the site (~5km) (Fig. 26). However, in the case of Quina and demi-Quina scrapers, the analysis of raw material types indicates that flint types originating from more distant outcrops were exploited. Indeed, the identified flint types come from sources located 12 to 13 km North of the cave (Cenomanian/Turonian outcrops) and more than 15 km South of the site (Campanian outcrops). Furthermore, differences in raw material sources have been identified within Quina and demi-Quina scrapers. A significant amount (35.3 %) of Quina scrapers in the Qesem cave assemblages is made on flint originating from the farthest Campanian outcrops (>15 km South of the site). This pattern, as stated in previous studies (e.g. Boaretto et al. 2009) indicates the detailed knowledge of the resources available to the Qesem hominins and highlights also the preference for a specific type of raw material. The choices leading to such an effort invested in the raw material selection are probably driven by both flint properties, mainly ease of knapping and durability, and by a clear planned function for the produced tools (Agam & Zupancich in press).

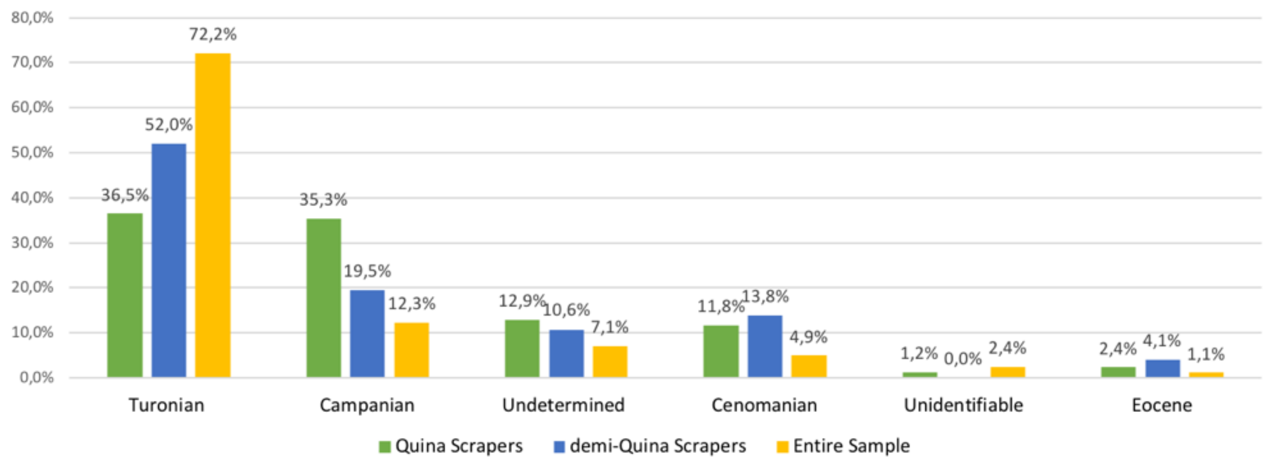


Figure 27. Raw material types characterising the Quina and demi-Quina scraper assemblage of Qesem Cave.

IV.5 The Use of Quina and demi Quina scrapers

Overall the lithic assemblage unearthed at Qesem cave is characterised by a high degree of preservation. Indeed, despite the age of the site, no severe post-depositional modification (henceforth PSDM) affects the stone tools. This high degree of conservation of the materials allowed performing a detailed and in-depth functional analysis, including the integration of use wear and residues analyses. As discussed in detail in the methodology chapter, the methodological framework proposed in this study included the observation of both the edges and surfaces at low and high magnifications along with the analysis of possible use-related residues utilising Micro-FTIR. In this way, it was possible to achieve a complete dataset regarding not only the use but also how these specific tools were manipulated and handled during the activities in which they were involved.

However, even though the majority of the tools are well preserved, several PSDM patterns have been observed within the assemblage, which, on the one hand, did not allow achieving high detailed functional data, and on the other hand provided relevant hints regarding taphonomic processes occurring at the site.

IV.5.1 Post Depositional Modifications Characterising the Quina and demi-Quina assemblage of Qesem Cave

Within the post-depositional modifications affecting the Quina and demi-Quina scrapers of Qesem cave, both mechanical processes and chemical phenomena have been identified. Mechanical processes are generally caused by the movement of the artefacts within the sediments (Burroni et al. 2002; Levi-Sala 1986). These movements exert compressions on the surfaces and edges of the tools, which results in edge damage and micro striations (Burroni et al. 2002). At Qesem cave, such phenomena are sporadic as it has been recognised mostly in association with white patina. Such scarce evidence of mechanical alterations indicates that the Quina and demi-Quina scrapers did not suffer heavy soil compressions or experienced severe movement after their deposition.

Chemical processes are more common at Qesem cave and result in the development of different types of patinas on the artefacts. Yet, the causes of patina formation are not clear. However, it is assumed that these phenomena are generated by the pH value of the soil in which the tools are buried and in an indirect way by water (Levi Sala 1986; Burroni et al. 2002; Rots 2010; Van Gijn 2010). Especially in the case of white patina, consisting of whitening of the flint surface often visible also by the naked eye, water plays a significant role (Caux et al. 2018). Indeed, flowing within the soil or dripping from the cave's ceiling, water carries particles of calcium carbonate ($CaCo_3$), which are nothing more than dissolved rocks that permeate the artefact's flint surface, altering its composition, leading to the formation of patina, whose white colour is given by $CaCo_3$.

At Qesem cave, white patina is the most common PSDM, and it is particularly frequent in a specific area of the cave: the Shelf (excavation squares E, F, G, D). Another well-represented kind of PSDM is glossy patina. This phenomenon consists of a uniform sheen affecting the surface of the tool, caused by both chemical and mechanical causes (Levi-Sala 1986). At the site, glossy appearance is very frequent in a particular area of the shelf, square G6. Worth of mention is the fact that in this square in particular within the range of elevations 670 and 700 small channels caused by water flow are visible. This said, it may be suggested with caution (since much of the area of the shelf has yet to be explored) that water activity was stronger in this area in a particular time, causing the objects to move and leading to the development of glossy patina over the tools' surface.

Finally, thermal alteration falls within the more common alterations affecting Quina and demi-Quina scrapers at Qesem cave. This alteration is related to the exposure of flint tools to thermal shocks caused by the contact with fire and has been recognised in the hearth and the shelf areas at the cave. Of particular interest is that in the shelf, most of the tools affected by thermal alteration come from the deeper levels, within a range of elevations from 1000 to 1120 below datum. This pattern is of relevance as it may be an indirect indication for the presence of a fireplace in the older levels of the site dated to ca. 400,000 years ago.

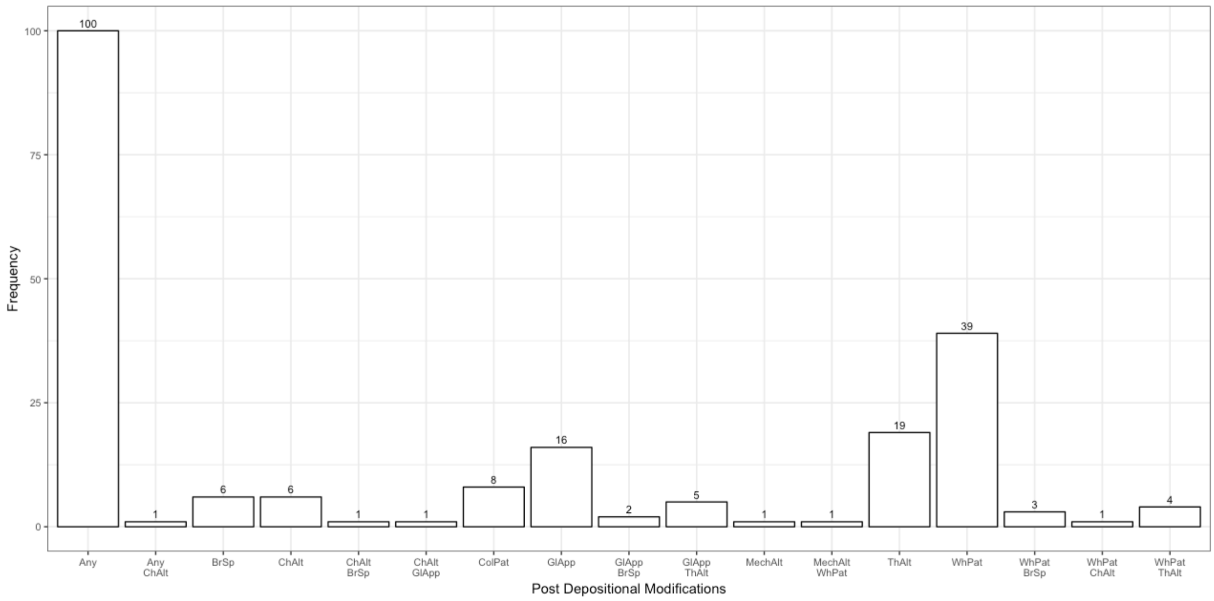


Figure 28. Types of post-depositional modifications affecting Quina and demi-Quina scrapers at Qesem cave. Ch.= Chemical Alteration; BrSP.= Bright Spots; GlApp. = Glossy Appearance; ColPat.= Coloured Patina; ThAlt.= Thermic Alteration; MechAlt.= Mechanical Alteration; WhPat.= White Patina

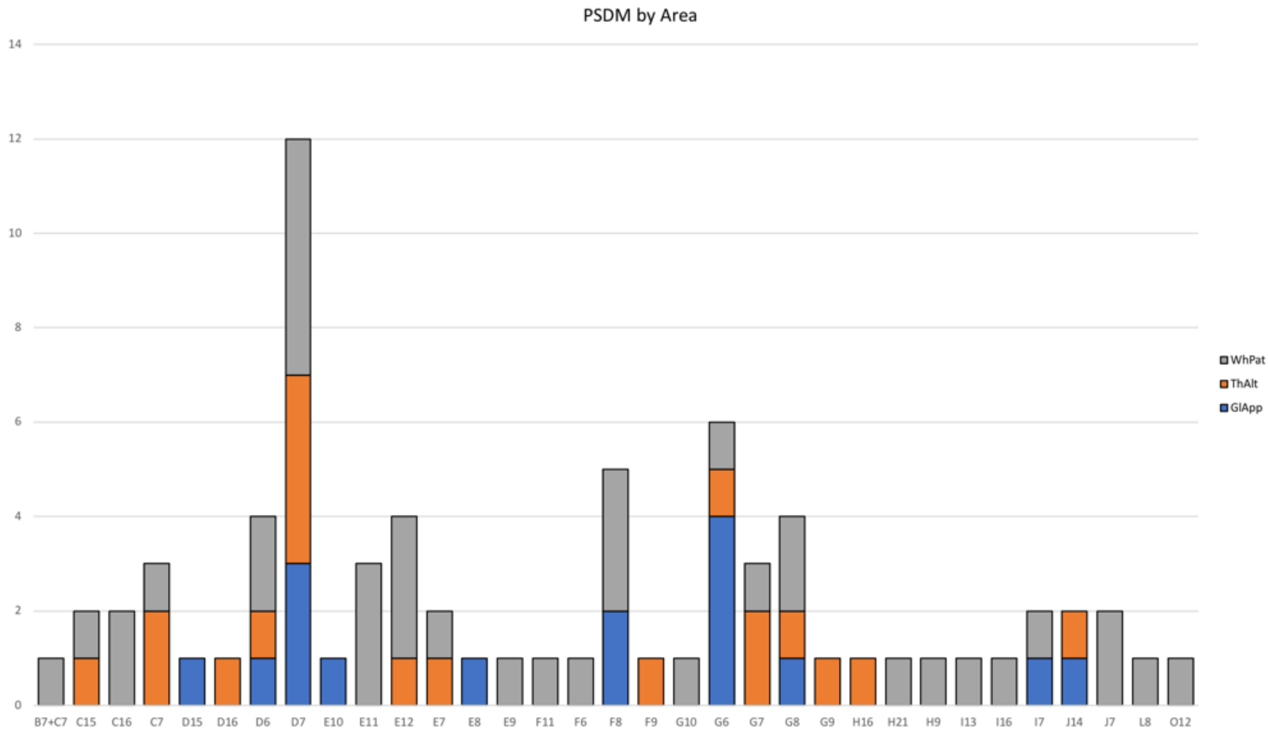


Figure 29. Most common types of post-depositional modification within the different areas of the site.

IV.5.2 The use of Quina scrapers at Qesem cave

Within the Quina and demi-Quina assemblage subject of this research, Quina scrapers (n=88) constitute 41.1% of the sample. From a spatial point of view, as visible in figure 47, most of the Quina scrapers (TMFG 2 and 3) come from the shelf area, while only a few items have been found in the Southern area, while no Quina scraper has been unearthed from the Hearth area of the cave.

Of the 88 Quina scrapers analysed, 50.6% have been used, 9.2% of the items exhibit possible use-related traces which, however, have been considered not diagnostic, 3.4% of the items have not been used, probably discarded after a resharpening episode, and 36.8% of the items are affected by PSDM which did not permit functional interpretation.

Within the worked materials, hide (at different stages), wood, bone, animal matters (meat) along with a range of substances defined as medium and soft have been identified. Scraping (n=29) is the most represented activity in which the tools were used, even though there are several cases of Quina scrapers used for cutting (n=7) and in mixed activities (n=2) involving both longitudinal and transversal movements, while in the case for six implements it was not possible to define the motion of use.

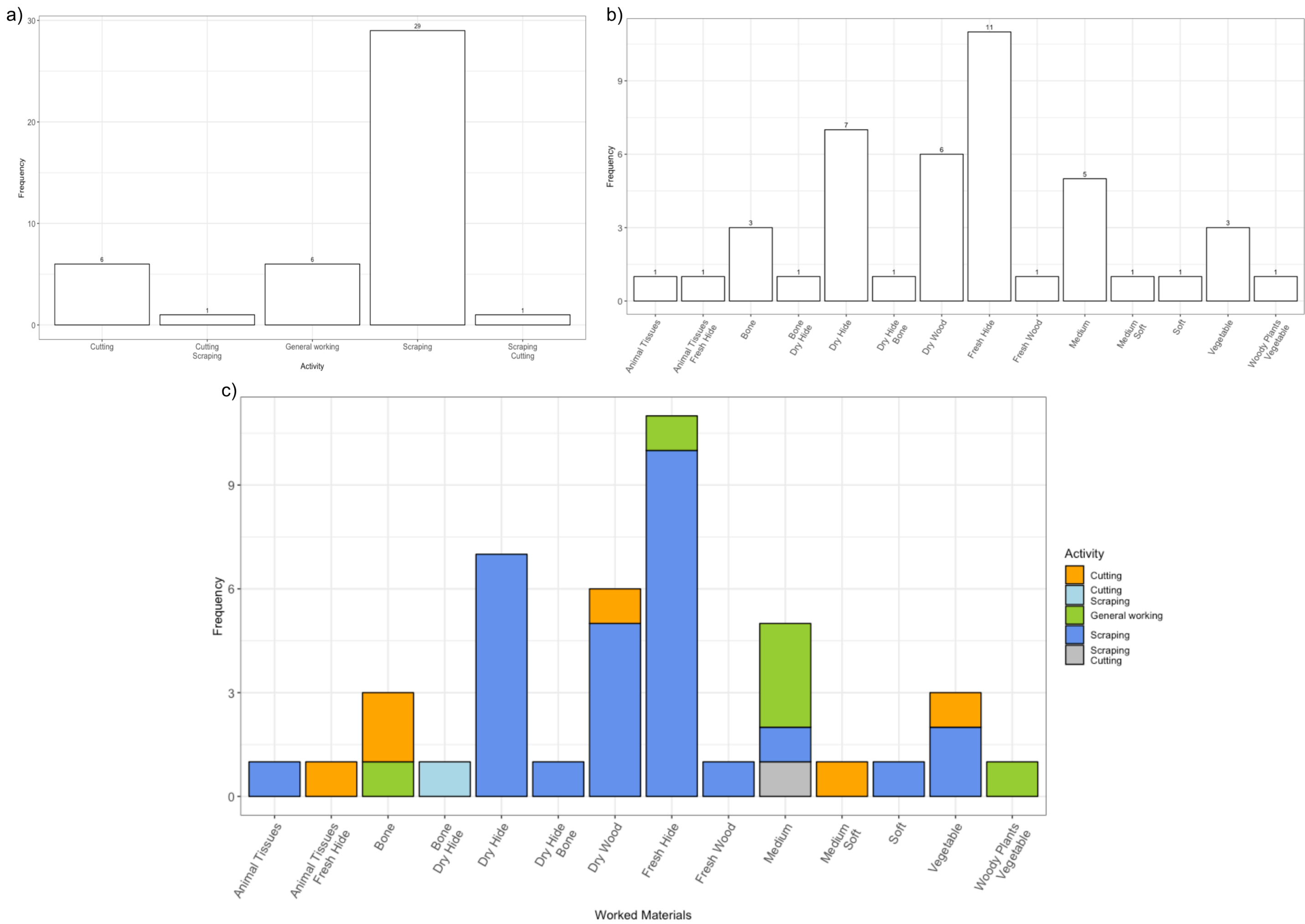


Figure 30. a) activities performed; b) materials processed; c) worked materials by activities

IV.5.2.1 Animal Substances Processing

Hide Working

Most of the Quina scrapers analysed were used for the processing of hide. Wear associable with both dry and fresh hide have been identified along with evidence related to the use of additives, probably ash. Regarding the motions performed in hide working, in the case of fresh hide, all of the tools were used through transversal movements, related to scraping activities (Fig. 30).

In both fresh hide and dry hide processing, most of the available edge area of the scraper is utilised, with its central portion bearing the more developed traces of use. These traces are characterised by edge damage consisting in both feather and step scars associated with a medium to high degree of edge rounding. In the case of tools used in dry hide scraping this rounding is more pronounced. At higher magnifications, polish with a smooth texture and a domed topography is visible over the edge/s of the tools (Fig. 31). In several cases, the combination of striations and high brightness of the polish lead to hypothesise the presence of an additive substance on the hide surface during its processing. As testified by the results emerged from the functional analysis of the blades coming from the hearth area of Qesem Cave (see Lemorini et al. submitted) and the comparison between the features observed on archaeological and the experimental traces, ash can be suggested as an additive substance utilised during the processing of hide.

Both the edge damage and polishes exhibit an overall transversal orientation. However, in most of the cases, a slight inclination is visible suggesting that the movement was not perfectly transversal, but there was some inclination and oblique movement within it. This pattern, also observed in the experimental record, can be associated with two factors: a slicing activity within the hide processing performed to remove thicker chunks of fat, and the use of the tool freehand, a matter that will be discussed in more detail later in this chapter.

Figure 31. Sample of Quina scrapers utilised to process Fresh Hide. Red dotted line indicates the location of the use wear. Yellow dotted line indicates the location of prehension or hafting traces.

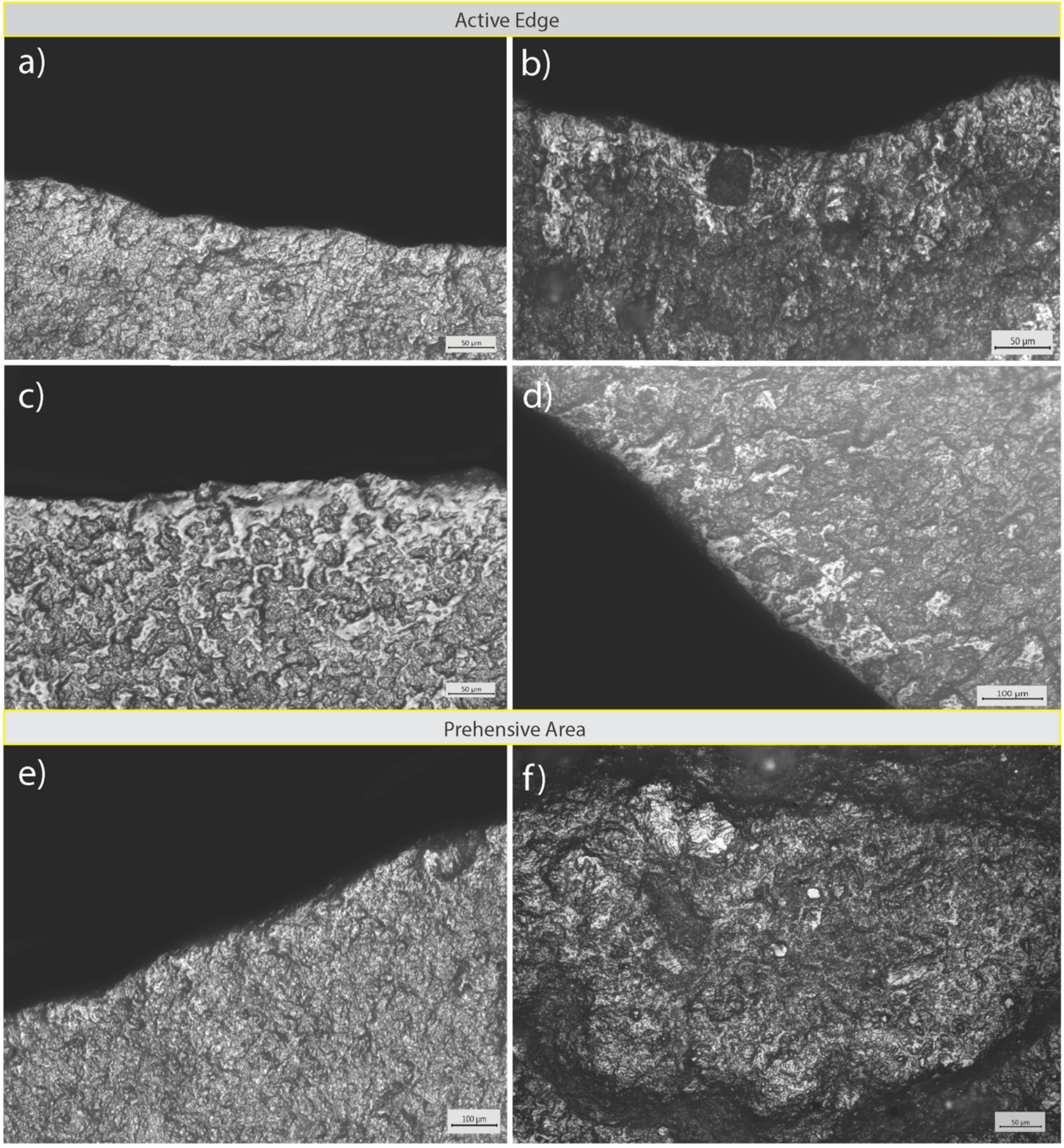


Figure 32. Microwear identified on the edge of Quina scrapers and associated with the processing of fresh hide. a) E12b 560-580; b) C8a 950-955; c) F8a 795-800; d) F11a 575-580; e) E12b 560-580; f) F11a 575 – 580. Microwear pictures are taken at 200x.

Bone Working

Working of bone represents the only case, within the Quina assemblage of Qesem cave, where the prominent activity is not scraping but instead cutting. Within the eight items showing bone working, longitudinal motions prevail, while transversal movements are recorded only in one case (E7b_935-940) (Fig. 37). Edge damage patterns observed on the tools consist of step scars often associated with the snapping of several areas of the edge. The degree of edge rounding observed is generally high.

The identified polish that developed over the tools' edges features a smooth texture in all of the observed specimens. Differences have been recorded in its topography. Polish related to the cutting of bone is characterised by a domed topography, while a flat topography is featured by the polish band associated with bone scraping.

Through the analysis of the orientation patterns of both edge damage and microwear, the one case of scraping identified shows a transversal orientation characterising both the microchipping and polish. Wear interpreted as evidence of cutting is, on the other hand characterised by a bi-directional oblique orientation, indicating a sawing of the bone. Concerning bone processing, a relevant aspect is related to the aim of the cutting activities recorded, which do not seem to be related to occasional contact with bone, as it can happen during butchering activities. Indeed, the continuous distribution of the band of polish over the edge surface indicates a prolonged activity, presumably devoted to the sawing of bone, not for nutritional purposes (Zupancich et al. 2017).

Animal Tissues Processing

Traces related to the processing of animal tissues (e.g., meat) have been identified only on two artefacts, C17a_645-650 and F8a_790-795. The identified edge damage consists of small feathered scars associated with a low to medium degree of edge rounding. A smooth texture characterises the polish identified over the tools' working edge. Given the low degree of polish development, it was not possible to define the texture of this polish. Both microchipping and polish have an oblique bi-directional orientation which indicates the use of both tools in cutting activities.

IV.5.2.2 Vegetal Substances Processing

Wood Working

Both fresh and dry wood were processed at Qesem cave utilising Quina scrapers, with dry wood being more represented (Fig. 32). Only in one case the wear identified suggested a cutting activity, while scraping is dominant across the assemblage. The observed edge damage consists of small step scars associated with a relatively high degree of edge rounding. The microwear identified of the tool is represented by a band of smooth reticulated polish developed over the tools' edge (Fig. 33). Both the edge damage and microwear exhibit a transversal orientation. It is worth underlining that in the case of wood scraping, the polish direction is extremely perpendicular to the edge, not exhibiting any obliqueness in its orientation, as instead observed on the Quina scrapers utilised to scrape hide. This may indicate a difference in the gestures performed. During wood scraping short and straight strokes were performed, contrary to what happens during hide scraping where the amplitude of the gesture is higher, and the movement is not entirely straight but slightly oblique.

Plant Working

Within the Quina assemblage of Qesem cave, several artefacts (n=4) exhibit traces associated with the processing of vegetal materials, interpreted as woody plants. The identified wear points towards mixed activities, including both transversal and longitudinal motions. Edge damage affecting the tools consists of small step scars associated with a medium rounding of the edge. At high magnifications, the identified polish is characterised by a smooth texture and a domed topography with a continuous distribution over the outer area of the edge (Fig. 33). The use-wear patterns identified, when compared to the experimental data related to the processing of woody plants, exhibit significant similarities with the traces generated by the processing of *Lentiscus.* Such evidence allows speculating regarding the exploitation by the Qesem inhabitants of small flexible plant fibres which can be used for various purposes (e.g. twining and rope making) (e.g. Adovasio 2016; Soffer et al. 2000).

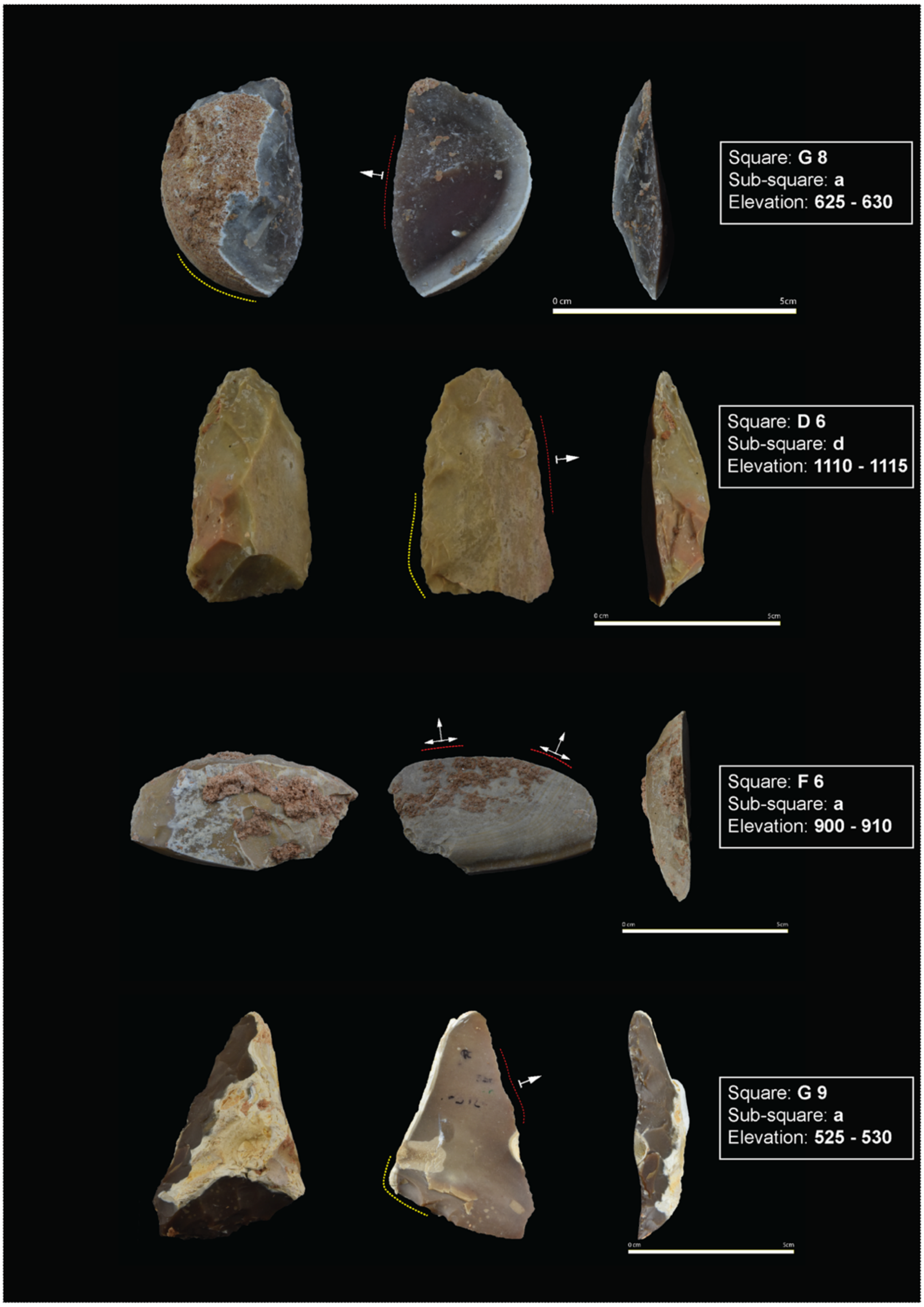


Figure 33Sample of Quina scrapers utilised to process wood and woody plants. Red dotted line indicates the location of the use wear. Yellow dotted line indicates the location of prehension or hafting traces

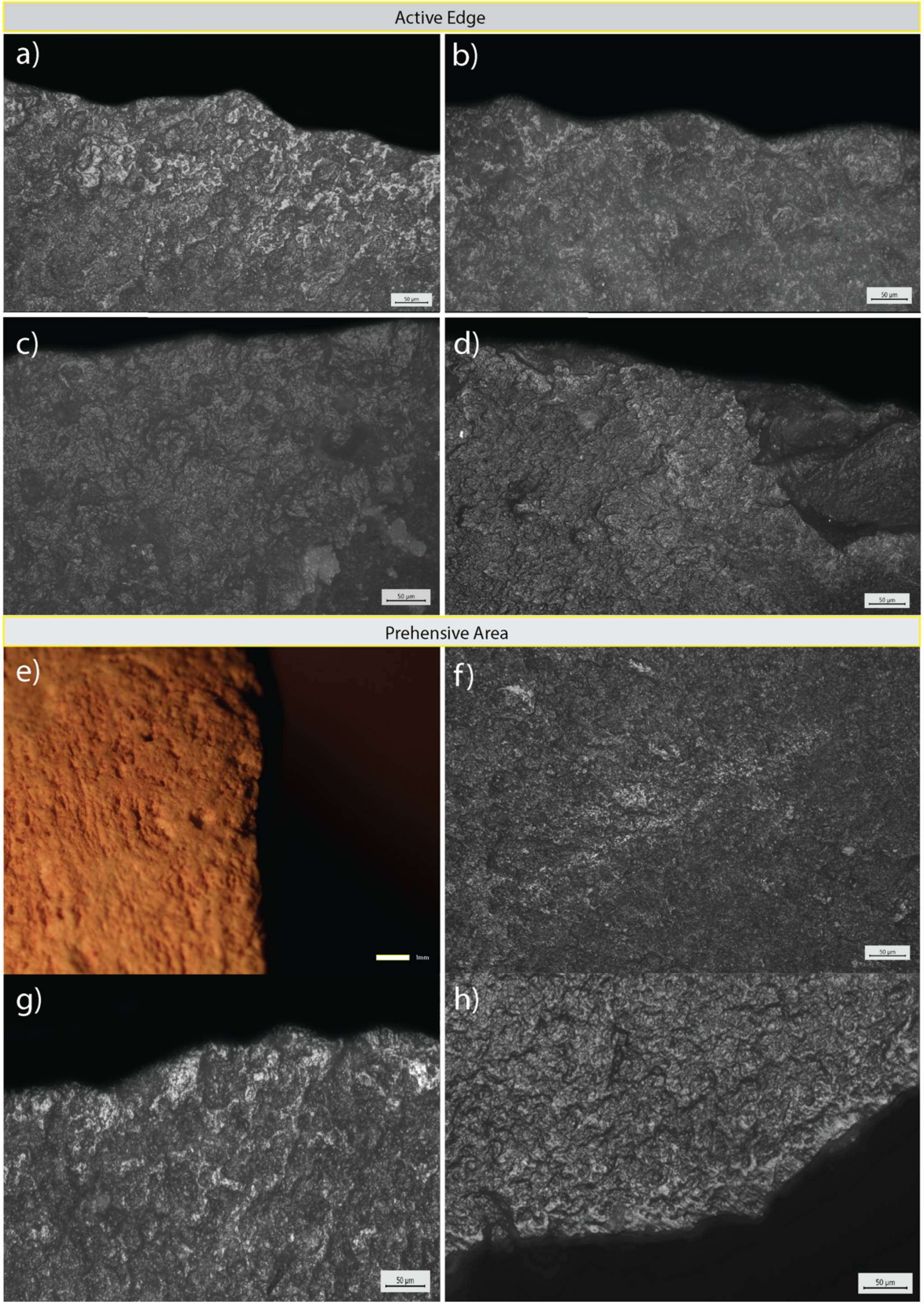


Figure 34. Use wear identified on the active edges of Quina scrapers and associated with the processing of wood (a,b) and plants (c,d). e-f) use wear identified on the surfaces of Quina scrapers and associate it to prehension. a,e,f) G8a 625-630; b,g) D6d 1110-1115 ; h) G9a 525-530. Micro Wear pictures are taken at 200x.

IV.5.2.3 Soft and Medium Materials Processing

In several cases, the alteration of the flint surface inhibited the observation and interpretation of microwear on the edge of the tool. However, the presence of well-developed edge damage allowed achieving general information regarding the hardness of the worked material and the gestures performed.

Edge damage suggesting the processing of soft and medium materials has been identified on the edges of 7 Quina scrapers from the analysed assemblage. The processing of soft materials has been identified only in one case (F8d_615-620), where small feathered scars and a medium degree of edge rounding have been observed. The transversal orientation of the scars allows suggesting the use of the tool in scraping activities.

Edge damage associated with the working of medium material has been observed on six items (C16a_600-605; D6b_115-1120; E11d_625-630; F6a_900-910; G6ab_675-680; G9c_585-590).

The identified micro chipping consists mostly of step scars, in several cases associated with feather terminating ones. In all of the analysed scrapers, the degree of edge rounding is medium. The orientation of the scars in most of the cases is both transversal and oblique, an indication that the tools were used in activities characterised by mixed gestures. Only in one instance (G9c_585-590) the orientation of the scars was mostly oblique and has been interpreted as evidence of cutting.

	Cutting	**Scraping**	**Cutting and Scraping**	**Indeterminable**
Animal Tissues	0	1	0	0
Animal Tissues and Fresh Hide	1	0	0	0
Bone	3	0	0	1
Bone Dry Hide	0	0	1	0
Dry Hide	0	7	0	0
Dry Hide and Bone	0	1	0	0
Dry Wood	1	5	0	0
Fresh Hide	0	10	0	1
Fresh Wood	0	1	0	0
Vegetable	1	2	0	0
Woody Plants Vegetable	0	0	0	1
Soft to Medium	1	0	0	0
Soft	0	1	0	0
Medium	0	1	1	3
Total	**7**	**29**	**2**	**6**

Table 15. Summary table regarding the use of Quina scrapers at Qesem Cave

IV.5.2.4 Quina Scraper Handling Modes

Along with the analysis of the Transformative TFU, also the traces generated by tools handling affecting the Prehensive TFU of the artefacts have been scrutinised (n = 214).

The identified edge damage and microwear allowed defining if the scrapers were handled by free hand, inserted in a haft or wrapped during their use. Overall, the majority (23.2%) of Quina scrapers on which handling traces have been identified, were used handheld. Hafting traces are rare and have been identified only on 9% of the analysed artefacts. In a few cases (3.5%) the wear identified over the Prehensive TFU of the tool has been interpreted as evidence of wrapping. Unfortunately, in most of the cases (64.2%) within the analysed scrapers, it was not possible to provide a sure and detailed identification of the adopted tool handling mode.

Traces generated by free-hand manipulation of the tools have been identified over the dorsal and ventral surfaces of the artefacts. Concerning the ventral surface, the more developed wear is located over the bulb area. At high magnifications, all of the Quina scrapers defined as handheld implements are characterised by a medium to high rounding of the ridges. Smooth polish appears continuously over the bulb area of the tools, and it is characterised by an overall medium degree of brightness. Striations have been identified only on two specimens (B7d+C7c_1045-1050; F11a_575-580). In both cases, the striae are short, narrow and shallow and are probably due to the friction between the tool's surface and dirt/soil present on the hand of the user.

Of particular interest is the presence within the analysed Quina assemblage of two cases in which it is possible to identify two technological behaviours: the exploitation of an old Quina edge as a prehensive area and the modification of the scraper's morphology to enhance its manipulation. In the former case (C7_900-905), the tool, made on a primary cortical flake, is characterised by two opposite edges, both featuring a scaled stepped retouch but exhibiting a significant difference in their edge angle and rounding degree. Prehension wear was identified on one edge, presumably the earlier one, showing a steeper edge angle and a very high degree of rounding, while use wear is present over the opposite one, which results "fresher" and significantly less rounded.

These features allow to suggest the following scenario:

- At first, the scraper featured a single active edge and the cortex present over the blank permitted a firm grasping of the tool, with no modification needed.
- However, once it was not possible to retouch the edge anymore due to an unfavourable knapping angle, a new opposite edge was created exploiting the cortical surface available, which represented the old prehensive area of the tool.
- At this point, exploiting the comfort provided by the steep edge angle, the working edge of the tool was transformed into its prehensive area.

A second example is given by specimen G6ab_675-680. In this case, a large scar is present over the scraper's ventral face, and the identified prehensive wear is localised in this exact spot, indicating that the surface of the tool was modified in order to provide a more comfortable grasp. The presence of large ventral detachments has been recorded only on several scrapers, not only Quina or demi-Quina specimens, and might indicate a typical technological behaviour aimed to favour the freehand prehension of the tools during their use.

Traces associated with hafting have been identified on few Quina scrapers (n=5). All of the tools are characterised by the presence of localised bright spots, affecting the edges and the surface. In most of the cases, bright spots are associated with edge damage, consisting of scalar scars characterised by different distributions. Moreover, a low to medium degree of surface micro ridge rounding is recorded as well, along with the presence of smooth polish.

Comparison based on the localisation of hafting traces between the experimental and archaeological dataset allows hypothesising the type of hafting utilised by the Qesem cave inhabitants. Given the development of wear, specifically bright spots and polishes on the edges (bright spots) and surfaces (polish) of the artefacts, both split and juxtaposed haft solutions may be suggested.

Finally, two Quina scrapers (E10b_700-715; E12b_560-580) within the analysed assemblage exhibit wear related to wrapping. Both the tools are characterised by well-developed smooth domed polish localised over their ventral and dorsal faces and spatially limited to their proximal area. The morphological features (texture and topography) of the polish are similar to the ones related to the processing of a dry hide, which allows suggesting that both tools were wrapped using a piece of hide which was not completely dry. The presence on both tools of numerous surface irregularities, which may have impeded a firm grasping of the tool during its use, the placement of a piece of hide over the prehensive area of the scraper might be a plausible and straightforward adopted solution.

IV.5.3 The Use of demi-Quina Scrapers at Qesem Cave

Demi-Quina scrapers are the most represented category within the Qesem Cave Quina assemblage subject of this research. One hundred twenty-six artefacts, comprising 58.8% of the whole assemblage, have been analysed. From a spatial point of view, most of the analysed demi-Quina scrapers (TMFG 4 and 5) come from the shelf area, a similar pattern to the one observed for the Quina scrapers (TMFG 2 and 3). Demi-Quina scrapers have also been found in the Hearth Area of the cave, where no Quina implements have been found so far.

Within the analysed sample, 46% (n=58) of the tools have been used, 15% (n=19) do not exhibit any trace of use and have been interpreted as not utilised items, 13.5% (n=17) of the scraper are characterised by poorly developed wear not considered diagnostic, and 25.4% (n=32) of the demi-Quina scrapers present altered surfaces which prevent the interpretation of their use.

Within the range of activities performed, scraping (n = 21) and cutting (n = 22) activities are equally represented while a lower amount (n=13) of demi-Quina scraper were utilised to perform mixed gestures. The worked materials processed include animal materials (fresh and dry hide, animal tissues and bone) vegetal material (wood and plants), along with medium and soft materials.

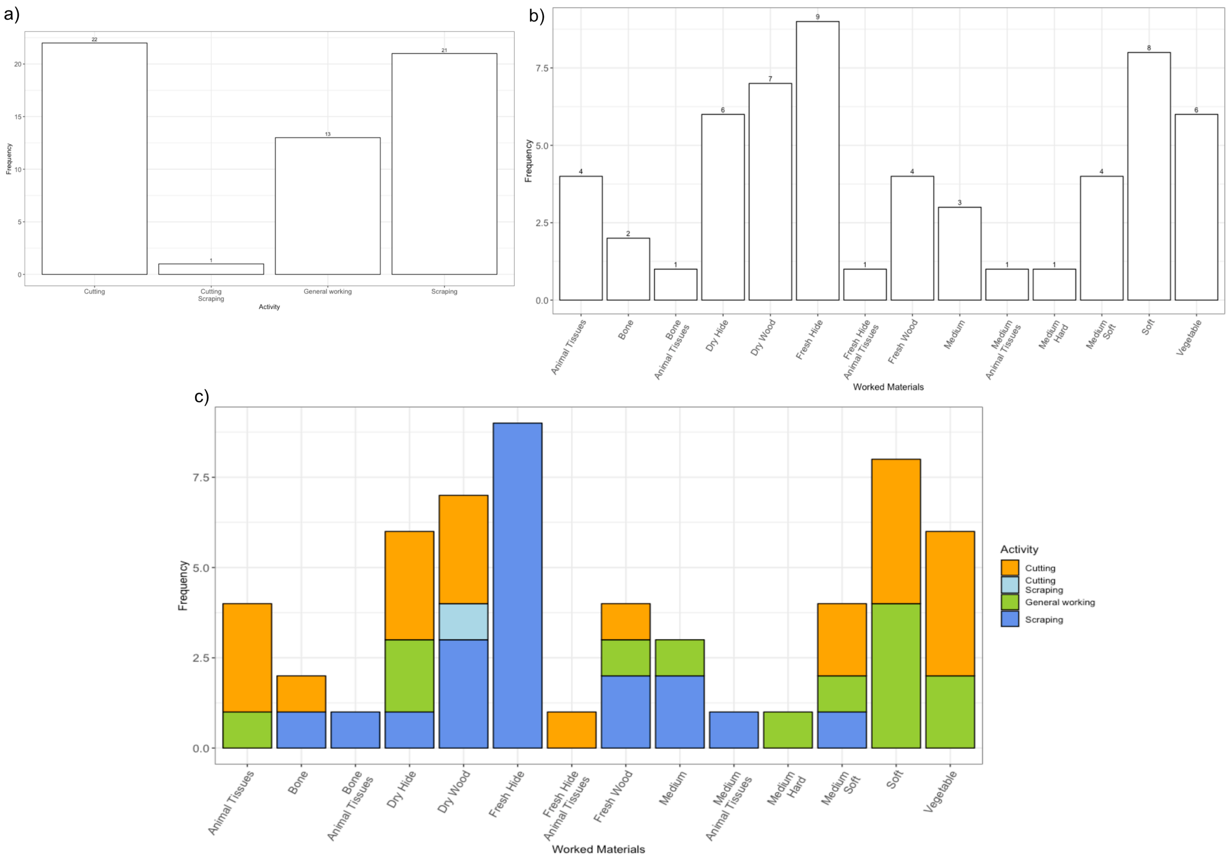


Figure 35. Activities performed and materials processed using demi-Quina scrapers at Qesem Cave.

IV.5.3.1 Animal Substances Processing

Hide Working

Hide, both in a fresh and dry state is the most represented material worked with demi-Quina scrapers at Qesem cave. Traces related to fresh hide are more frequent than the ones associated with dry hide (Fig. 35). Hide was processed principally through transversal motions (n=31), with only a few items exhibiting use wear associated with cutting or mixed activities.

Edge damage identified on the edge of the tools consists of step terminating scars associated with a medium to a high degree of rounding. At high magnifications, a continuous band of smooth domed polish is visible over the edge associated with a high degree of rounding of the surface micro ridges (Fig. 36). In most of the cases, both edge damage and polish exhibit a transversal orientation following a scraping activity. In the case of the few items used in cutting activities, wear orientation is oblique and unidirectional, suggesting single strokes rather than sawing like continuous back and forth gestures.

In two cases, D7bd_1085-1095 and E11d_665-670, the items have been used to process hide and are characterised by a very shiny micro polish and by micro striations. These striations appear as short, shallow and narrow with a matt bottom. Both the polish brightness and the presence of striations, as observed on several Quina scrapers and on the experimental replicas, can be associated to the processing of the hide, in this case dry, with and additional substance on it, probably ash.

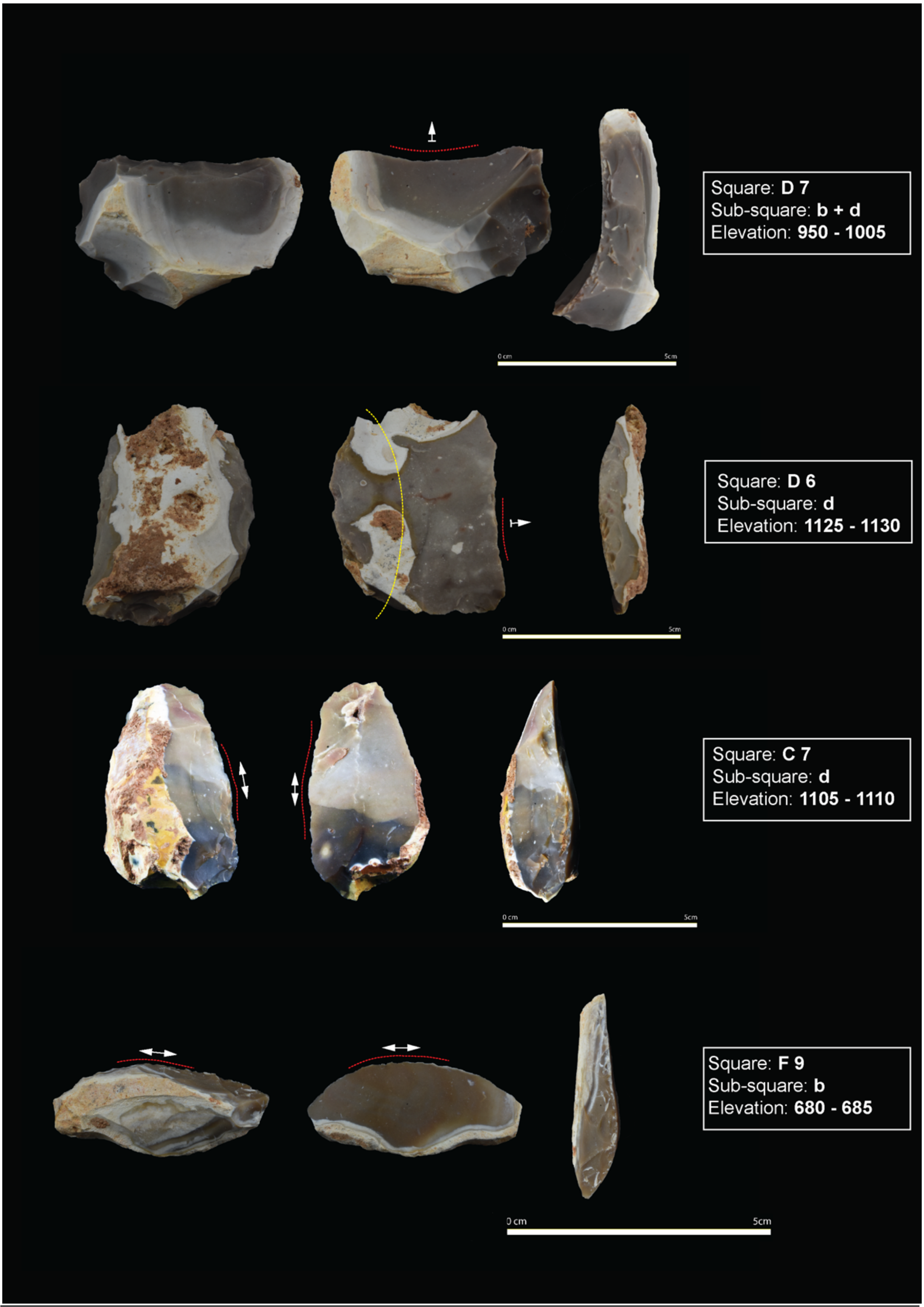


Figure 36. demi-Quina scraper specimens utilised to process hide through scraping and cutting activities. Red dotted line indicates the location of the use wear. Yellow dotted line indicates the location of prehension or hafting traces.

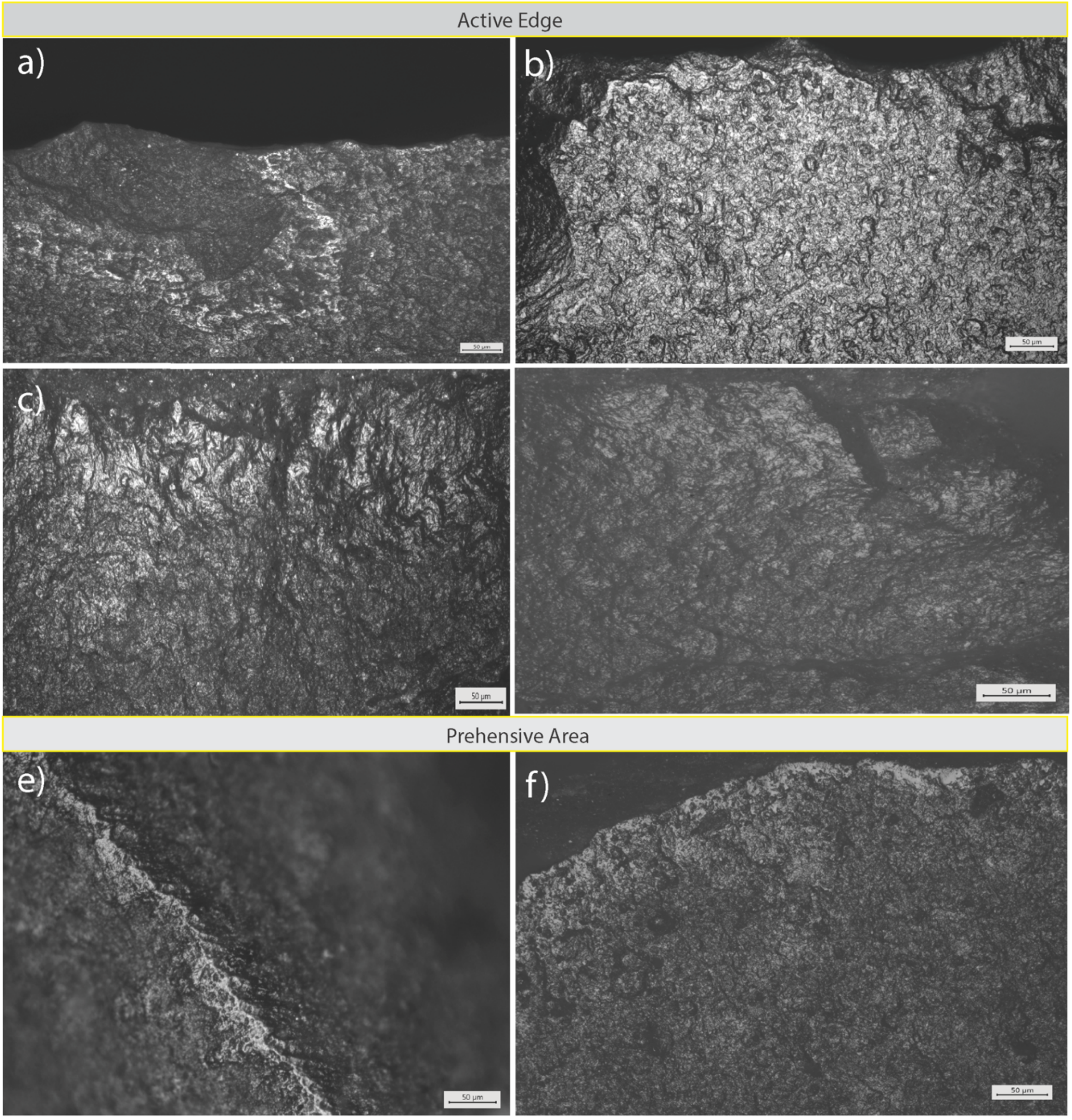


Figure 37. Microwear identified on demi-Quina scrapers utilised to process both fresh (a,b) and dry hide (c,d). a) D7b+d 950-1005; b) D6d 1125-1130; c) D7d 1105-1110; F9b 680-685; e,f) polish and bright spots identified on specimen D6d 1125-1130 and associated to hafting. Micro Wear pictures are taken at 200x.

Bone Working

At Qesem cave, few demi-Quina scrapers (n=3) have been used to process bone. The traces identified are related to both scraping and cutting activities. The edges of the tools are affected by small and large step scars, associated with a high degree of rounding. The identified polish texture is smooth, while its topography ranges from flat to domed (Fig. 38). The band of polish is often discontinuous along the edge of the tool. This polish suggests that the wear identified is related to the processing of bone during butchering. Indeed, all of the wear identified point towards a meaty component with the bone, suggesting that the tools were most probably used to remove meat remains from the bones. This leads to the development of a discontinuous polish distribution and explains the "greasy" component characterising the polish band. The wear orientation patterns observed includes both transversal and oblique directions, indicating that the motions involved in bone cleaning were both transversal and longitudinal.

Animal Tissues Processing

Five (n =5) within the analysed demi-Quina sample have been used in activities devoted to the processing of animal tissues other than hide. The edges of the tools are affected by feather terminating scars, associated with a range of rounding degree varying from low to high. At high magnification, polish texture appear as rough to smooth and smooth, with the smooth being mostly represented. Polish topography is indeterminable most of the times, except for one item (D7cd_1040-1095), where the polish exhibits a domed topography (Fig. 38).

Micro surface ridge rounding is overall high, and the polish extension is always limited to the outer area of the edge. The identified orientation patterns of edge damage and microwear are both transversal and oblique, with a slight predominance of the latter. This suggests that the activities performed were more dedicated to cutting than scraping, while evidence of mixed gestures is scarce.

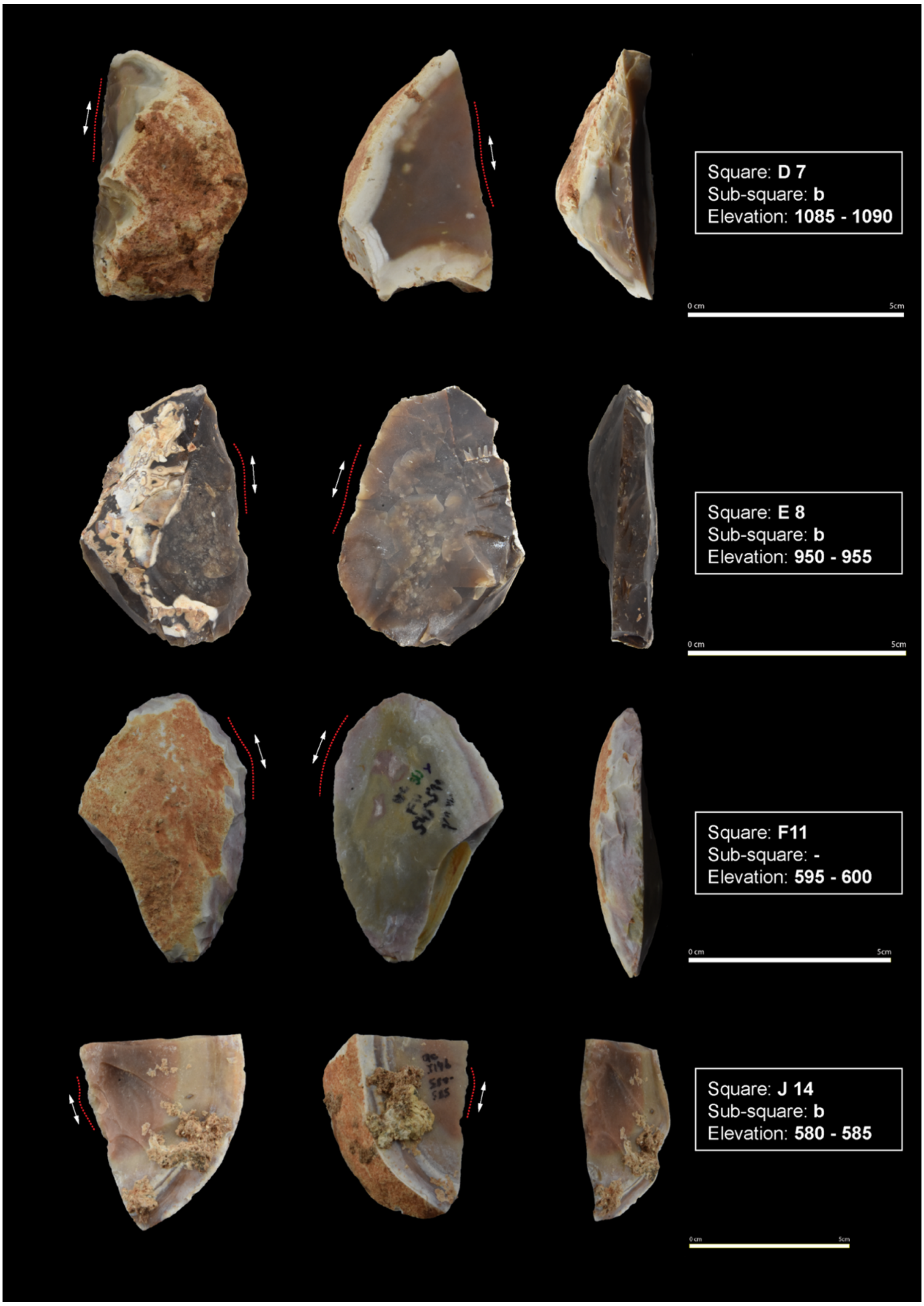


Figure 38. Sample of Quina (D7b 1085-1090) and demi-Quina scrapers utilised to process bone (D7b 1085-1090; E8b 950-955) and soft animal materials (F11 595-600; J14b 580-585). Red dotted line indicates the location of the use wear.

IV.5.3.2 Vegetal Processing

Wood Working

Along with hide, wood represents the second most common substance worked utilising demi-Quina scrapers at Qesem cave. As observed in the case of Quina scrapers, the wear patterns identified are mostly associated with the working of dry wood (n=14), while traces related to fresh wood processing are not as common (n=5) (Fig. 39). The edge damage affecting the tools' edge is characterised by small step terminating scars, related to a high degree of edge rounding. Polish topography is smooth, while its texture is reticulated (Fig. 40). The degree of micro surface ridge rounding ranges from medium to high.

A typical pattern observed on almost all of the demi-Quina scrapers utilised to process wood is the extension of the polish, which affects mostly the higher point of the flint surface.

Wood scraping is the most represented activity (n=12) as indicated by the orientation of both edge damage and microwear, which is transversal in most of the times. Even if with a lower frequency (n=5), cutting is attested as well. In these instances, the orientation of the traces is oblique and unidirectional, suggesting single longitudinal strokes. Mixed transversal and longitudinal gestures are observed only in the case of two items (I7b_460-530; G6c_680-685).**Plant Working**

Use wear interpreted as evidence of plant processing has been observed on six scrapers within the Qesem cave demi-Quina sample. The wear patterns observed are related mostly to the working of woody plants, and just in one case (D16a_575-580,) the processing of herbaceous plants can be suggested.

The edge of the tools is affected by small feather and step terminating scars, and the degree of edge rounding ranges between low to medium. The polish observed over the outer portion of the edge is generally located on the higher points of its surface and is typically rough, sometimes tending to smooth (Fig. 40). When identifiable, the polish topography appears as domed or reticulated. The orientation of both edge damage and microwear is mostly oblique bi-directional indicating a cutting activity. In two cases (F8b_650-660; D16a_575-580) ,the microchipping and polish observed exhibit a transversal orientation.

Given the similarities to the patterns seen on the experimental replicas, these two artefacts have been interpreted as being utilised to de-fibre woody plants. This evidence is relevant as it may be an indirect indication of the exploitation of thin layers of bark and wood for rope making and basketry activities at Qesem cave.

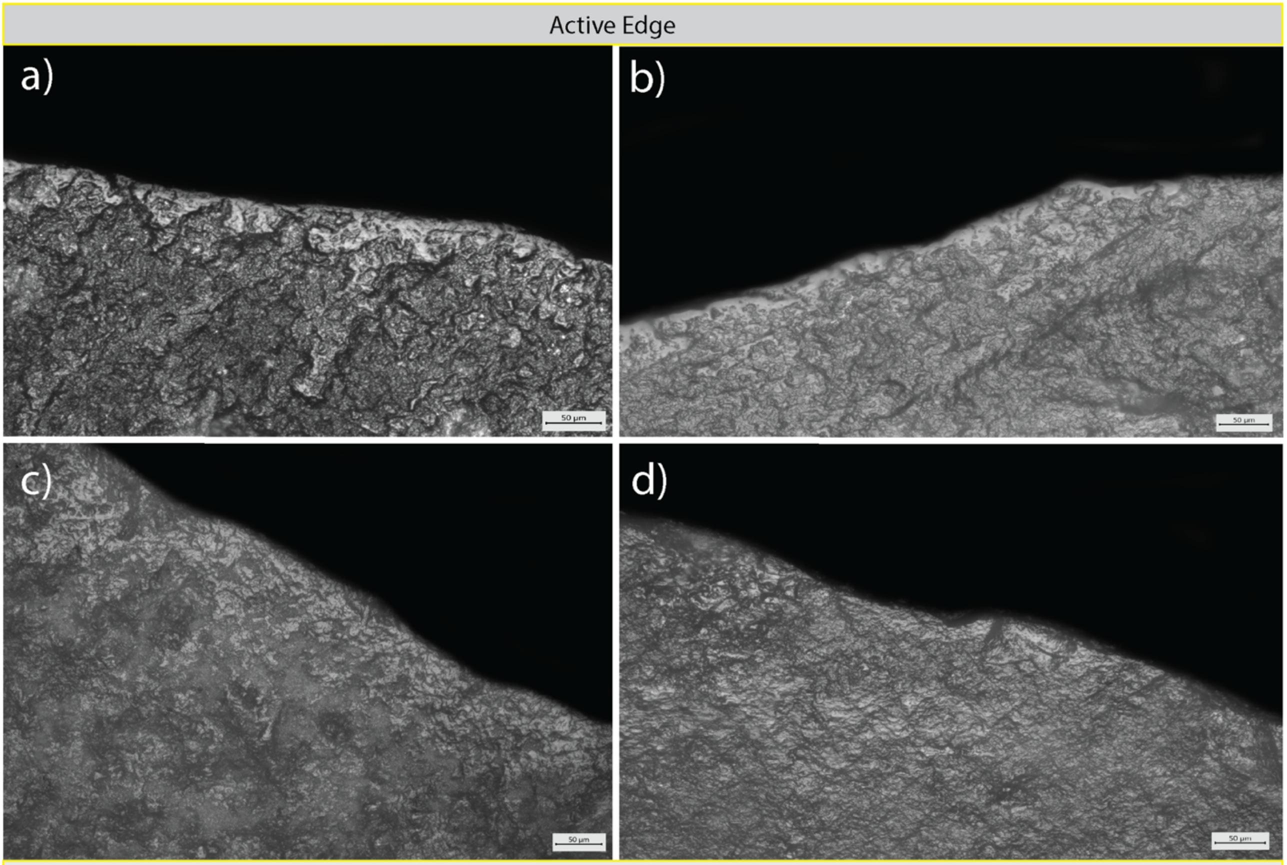


Figure 39. a,b) Microwear associated with bone; c,d) microwear associated with the processing of soft animal materials. a) D7b 1085-1090; b) E8b 950-955; c) F11 595-600; d) J14b 580-585. Microwear pictures are taken at 200x.

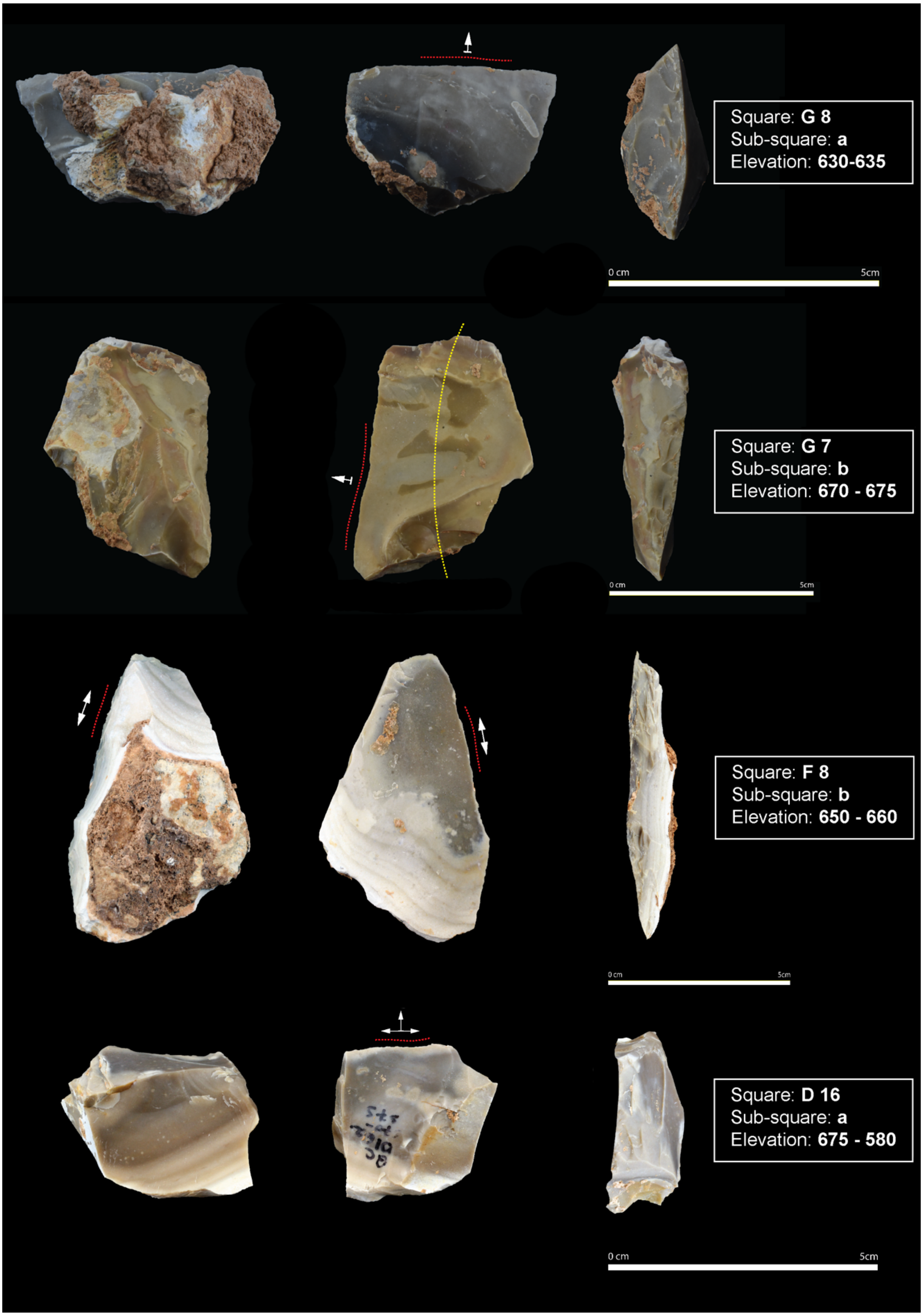


Figure 40. demi-Quina scrapers utilised to process dry wood and plants. Red dotted line indicates the location of the use wear. Yellow dotted line indicates the location of prehension or hafting traces.

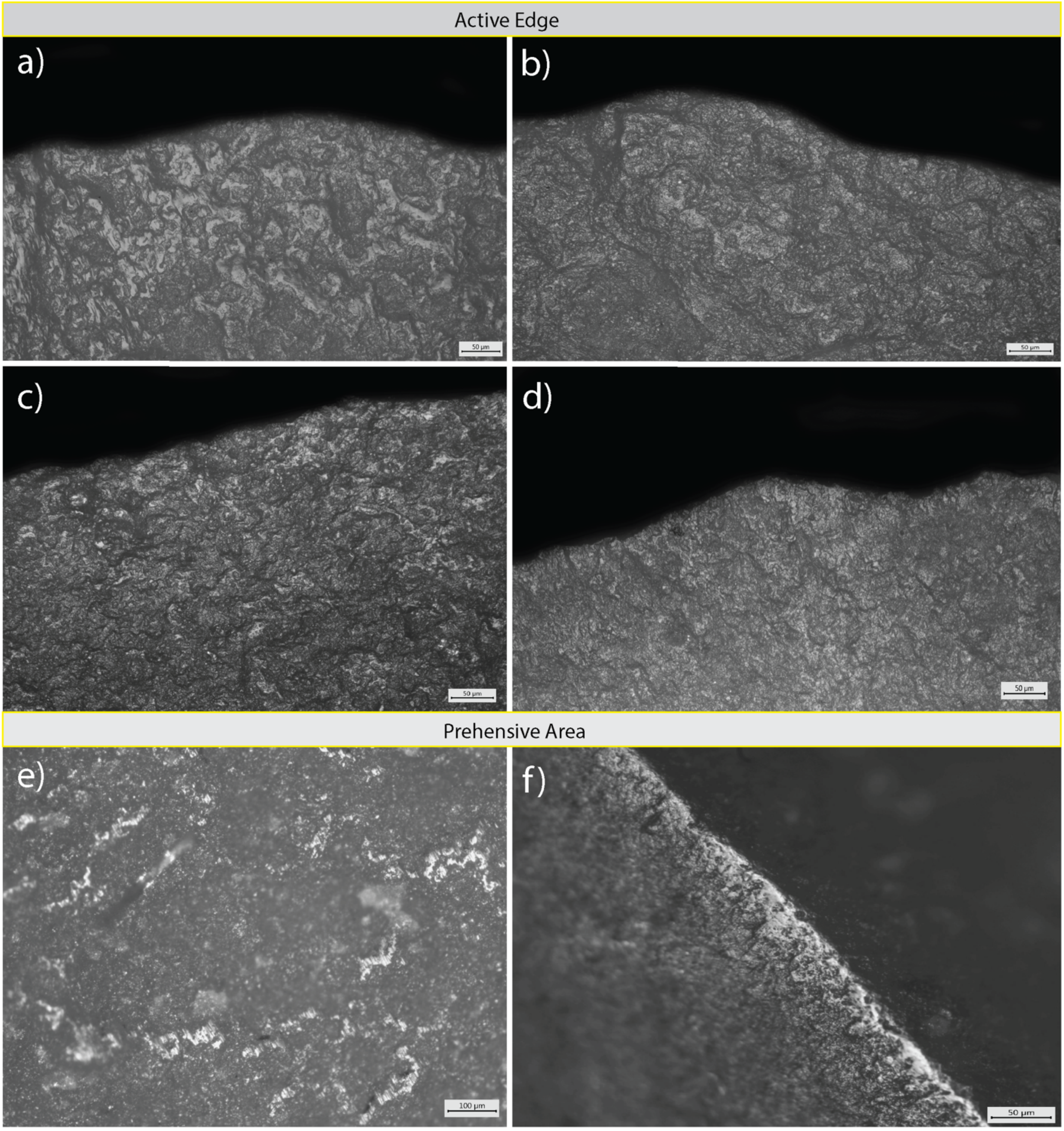


Figure 41. Microwear identified on demi-Quina scrapers and associated twiththe processing of dry wood (a,b) and plants (c,d). e,f, Microwear related to the use of a haft identified on artefact G7b 670-675. a) G8a 630-635; b) G7b 670-675; c) F8b 650-670; d) D16a 575-580. Microwear pictures were taken at 200x.

IV.5.3.3 Soft and Medium Material Processing

Within the analysed demi-Quina scrapers affected by PSDM not allowing to investigate use wear at high magnification, most of the items exhibit edge damage related to the processing of soft materials. Only several tools are characterised by traces associated with the working of medium materials.The demi-Quina scraper utilised to work soft materials (n=12) exhibit edge damage consisting of feather terminating scars and edge rounding degrees ranging between low and medium. In most of the cases scars, orientation is oblique and unidirectional indicating that the tools were used to perform longitudinal gestures associated with cutting.

On the other hand, scrapers interpret as being used to work medium materials (n=5) exhibit step terminating scars and a medium degree of edge rounding. The observed edge damage orientation is transversal, suggesting the performing of "scraping-like" activities.

IV.5.3.4 Demi-Quina Scrapers Handling Modes

Analysing the edge damage and microwear identified over the Prehensive TFU of the utilised demi-Quina scrapers of Qesem cave indicates that freehand manipulation is the most common tool handling strategy.

Unfortunately, in most of the cases (74%) traces related to prehension, hafting or wrapping were not determinable. However, 20.5% of the analysed demi-Quina scrapers exhibit both edge damage and microwear pertaining to their use as freehand implements. Hafting traces have been observed only on 5.5% of the artefacts, while only in one case wear related to a possible wrapping of the tool was identified.

Demi-Quina scrapers interpreted as handheld implements exhibit a medium to a high degree of surface ridge rounding, associated with continuous areas of polish with a smooth texture. Bright spots are not common, while striations have been observed on two artefacts (C7d_1105-1110; I6cd_510-540).

The identified striations located over the bulb area of the ventral surface are short, narrow and shallow, with an oblique unidirectional orientation and a polished bottom.

Hafting traces have been observed on 4 scrapers (D7c_1090-1095; D6d_1125-1130; D7b_1075-1080; G7b_670-675). On these tools, bright spots are visible over the ventral surface, along with a high degree of surface ridge micro rounding. Edge damage consists mainly of different sized scalar, trapezoidal and balloon terminating scars running together along the edge of the tool. Striae are observed as well over the ventral surface of the tools. These are short, narrow and shallow, characterised by a mixed or oblique unidirectional orientation.

Finally, traces of wrapping are visible on artefact I7_440-445. The tool is characterised by a high degree of surface ridge rounding associated with even scalar terminating scars running together along the tool's edge in a well-defined line. Microwear consisted of smooth polish developed affecting a large portion of the bulb area of the tool.

	Cutting	Scraping	Cutting and Scraping	Indeterminable
Animal Tissues	3	0	0	1
Bone	1	1	0	0
Bone and Animal Tissues	0	1	0	0
Dry Hide	3	1	0	2
Dry Wood	3	3	1	0
Fresh Hide	0	9	0	0
Fresh Hide and Animal Tissues	1	0	0	0
Fresh Wood	1	2	0	1
Vegetable	4	0	0	2
Soft	4	0	0	4
Medium	0	2	0	1
Medium Soft	2	1	0	1
Medium Hard	0	0	0	1
Medium and Animal Tissues	0	1	0	0
Total	**22**	**21**	**1**	**13**

Table 16. Summary table regarding the use of demi-Quina scrapers at Qesem Cave.

Overall the functional analysis of the Quina and demi-Quina scrapers unearthed at Qesem Cave provided a detailed dataset concerning the use of these tools at the site. Both Quina and demi-Quina implements were utilised mostly in transversal gestures associated with scraping activities. To this matter, the analysis carried out so far suggest that Quina scrapers were nearly exclusively employed in scraping activities, mostly devoted to the processing of hide. On the other hand, regarding demi-Quina implements, while scraping remains the most common performed activity, uni-directional and bi-directional longitudinal motions, related to cutting, are well represented within the assemblage. Moreover, regarding the processed substances, several differences have been identified within Quina and demi-Quina scrapers. At Qesem Cave, hide, in both fresh and dry state is the most represented matter worked with Quina scrapers, followed by wood and hard animal materials. A wider range of substances, including both animal (e.g. hide, meat) and vegetal (wood and woody plants) were instead worked utilising demi-Quina scrapers.

These patterns, which will be discussed with further details in the concluding chapters of this works, may indicate a different role played by Quina and demi-Quina scrapers at Qesem Cave hominin, providing additional behavioural clues regarding the early hominins occupying the cave during the Acheulo Yabrudian.

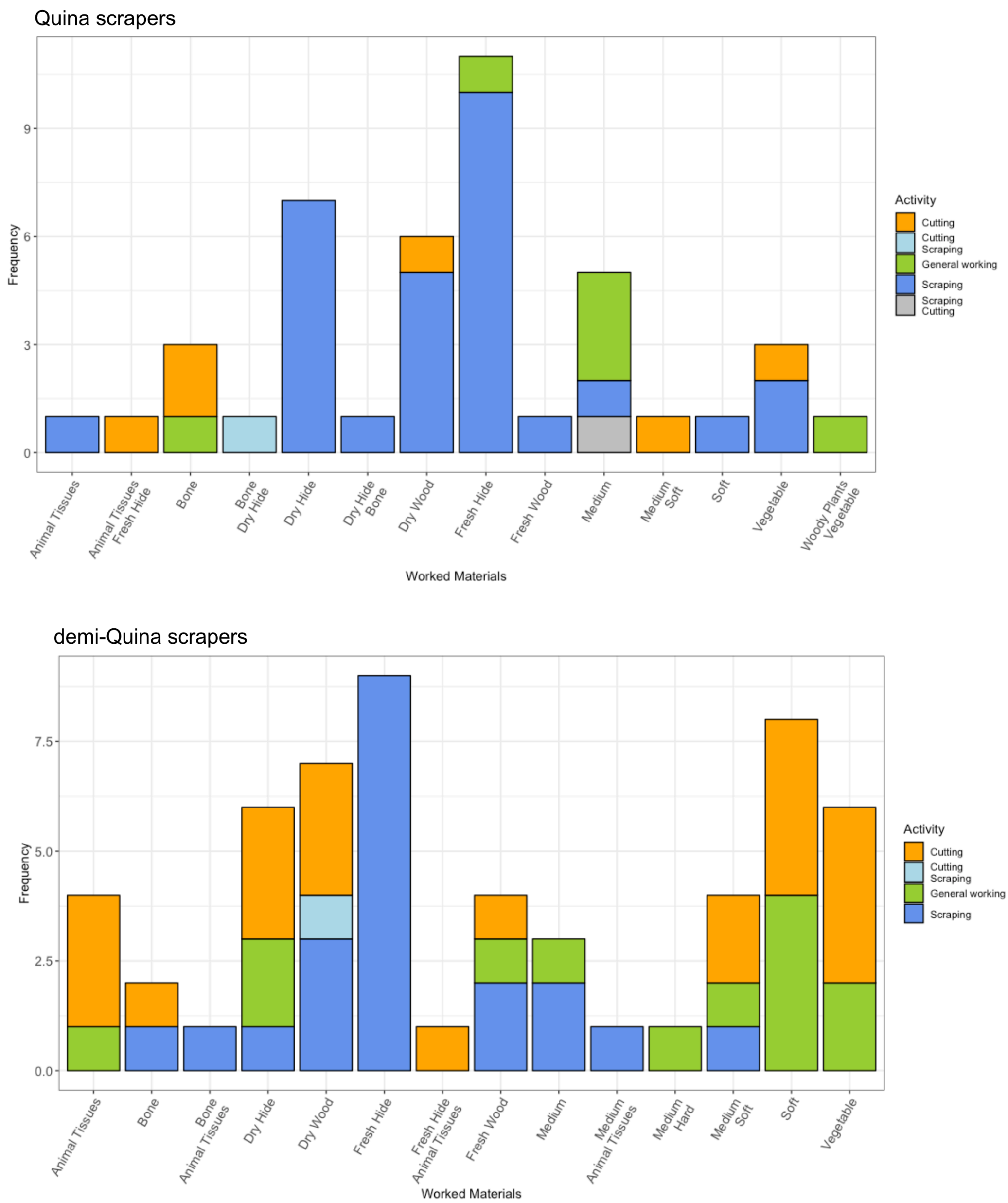


Figure 42. Comparison between the use of Quina and demi-Quina scrapers at Qesem Cave.

Quina Scrapers							
	n.	*%*	*Activity*	*n.*	*%*	*Worked Material*	*n.*
Used	44	50	Cutting	7	16	Animal Tissues	1
Not Used	3	3.4	Scraping	29	66	Animal Tissues and Fresh Hide	1
Not Diagnostic	0	0	Cutting and Scraping	2	4.5	Bone	4
Altered	32	36.3	Indeterminable	6	13.6	Bone and Dry Hide	2
						Dry Hide	7
						Fresh Hide	11
						Dry Wood	6
						Fresh Wood	1
						Vegetal	3
						Woody Plants	1
						Soft	1
						Soft to Medium	1
						Medium	5
½ Quina Scrapers							
	n.	*%*	*Activity*	*n.*	*%*	*Worked Material*	*n.*
Used	58	46	Cutting	22	39.2	Animal Tissues	4
Not Used	19	15	Scraping	21	37.5	Bone	2
Not Diagnostic	17	13.5	Cutting and Scraping	1	1.8	Bone and Animal Tissues	1
Altered	32	25.4	Indeterminable	13	23.2	Dry Hide	6
						Fresh Hide	9
						Fresh Hide and Animal Tissues	1
						Dry Wood	7
						Fresh Wood	4
						Vegetal	6
						Soft	8
						Soft to Medium	4
						Medium	3
						Medium Hard	1
						Medium and Animal Tissues	1

Table 17. Summary table of the use-wear results related to Quina and demi-Quina scrapers from Qesem Cave.

IV.5.4 The Use of *Reaffutage* at Qesem Cave

Several studies (Claud et al. 2012) highlighted the functional role of re-sharpening flakes (*reaffutage*) within Quina technological complexes. At Qesem cave, Quina retouching flakes are not frequently found within the sequence. This relates to the fact that complete scrapers were imported to the cave after being produced elsewhere.

However, a discrete number (n=74) of retouching flakes have been identified within the lithic assemblage and have been described and divided according to Bourguignon (1997, 2001)[2]. The most

2 For a detailed description of the morphological features and association to a specific *amenagement* episode of each *reaffutage* type refer to Chapter I.

common *reaffutage* type found at Qesem cave is *Type 3*, which is well represented (n=26) in both the Upper and Lower shelf areas, while other types of resharpening flakes are rare (n=<5), except for *Type 2* (n=21). While very rare within the Yabrudian levels, this resharpening flake type is frequent in the Shelf Area, suggesting possible differences within the two areas of the shelf.

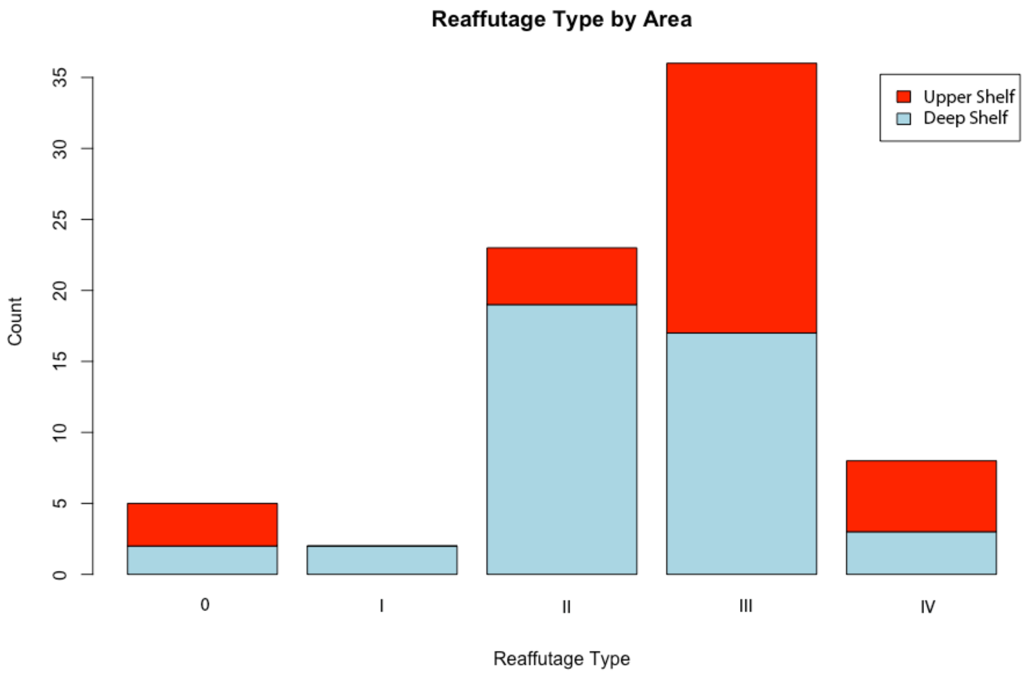


Figure 43. Reaffutage type found within the Yabrudian levels and the Shelf Area of Qesem Cave.

Indeed, type III flakes are associated with an advanced stage of the Quina retouching sequence and are usually associated with a fine adjustment of the scraper's edge. Their profile is convex and given their dimensions (>3cm) these flakes can be utilised as tools.

Type II retouching flakes are smaller and characterised by a concave profile. The stage of production of these flakes is earlier than the one of the Type III ones, and they are related to gestures devoted to the management of the Quina edge.

Within the analysed *reaffutage* sample several specimens of Type IV, I and 0 flakes have been identified. Type IV flakes are associated with an advanced stage of the life-cycle of a Quina edge, in which the edge is heavily modified, to re-start a new Quina retouch cycle.

Type 0 and I are, on the other hand related to an initial stage of the Quina cycle. Type 0, morphologically similar to the biface *façonnage* flakes, is related to the creation of a convexity over the scraper edge, while Type I is associated with the production of the concavities over the latter.

The analysis at low and high magnification of the *reaffutage* sample of Qesem cave indicated that some of these items were used (Fig. 43). Unfortunately, most of the tools are affected by post-depositional modifications, which affected severely both the surface and the edges, preventing a thorough functional analysis. Most of the analysed items exhibit white patina often associated to a fracturing of the edge due to mechanical processes. Such a high frequency of altered items, contrasting with the good overall preservation of Quina and demi Quina scrapers at the site, can be explained by the morphological characteristics of reaffutage elements. Indeed, the small dimensions of these items favour their movement within the soil, causing the frequent compression fractures over their edge.

Overall, diagnostic traces of use have been identified on 15 reaffutage elements, ten from the Upper Shelf levels and five from the Lower Shelf Area of the cave (Fig. 44). The identified traces are all localised on the distal end of the flake (i.e. the edge), opposed to the bulb (i.e. part of the old scraper's edge), indicating their use after being detached from the scraper's edge. Only on two flakes coming from the Yabrudian levels, knapping wear has been identified on the proximal area of the flake and have been associated with the original use of the scraper.

The orientation patterns of both edge damage and polish indicate that all of the flakes were mostly for cutting purposes. Regarding the worked materials, fresh hide, dry hide, and fresh wood have been identified along with edge damage related to medium and hard materials, on the resharpening flakes coming from the Shelf Area. Use wear has been found on Type II (n=2), III (n=1) and IV (n=2) flakes. Two specimens of Type II flakes exhibit traces of fresh hide and fresh wood processing. On four Type III flakes wear related to fresh hide (n=2) and hard material (n=2) have been observed, while on two Type IV flakes traces of dry hide and soft materials are present.

Within the reaffutage sample from the Yabrudian levels, use-wear has been identified on Type III and IV flakes. Traces associated with the processing of fresh hide (n=3) and animal tissues (n=1) have been detected on Type III flakes, while use wear related to the working of fresh hide was observed on two Type IV *reaffutage* specimens.

Even though the sample is small, some preliminary observation may be proposed. On the one hand, from a functional point of view, the two reaffutage samples do not exhibit any significant difference, with Type III flakes being more exploited to perform cutting activities on fresh hide. On the other hand, differences in the *reaffutage* type are present. While Type II flakes are nearly absent in the Upper Shelf Area, these are very well represented in the Lower Shelf area. This may be considered indirect evidence, to be further confirmed by future studies, related to the activities performed in this area of the cave, leading to numerous and frequent edge resharpening.

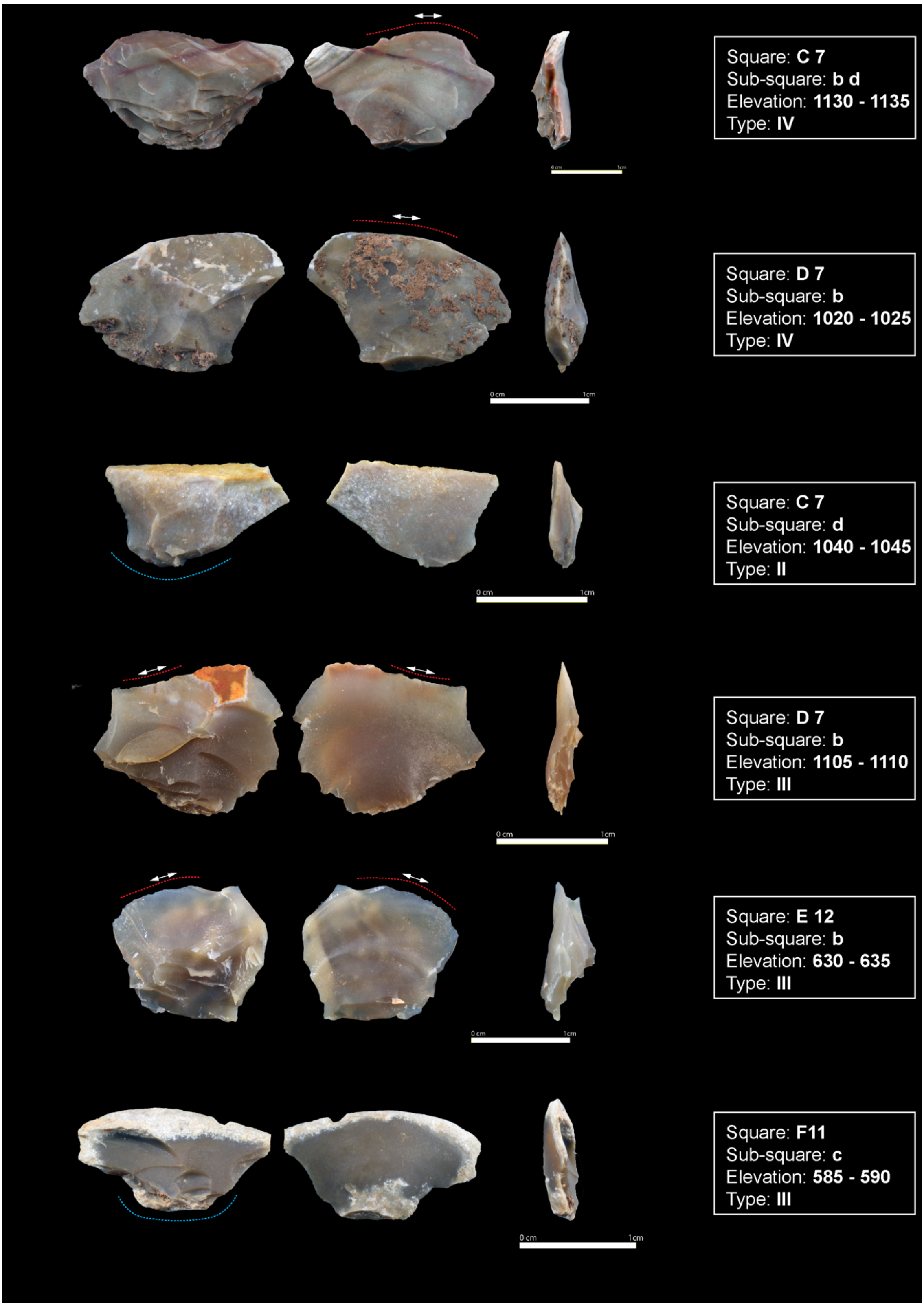


Figure 44. Sample of reaffutage flakes coming from the Upper and Lower Shelf areas. Red dotted line indicates the use-wear identified on the new sharp edge of the flake. Blue dotted line indicated use wear associated with the use of the scraper before the flake detachment.

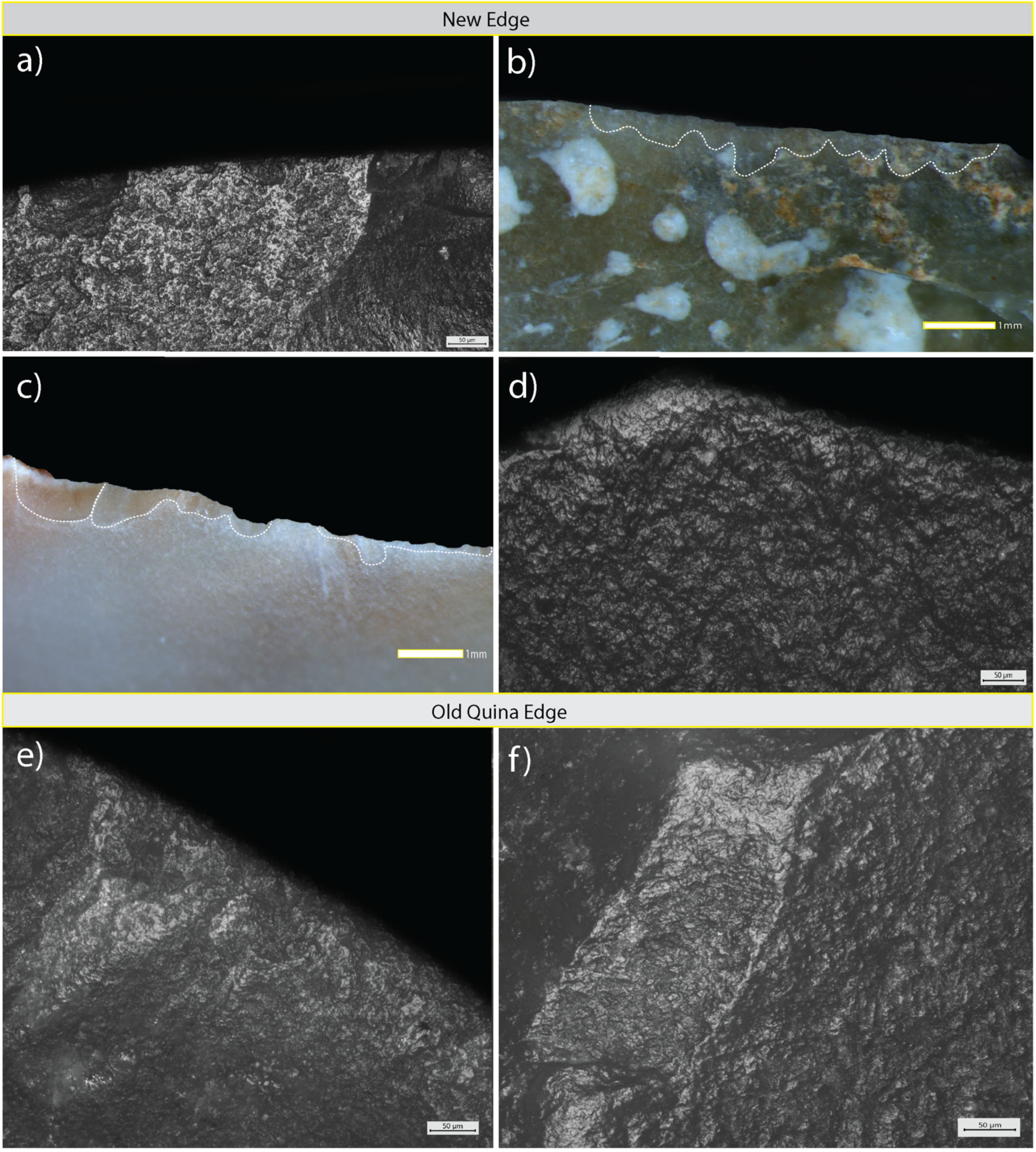


Figure 45. Microwear and edge damage identified on reaffutage flakes and associated to a) dry hide; b) soft material; c) hard material; d) animal material; e) wood; f) fresh hide. Edge damage pictures are taken at 12x. Microwear pictures are taken at 200x.

Area	Type		Animal Material	Dry Hide	Fresh Hide	Fresh Wood	Hard Material	Soft Material	Technological Wear
			Worked Material						
Lower Shelf	**0**	2	0	0	0	0	0	0	0
	I	2	0	0	0	0	0	0	0
	II	17	0	0	1	1	0	0	0
	III	13	0	0	2	0	2	0	0
	IV	1	0	1	0	0	0	1	0
	Sum	35	0	1	3	1	2	1	0
Upper Shelf	**0**	3	0	0	0	0	0	0	0
	I	0	0	0	0	0	0	0	0
	II	4	0	0	0	0	0	0	0
	III	13	1	0	3	0	0	0	2
	IV	3	0	0	2	0	0	0	0
	Sum	23	1	0	5	0	0	0	2
	Total	**74**	1	1	8	1	2	1	2

Table 18. Materials processed utilising resharpening flakes at Qesem Cave.

IV.6 Residues Analysis

Within the methodologies applied to investigate the use of Quina and demi-Quina scrapers at Qesem cave, residues analysis was applied as well. This was performed through the use of micro-FTIR, a non-destructive technique based on the gathering of spectral data directly from the sample's surface (for details see Chapter II).

Micro-FTIR has been performed on 148 of the 214 scrapers comprising the Quina assemblage of Qesem cave subject of this research. This discrepancy is given by the fact that Micro-FTIR was performed only on the tools found during the 2012-2016 excavation seasons, which were bagged along with their sediments just after their finding to minimise the risk of contamination.

Both animal and vegetal residues have been found entrapped over the artefact edges and surfaces.

Adipocere was identified on four scrapers. Adipocere, also referred as "grave wax" is a waxy or unctuous brownish substance consisting chiefly of fatty acids and calcium soaps produced by chemical changes affecting dead body fat and muscles buried for a long time or immersed in moisture (Evershed et al. 1991). *Adipocere* (peaks at ~1575-1538cm^{-1}) has been found mostly over the ventral surface of Quina scrapers (n=3) and on one demi-Quina scraper. All of the artefacts, except for one (E7b_935-940), were utilised to process fresh hide through scraping activities. Artefact E7b_935-940, on the other hand, was used to process dry hide and bone. Moreover, on this latter implement *adipocere* was identified over the inner surface area, and not on the edges, where it was absent. This indicates that the tool was first used to process fresh hide, probably through transversal gestures as suggested by the location of *adipocere* over the inner surface area. As indicated by the multiple retouch registers identified over the edge, after its use, this item was re-sharpened to be used on different materials (i.e. dry hide and bone). This led to the loss of part of the edge surface and of the *adipocere* entrapped within it, explaining its presence over the tool's surface and its absence over its edge.

Hydroxyapatite (mineralised bone), indicated by peaks in the spectra at ~913cm^{-1}, have been identified on 42 artefacts, comprising Quina and demi-Quina scrapers. Despite this high frequency, only in eight instances, this evidence has been considered diagnostic. This is due to the fact that the sediments of Qesem cave are characterised by a very high percentage of bone particles (Karkanas et al. 2007; Shahack-Gross et al. 2014). Despite the thorough cleaning procedure applied, "sediment-related" bone particles may remain entrapped within the surfaces and edges of the tools leading to an erroneous association to use. This is the reason why only bone residues directly associated with bone processing use wear have been treated as diagnostic.

Within the cases where bone-related use wear and hydroxyapatite are associated, cutting activities are more frequent (n=5) than scraping (n=3), while mixed gestures are represented by a single artefact.

The overall dimensions of the artefacts did not allow to investigate further the presence of residues using SEM-EDS, except for one item only (E8b_950-955) (Fig. 45). The relatively small dimensions of this demi-Quina scraper allowed observing it using an SEM at magnification ranging between 600x and 800x, leading to the identification of several collagen fibres on the tool's edge (Zupancich et al. 2016). The preserved fibres were oriented longitudinally following the cutting motions indicated by the wear identified on the tool's edge, which allowed to hypothesis the use of this tool to saw bone for non-nutritional purposes (Zupancich et al. 2016).

Peaks probably associated with residues of vegetal nature have been identified on two demi-Quina scrapers and one Quina scraper. The peak bands are located at ~1600cm^{-1} over the spectra. Yet, the single association of these peaks to vegetal materials is problematic. However, in this case, all of the three scrapers exhibit use wear associated with the processing of wood (G6c_680-685; D6d_110-1115) and plants (J16_590-595), which strengthens the association of the ~1600cm^{-1} absorption band to vegetal substances.

Finally, in several cases, the presence of organic residues is suggested by the C-H stretching, indicated by peaks on the spectra at 2918cm^{-1} or 2848 cm^{-1}. In these cases (n=5) it was not possible to provide a detailed interpretation of peak, and further investigation is needed.

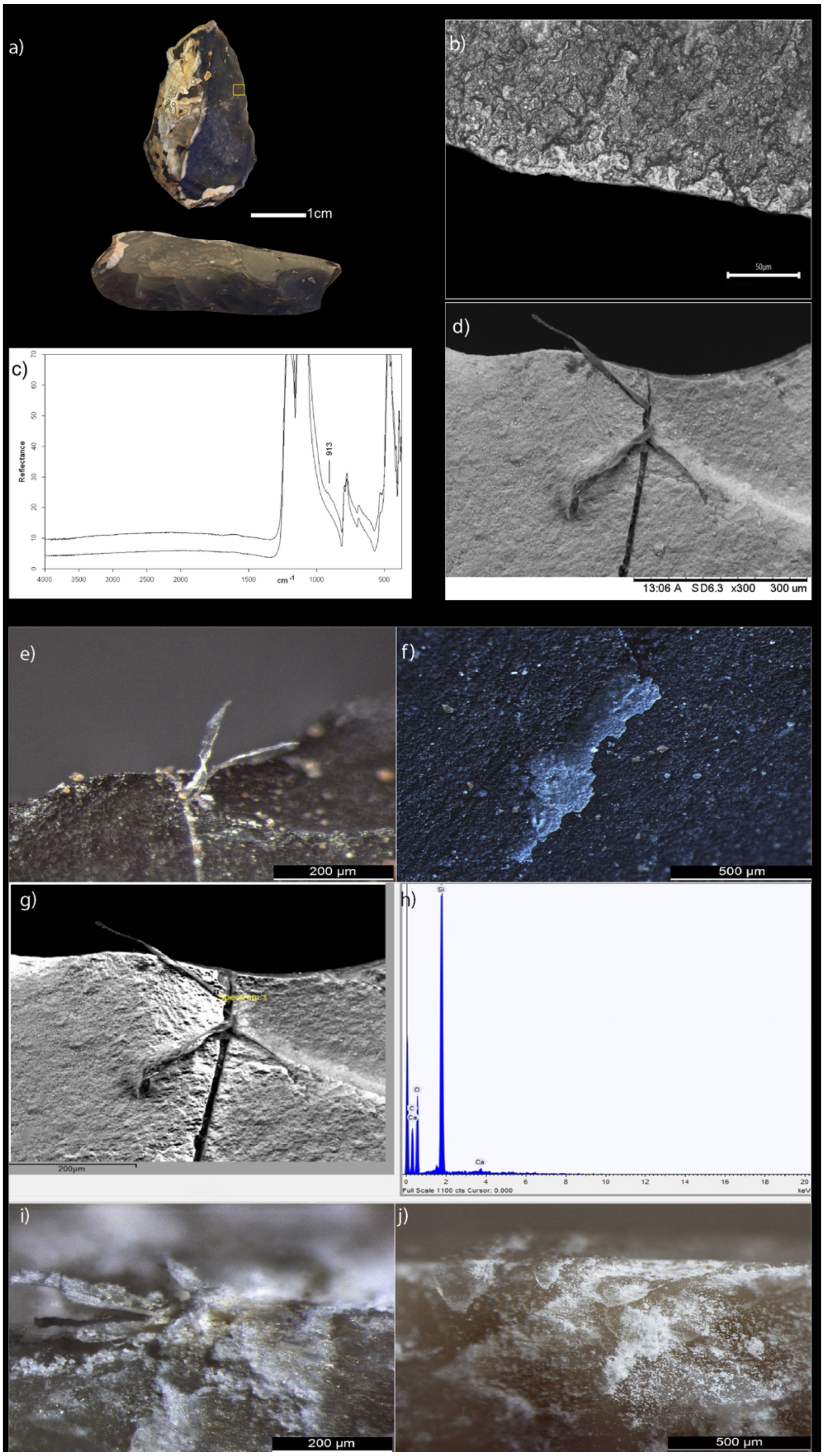


Figure 46. Bone collagen fibre found entrapped on the ventral surface of a demi-Quina scraper (E8 b 950-955) utilised to cut bone. a) the scraper and the sampling point; b) microwear identified on the tool's edge and associated to bone cutting; c) Micro-FTIR spectra showing the presence of hydroxyapatite at freq. 913; d) SEM picture of the identified bone collagen fibre; e) picture of the collagen fibre observed at the OLM; f) mineralised bone fragment entrapped over the tool's ventral surface; g-h) EDX analysis of the collagen fibre; i-j) bone residues identified on the experimental tool replicas utilised to cut bone.

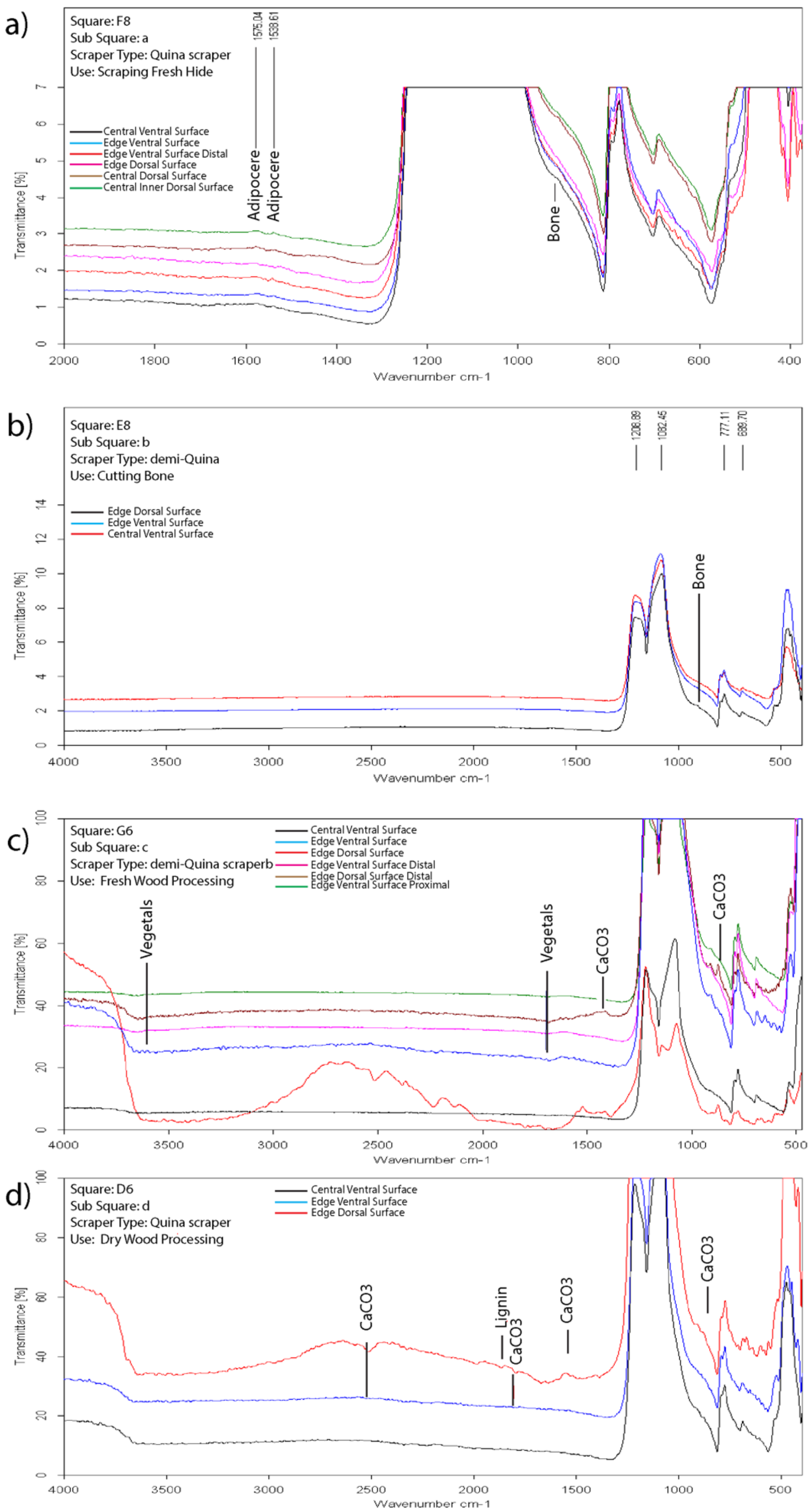


Figure 47. Sample of Micro-FTIR spectra performed on the Quina and demi-Quina sample of Qesem Cave from which residues of animal (a,b) and vegetal (c,d) nature have been identified.

IV.7 Spatial Distribution of Quina and demi-Quina Scrapers at Qesem Cave

To better understand the functional role of Quina and demi-Quina scrapers at Qesem Cave, a spatial analysis was performed, aiming to underline the existence of possible "function-specific" distribution patterns.

Overall, the majority of Quina and demi-Quina scrapers is localised in the Shelf area, on both its upper and deeper levels, including areas C to G squares 7 to 12. On the other hand, Quina and demi-Quina scrapers are rare in other areas of the cave, including the Hearth and the Southern Areas (Fig. 47).

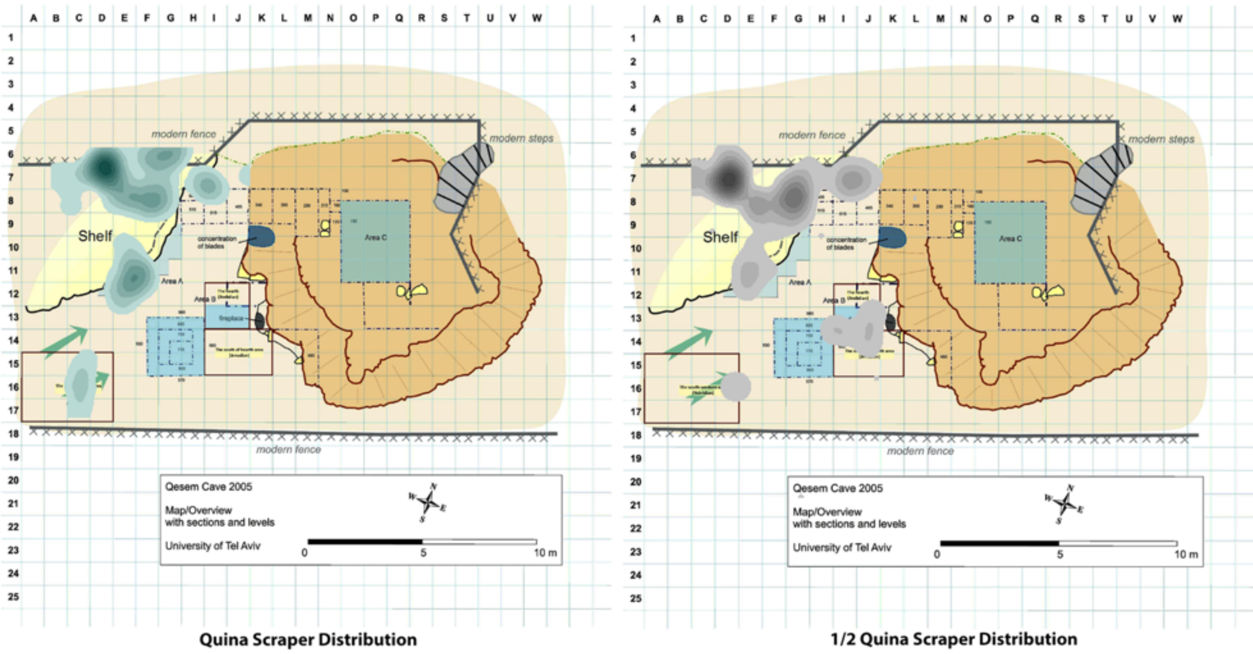


Figure 48. Distribution maps of Quina and demi-Quina scrapers found at Qesem Cave.

When a distinction is made within the spatial distribution of Quina and demi-Quina scrapers, some differences emerge. As already stated, demi-Quina implements dominate the Quina assemblage of Qesem. These are localised in almost every square comprising the Shelf Area and are also found in the Hearth and South Areas. On the contrary, the distribution of Quina scrapers appears more limited. Indeed, these latter are found nearly exclusively within the shelf area (squares C, E, F and G). This difference in the overall number and localisation across the site within Quina and demi-Quina scrapers may provide interesting insights concerning their role in the life of the Qesem Cave hominins. Indeed, one explanation of such difference may relate to the life cycles of these two kinds of scrapers. While demi-Quina scrapers were utilised and discarded just after, Quina scrapers were re-used and probably transported by the Qesem inhabitants, explaining the difference in the amount of demi-Quina and Quina scrapers found at the site.

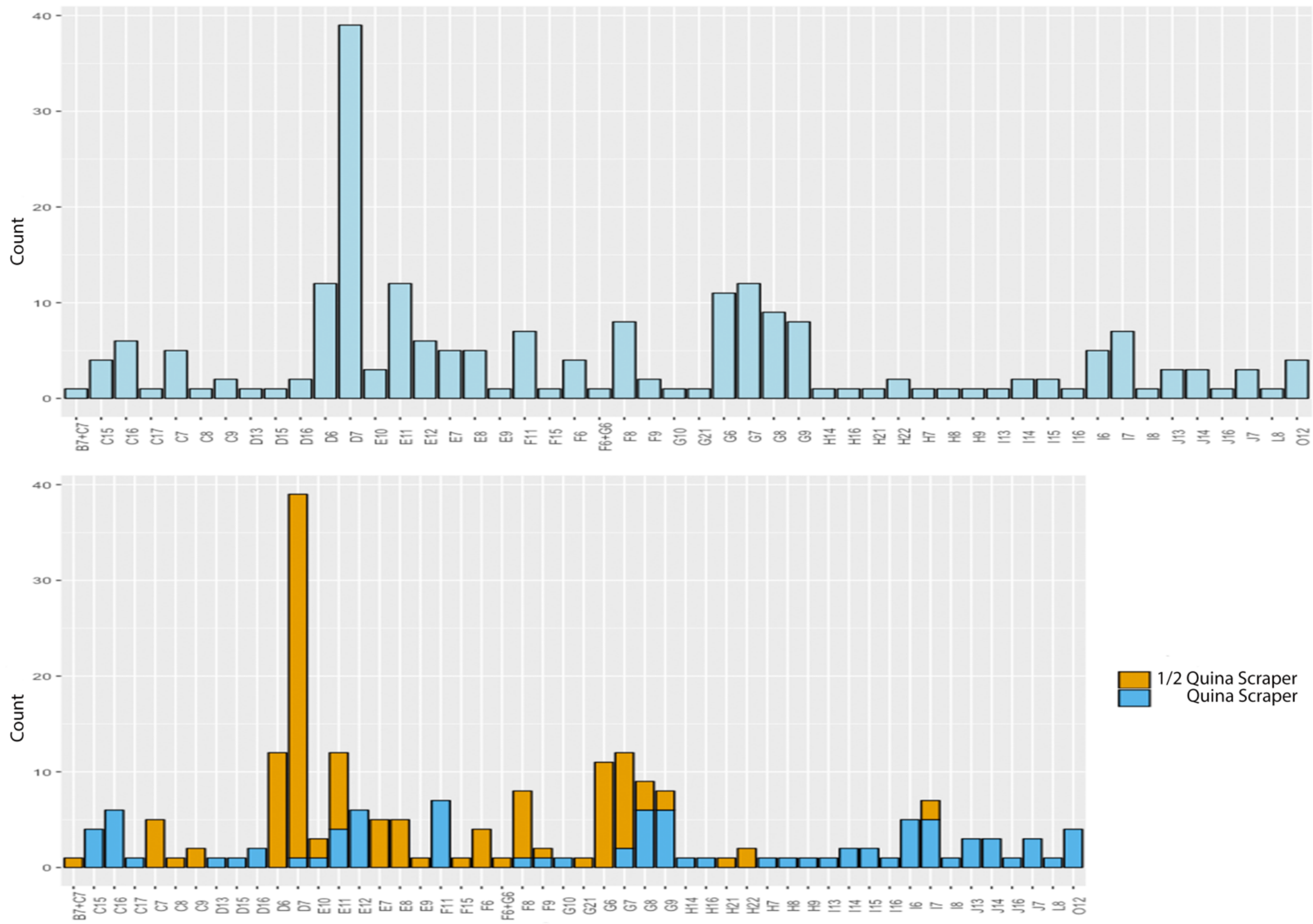
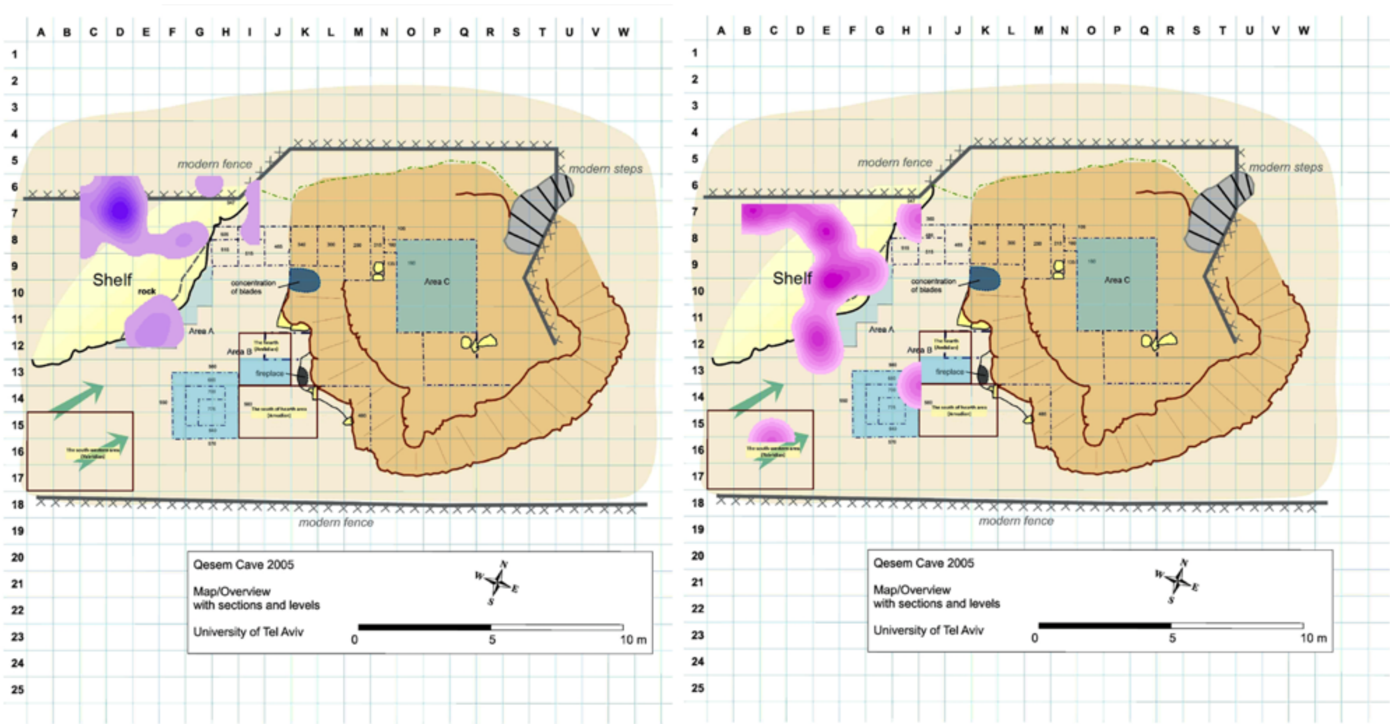


Figure 49. Barplot showing the distribution of Quina and demi-Quina scrapers within each square at Qesem Cave.

Moreover, spatial differences are visible also concerning the worked materials. In particular, hide, both at a fresh and dry state, is processed exclusively in the Shelf. Interestingly it seems that fresh hide processing was performed mostly in squares C and D, while dry hide was also worked in squares B, E and F of the Shelf. Moreover, evidence of dry hide scraping come from other areas of the cave as the South area (square C15 and 16) and in the proximity of the hearth area (square H 13 and 14).



Quina and 1/2 Quina Scrapers Utilised to Process Fresh Hide

Quina and 1/2 Quina Scrapers Utilised to Process Dry Hide

Figure 50. Distribution maps of Quina ad demi-Quina scrapers utilised to process hide across the site.

Within the range of materials processed within the Shelf area, wood is also present. In particular, the majority of scrapers used to process wood are localised in square D7 and G8, partially mimicking the distribution of Quina and demi-Quina scrapers utilised to process hide (both fresh and dry).

If on the one hand, woodworking is mostly performed within the shelf area, vegetal and woody plants are instead processed outside of it. Indeed, the majority of Quina and demi-Quina scrapers exhibiting traces associated to plant processing are localised in squares I7 and J7, along with sporadic evidence coming from the South of the Hearth (square J15) and Southern Area (square D16). Also animal matters and soft materials are mostly processed outside of the shelf area, as observed for vegetal and plants. The majority of scrapers bearing traces of soft material and animal processing concentrated in the Hearth Area of the cave (squares I13, I14, J13 and J14). Another area where animal and soft materials processing are well represented is squares E11 and F 11, localised just on the limit of the Shelf area, while only a few instances come from the inner Shelf and the Southern areas of the cave.

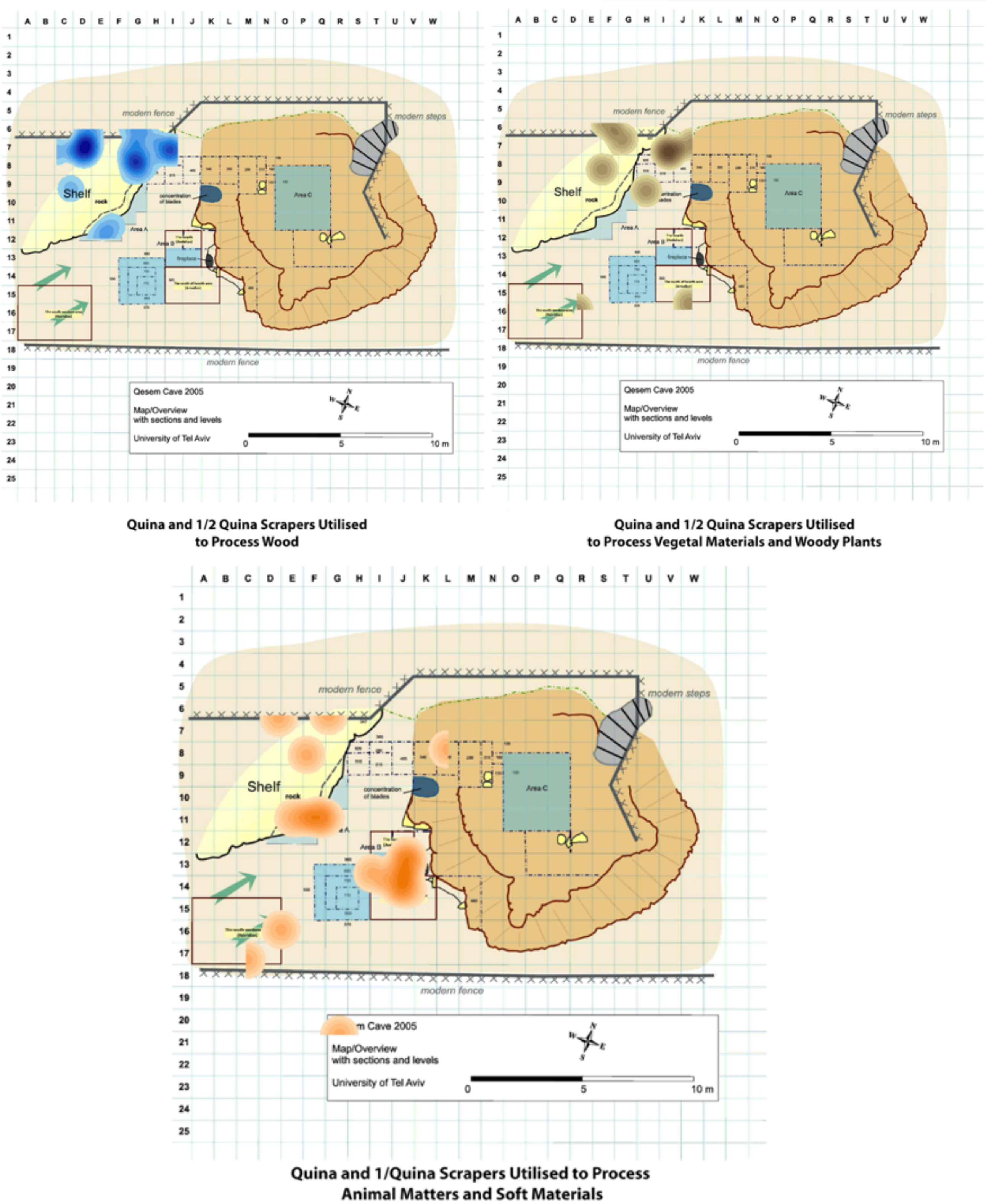


Figure 51. Distribution maps of Quina and demi-Quina scrapers utilised to process wood, vegetal materials and woody plants and animal matters and soft materials.

Patterns of spatial distribution have also been analysed concerning *reaffutage* elements found at the cave. Given their small numbers within the reaffutage sample, type 0, I and IV have been analysed all together. As previously mentioned, these are related to both an advanced stage of Quina retouch (Type IV) and an initial one (Type 0 and I). Within the cave, these kinds of reaffutage elements are found within the shelf area in approximately the same areas where the majority of hide processing was carried out using Quina and demi-Quina scrapers.

A similar distribution pattern across the cave is observed concerning Type II and III reaffutage elements, associated with the adjustment of the Quina edge.

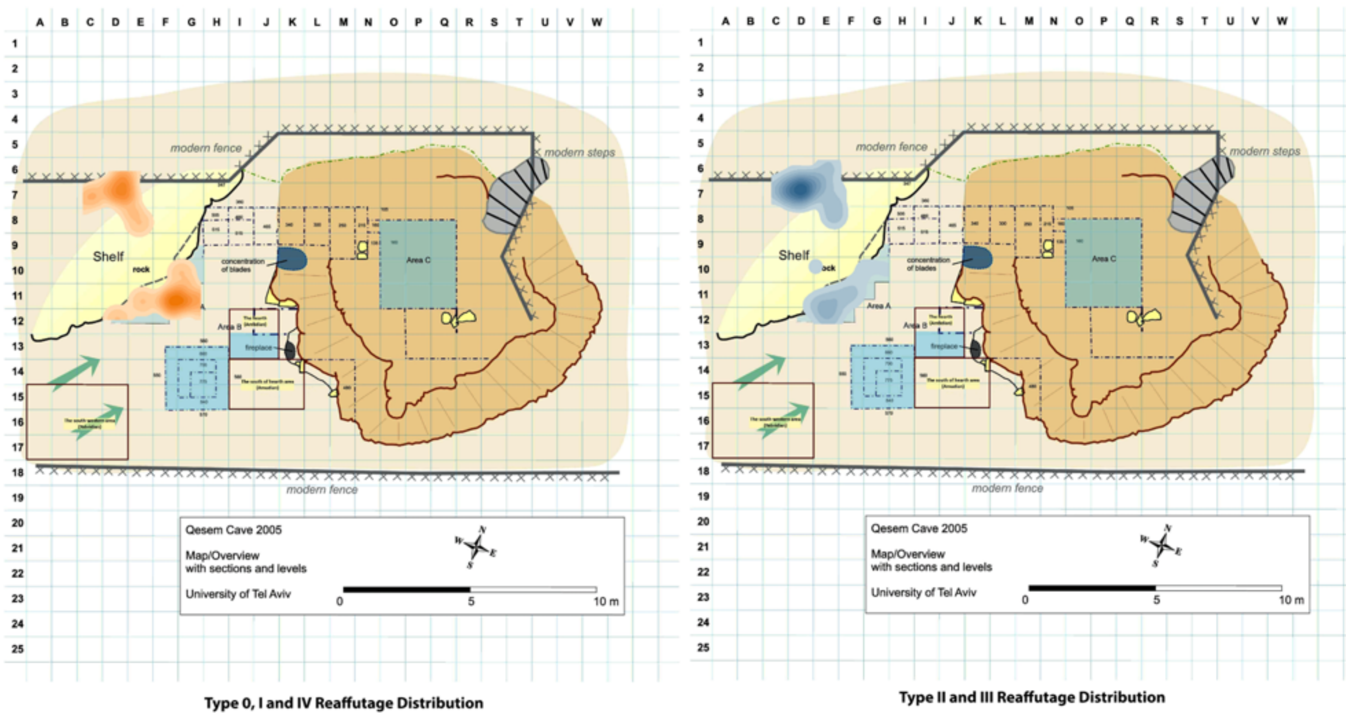


Figure 52. Distribution maps of the reaffutage elements found at Qesem Cave.

From the analysis of the distribution patterns concerning reaffutage elements, two main observations can be made. First of all, the presence of resharpening flakes in areas of the cave where hide processing was performed, confirms, in an indirect way, what already suggested by the use-wear patterns observed on Quina and demi-Quina scrapers: that the Qesem inhabitants were skilled hide workers, able to process hide at different stages and with the occasional use of additives (e.g. ash), dedicating a considerable amount of time and energy to this task.

Moreover, the scarcity of use wear associated to soft material processing identified on reaffutage items, suggests a difference, from what has been observed in Middle Palaeolithic European Quina contexts, in the exploitation of these implements.

Indeed, in Europe, re-sharpening flakes are commonly used as tools to process animal substances and soft materials (Claude et al. 2012) and are often referred as evidence of a ramification of the Quina system (Bourguignon et al. 2004). This behaviour is not observed at Qesem Cave, and its absence could be explained by the fact that other components of the Acheulo Yabrudian toolkit, as NBKs, blades and recycled items, were utilised in these tasks, preventing the exploitation of Quina reaffutage elements as cutting tools (Lemorini 2006, 2015; Venditti 2019).

Chapter V

The Use of Quina and demi-Quina scraper during the European Middle Palaeolithic: a view from Roc de Marsal (France) and Cueva de El Esquilleu (Spain).

From the analysis of the Quina scraper assemblage unearthed at the Lower Palaeolithic site of Qesem Cave, one of the most relevant aspects that have been recorded is their similarities, in terms of techno-morphological features, with the Quina scrapers found in later Western European Middle Palaeolithic contexts. This led to include in this research two Western European Quina assemblage, which has been analysed both in terms of technology and use to identify possible similarities or underline differences which may aid to enhance our current knowledge regarding the Quina phenomenon, both in the Levant and Western Europe.

The two Quina sample assemblages that have been selected are Roc de Marsal and Cueva de El Esquilleu, the former located in France, while the latter is in the Cantabrian region in Spain. The site of Roc de Marsal is located in the Dordogne region in SW France, and its levels have been recently dated to MIS 5 to 4 (87.000 – 45.000 years ago) (Guérin et al. 2017). Excavations at the site identified 13 archaeological layers, where both Levallois and Quina Mousterian evidence have been unearthed. Here, a sample of Quina and demi-Quina scrapers coming from Level 2 of the cave, dated between 61.000 and 45.000 years ago, have been investigated through use-wear analysis. Unfortunately, the general state of preservation did not allow to observe the edges at high magnification to analyse microwear. In this case, the analysis of edge damage permitted to investigate the gestures along with the hardness of the processed materials, providing relevant data regarding the use of Quina implements at the site.

The second selected Quina assemblage is Cueva de El Esquilleu. The cave, located in the Cantabrian region in Spain yielded a very long sequence associated with the Middle Palaeolithic, dated between ca. 55.000 and 34.000 years ago, including Levallois, Quina and Discoid evidence. The Quina assemblage from Level XIII, dated to 39.000 years ago, of the site has been analysed. Contrary to

Roc de Marsal, the excellent state of preservation of the Quartzite Quina and demi-Quina scrapers allowed to observe the tools at both low and high magnifications, including the use of SEM. This permitted to achieve a detailed dataset concerning the activities and the materials processed at the site. Overall, the comparison between the Middle Pleistocene Qesem Cave Quina assemblage and the two European samples allowed a view on long-term chronological and a broad geographical range regarding the techno-morphological aspects and the functional role of scrapers. This, in turn, may allow a better understanding of the Quina phenomenon and its evolution over time and space.

V.1 Roc de Marsal (France)

Roc de Marsal is a cave located along the tributary valley of the Vézère River, in the Dordogne region in South Western France (Fig. 52). The site was found and first excavated by Jean Lafille from 1953 until 1971, and is known for the discovery, in 1961, of the remains of a Neanderthal child (Bordes and Lafille 1962; Sandgathe et al. 2011; Turq 1985). Recently, from 2004 to 2010, excavation at the site have been resumed and led to a reconsideration of the archaeological sequence first described by Lafille (Castel et al. 2017; Guérin et al. 2017) (Fig. 53). A total of 13 layers have been identified, with the lowermost strata, 13 to 10, being sterile and layer 1 chronologically associated with the Holocene (Guérin et al. 2017, 2012).

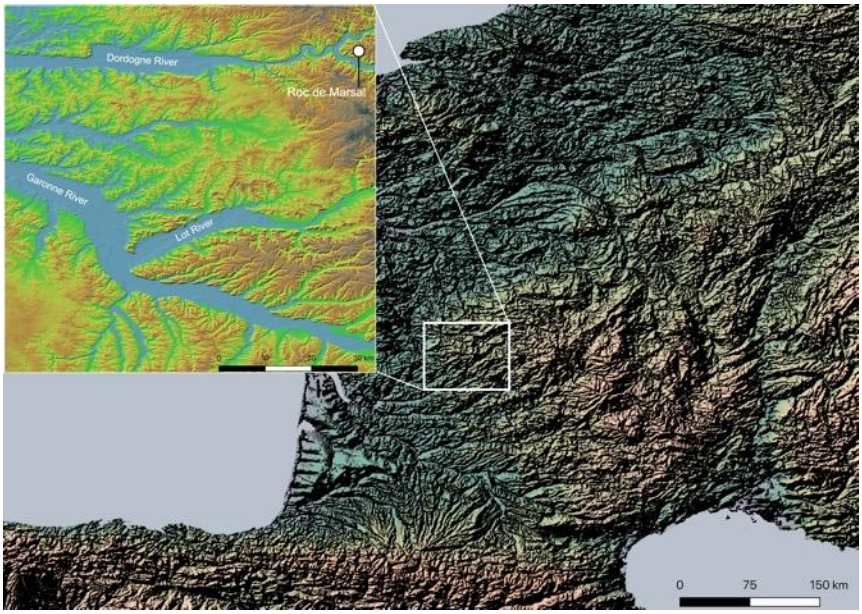


Figure 53. Map showing the localisation of the site of Roc de Marsal.

Late Pleistocene evidence has been found in layers 9 through 2, where significant concentrations of Middle Palaeolithic lithic and faunal remains have been recovered (Sandgathe et al. 2017).

Recent TL dates allowed to chronologically associate layers **9 to 7** to MIS 4 (between 70,000 – 65.000 years ago). The lithic assemblage recovered from these strata is characterised by a dominant Levallois component and a low frequency of retouched implements (Turq 1985; Dibble and McPherron 2006). Furthermore, in these layers, a significant number of combustion features have been discovered as well, divided from each other by thin phosphatic layers related to abandonment stages of the cave (Goldberg et al. 2012; Sadgathe et al. 2011).

Layer **6 and 5** are described as transitory levels, where a lower representation of Levallois occurrence is recorded in association to an increase in the number of retouched implements (Turq 1989; Castel et al. 2017). Layers **4 to 2** yielded TL dates ranging between 61.000 and 45.000 years ago corresponding to a later MIS 4 stage and an early MIS 3 phase (Guerin et al. 2012, 2017). Within these layers, the lithic assemblage is dominated by large, flint scrapers characterised by Quina retouch, allowing to assign levels 4 to 2 of the cave to the Quina Mousterian. Level **4** represents the earliest Quina occurrence at Roc de Marsal, dated around 50,000 years ago (Guerin et al. 2012, 2017).

Lafille strata 1953–1961	New Strata 2004–2010	Lithic industry	Absolute dates	Marine isotope stages	Volume of sediment (litres)	Faunal remains recorded	Lithic remains recorded
XIV–XIII	1	Holocene/disturbed	n/a		2233	853	553
XI–XII	2	Quina Mousterian	61–45 ky (TL)	end of 4–early 3	1631	4503	988
X	3				182	1566	276
IX	4				1925	23,094	2969
VIII							
VI–VII	5	High frequency of Levallois		4	532	5432	2422
V	6	and low frequency of retouching			154	1230	759
IV	7		70–65 ky (TL)		504	3607	4035
III	8				511	2604	3738
I–II	9				868	3655	8148
A	10	archaeological ?		5	161	40	133
C–B	11 to 13	non archaeological	87–77 ky (TL)		98	37	25

Figure 54. Correlation between Lafille's strata and the new lithostratigraphic units including lithic industries, chronology, excavated volume, lithics and faunal remains per layer. From Castel et al. 2017, pp. 142.

V.1.2 Environmental and Archaeozoological Settings

Evidence related to the environmental setting of Roc de Marsal come entirely from the analysis of the faunal assemblage recovered at the site (Hodgkins et al. 2016). Temperate conditions seem to have characterised the Levallois occupation (Levels 9 to 5) of the site, given the abundance of forest species such as roe deer and horse (Sandgathe et al. 2011). A change towards a colder climate in the Quina levels (4 to 2) is attested by the dominance of reindeer and different vole species, in particular, snow vole (*Chionomys nivalis*) suggesting more open, colder and drier environments (Sandgathe et al. 2011).

From an archaeozoological point of view, the faunal remains recovered from the Levallois and Quina levels of the site present relevant differences.

Red deer and roe deer dominate the lower (Levallois) levels, while reindeer and horse are rare (Castel et al. 2007, 2010, 2017) (Fig. 54). On the contrary, the rich faunal assemblage coming from the Quina levels of the site (layers 4-2) is highly dominated by reindeer, with the horse being the second most exploited prey. Castel and colleagues (2017) performed a detailed study of part of the reindeer dominating the faunal assemblage of the Quina levels at Roc de Marsal. From their analysis, several patterns concerning prey selection and processing have been identified. First of all, the abundance of metapodials and other kinds of long bones suggest that complete reindeer limbs were transported to the site and then processed (Castel et al. 2017). The analysis of cutmarks affecting the bone surface indicates that de-fleshing was carried out at the site, while there is no evidence for evisceration. Moreover, two kinds of cutmarks have been identified on reindeer metapodials which suggest also skinning and sinew removal within the butchering activities ongoing at the site (Castel et al. 2017). Bone breaking aimed to access marrow is recorded as well at Roc de Marsal along with the exploitation of bones for non-dietary purposes as the use of bone shafts as retouchers (Castel et al. 2017).

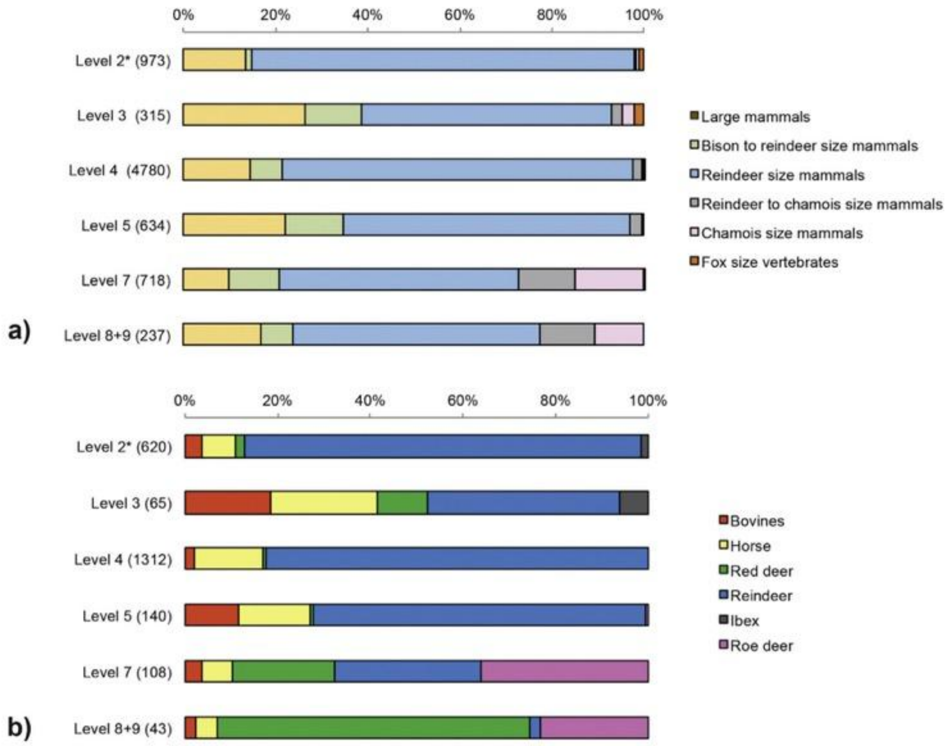


Figure 55. Faunal assemblage composition at Roc de Marsal. a) relative proportions of vertebrate b size classes; b) relative proportions of ungulates by species. From Castel et al. 2017, pp. 143.

V.2 The Quina and demi-Quina lithic assemblage from Roc de Marsal Level 2

A total of 46 Quina and demi-Quina flint scrapers, composing the entire Quina assemblage of Level 2 of Roc de Marsal have been analysed to assess their function through use-wear analysis (Tab. 18). Demi-Quina implements are the most represented (n=30) scraper type within the sample. Within the demi-Quina sample of Roc de Marsal, the majority of the tools (n.17) exhibits a steep scale stepped retouch affecting part of their edges and fall into the techno-morpho functional group (TMFG) V (more scalar retouch affecting parts of the edges). The remaining artefacts (n.13) are characterised by a less abrupt scale stepped retouch and fall into TMFG IV.

Within the scraper assemblage of Level 2 of Roc de Marsal, 16 Quina scrapers are present. Most of them (n.8) fall into TMFG II (long Quina resharpening cycle). In contrast, five implements fall into TMFG III (single Quina resharpening cycle) and three Quina scrapers, that exhibit Clactonian notches and ventral detachments suggesting their re-use as cores fall into TMFG I.

	n.	*%*		*n.*	*%*	
Quina	16	34.8	**1/2 Quina**	30	65.2	
TMFG I	3	18.7	*TMFG IV*	13	43.3	
TMFG II	8	50	*TMFG V*	17	56.7	
TMFG III	5	31.2				
Total	16	-		30	-	**46**

Table 19. The Quina assemblage composition from Level 2 (XI) of Roc de Marsal.

All of the analysed scrapers are made on a fine grain flint, and all of the exploited blanks are primary, exception made for one item (13_K9), which is made on a recycled blank. Regarding blank morphology, no significant difference between the blanks utilised to produce Quina and demi-Quina scrapers is recorded, exception made for the blank thickness, which resulted in being higher for the ones exploited in the production of Quina scrapers. Furthermore, the majority of the blanks are asymmetrical in section (n.22) and exhibit a low to medium degree of cortex covering between 5% and 20% of the dorsal surface. Only in 9 cases the presence of cortex over the scrapers' surface is higher than 50%. Prominent bulbs of percussion characterise 31 of the analysed Quina and demi-Quina scrapers, while diffuse (n.5) and scaled bulbs (n.1) are rare. The high number of prominent bulbs suggests the use of hard hammers at least in the first stages of production (i.e. blank production) of the tools recovered at Roc de Marsal, with soft hammers, used to the retouching of the tools' edge and its maintenance. This hypothesis is also supported by the conspicuous presence of bone retouchers found within the archaeozoological assemblage (Castel et al. 2017).

Within the analysed scraper sample, the majority of the tools (n.26) feature a flat striking platform, a cortical one is exhibited by eleven scrapers, while in nine cases out of 46, the striking platform morphology was not recognisable.

In terms of edge retouch, both Quina and demi-Quina implements from Level 2 of Roc de Marsal, are characterised by a scaled stepped retouch. In the majority of the cases (n.45), this exhibits a direct position, affecting the dorsal surface of the blank. Only in one instance, the retouch position is inverse (1_K19). Regarding the morphological characteristics of the edge of the scrapers at Roc de Marsal, most of the artefact (n. 25) are characterised by convex edge delineations. In contrast, only 16 scrapers exhibit straight edges. In profile view 32 out of 46 Quina and demi-Quina scrapers' edges are straight, seven are convex, four irregular and 3 are concave.

When a distinction is made within Quina and demi-Quina scrapers in terms of edge morphology, no significant difference is noted. Indeed, in both scraper categories, the most represented edge shape is convex, and the majority of edge profiles are straight. No variation between the two scraper categories is present also in terms of edge cross cross-section. Most of the tools exhibit a Straight-Straight cross-section. A difference is instead recorded in the edge angle. Indeed, Quina scrapers show more abrupt edges (mean measure 66.1°). In comparison, demi-Quina scrapers feature fewer steep edges (mean measure 54.3°), a difference, as will be shown later in this chapter, probably related to the use of the tools at the site (Fig. 55).

Blank Morphological Features			Edge Morphology		
	n.	%		n.	%
Bulb of Percussion			**Edge Delineation**		
Prominent	31	67,4 %	*Straight*	16	34,8 %
Diffused	5	10,9 %	*Convex*	25	54,3 %
Scaled	1	<1%	*Irregular*	5	10,9 %
Indeterminable	10	21,7 %	**Edge Profile**		
Striking Platform			*Straight*	32	69,6 %
Flat	26	56,5 %	*Convex*	7	15,2 %
Cortical	11	23,9 %	*Concave*	4	8,7%
Indeterminable	9	19,6 %	*Irregular*	3	6,5%
Total	46				

Table 20. Morphological characteristics Quina and demi-Quina scrapers blanks and edges.

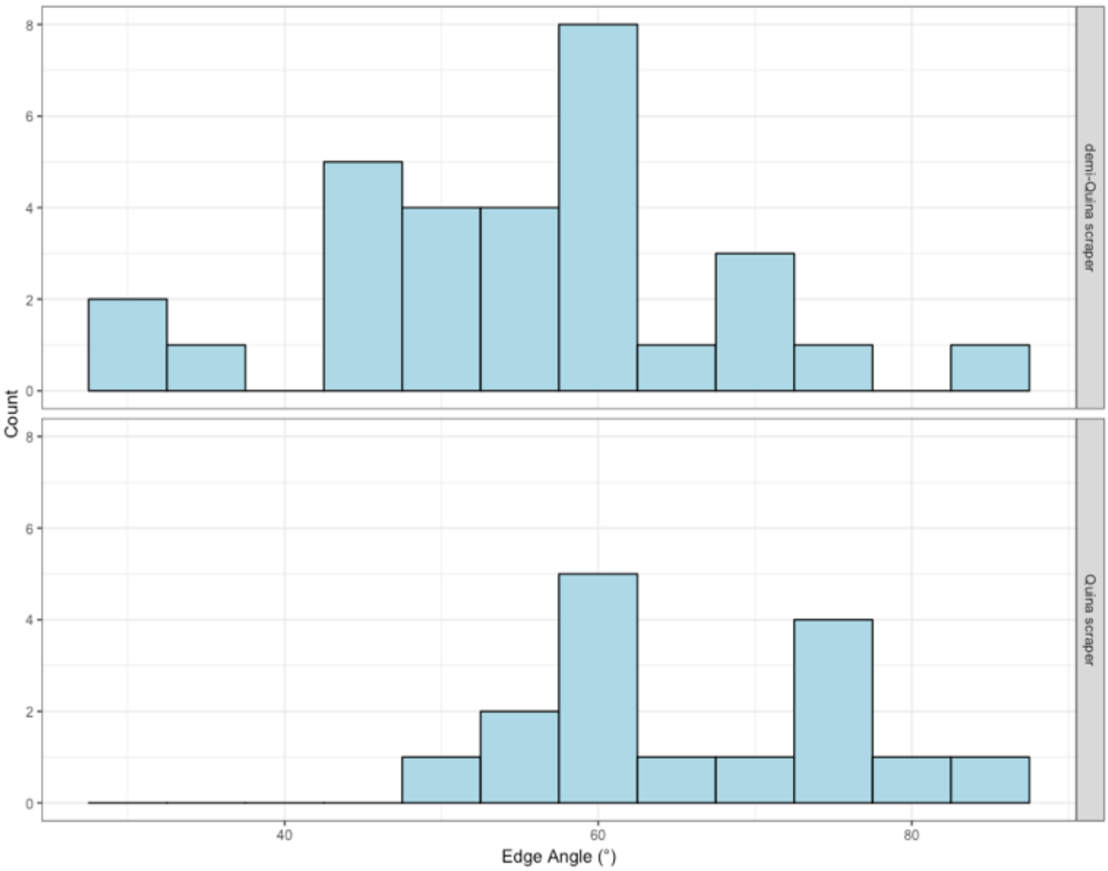


Figure 56. Edge angle comparison between Quina and demi-Quina scrapers at Roc de Marsal (Level 2).

V.2.1 State of preservation and Post Depositional Modification Affecting the Quina sample from Level 2 of Roc de Marsal

A total of 46 Quina and demi-Quina scrapers coming from Level 2 of Roc de Marsal have been analysed through use-wear analysis. Within the sample, 24 artefacts exhibit diagnostic wear and are defined as used, with only one item, a demi-Quina scraper (37_11), which does not show any trace associable to use, suggesting its abandonment just after its edge was re-sharpened.

Fourteen items exhibit potential use related wear, which, however, given their morphological characteristics and distribution along the tools' edge have not been defined as diagnostic. Finally, 7 out of the 46 analysed scrapers are affected by heavy post-depositional alterations which impede the identification of potential diagnostic traces of use even at low magnifications.

Unfortunately, the entire analysed scraper assemblage is affected by PSDM, specifically by surface patination, which prevents the observation of microwear at high magnifications (Fig. 56). The most commonly identified kind of patina is glossy patina, along with several instances of white patina.

The second most common kind of alteration is represented by mechanical alterations happening mostly in the form of edge fractures and surface corrosions. These data indicate that the alteration of the artefact surface was due to multiple factors, as the chemical composition of the sediments, leading to the development of glossy and white patina, along with thermal and tribological factors causing fractures and surface corrosions (Burroni et al. 2002).

As mentioned before, the state of preservation of the surfaces did not allow in most of the cases to identify potential diagnostic microwear which might provide detailed information regarding the processed materials and the gesture performed. However, the overall good degree of preservation of the scrapers' edges permitted to identify edge damage (e.g. microchipping and rounding) allowing to achieve useful functional data concerning the hardness of the worked material and the gestures performed (for more details regarding edge damage characteristic refer to the methodology presented in Chapter II).

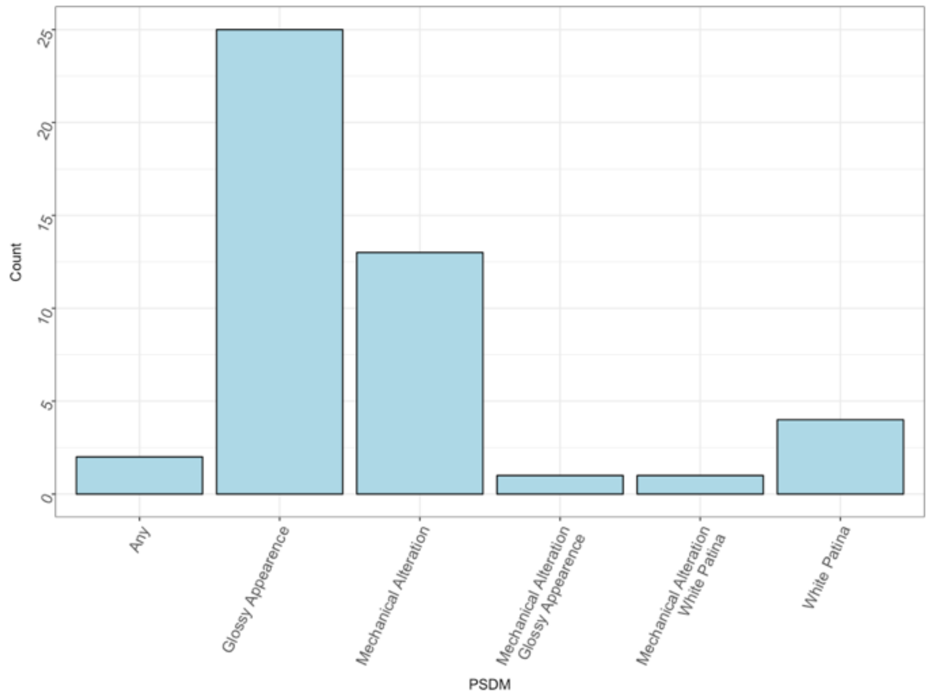


Figure 57. Post depositional modifications affecting the Quina and demi-Quina scraper sample coming from Level 2 of Roc de Marsal.

V.3 The Use of Quina scraper at Roc de Marsal (Level 2)

Edge damage analysis indicates that at Level 2 of Roc de Marsal, Quina scrapers were mostly exploited to process substances with a medium hardness through transversal motions (Fig.58). Step and feather terminating scars are visible over most of the edges of the analysed scraper. When identified the initial portion of the scar is cone. Microchipping exhibits a close regular distribution over the tool's edge. Only in a few cases, this is overlapping or wide regular. Micro scars orientation is transversal in most of the cases (n.12), with only three scrapers bearing an oblique unidirectional edge damage orientation pattern. Further, most of the analysed Quina scrapers are characterised by a high degree of edge rounding. All of the features mentioned above confirm the use of the tools for the processing of medium and medium-hard materials, which were worked, nearly exclusively, through transversal motions suggesting a scraping activity.

Only in two instances, 10_M16 and 54_J10, a different pattern is observed, with the former characterized by hinge terminating micro scars associated to a very high degree of edge rounding, and the latter, 54_J10, exhibiting feather terminating micro scars along with a low degree of edge rounding. The recorded edge damage characteristics, not identified on the remaining used Quina scrapers of the analysed assemblage, suggest the use of these tools to process hard materials through scraping (10_M16) and soft materials through cutting (54_J10) (Fig. 59).

Within the analysed Quina sample, in two cases (N19_54 and M18_13), it was possible to identify diagnostic microwear (Fig. 57). A smooth domed polish is visible on both tools' ventral surfaces, localised over the outer portions of their edges and bearing a transversal orientation. A high degree of surface micro rounding is visible as well. Polish distribution along the edge is indeterminable due to the effects of PSDM. The morphological characteristics (smooth texture, domed topography and tight linkage) of the observed microwear along with the morphological features of the identified edge damage (*i.e.* step terminating scars and a high degree of edge rounding) indicates the utilisation of both scrapers to process fresh hide performing transversal motions.

Overall, while the orientation of the micro scars generated by use allows suggesting with a certain degree of confidence that the primary activity in which the Quina scrapers were involved was scraping, providing details regarding the processed substances remains challenging, due to the alteration affecting the analysed tools. However, to this matter, it is relevant to underline the low degree of variation characterising the edge damage observed on the utilised Quina scrapers from Level 2 of Roc de Marsal. As mentioned earlier in this paragraph, from the analysis at low magnification of the edges it emerges that most of them are affected by small step and feather terminating scars associated to e high degree of edge rounding. An identical pattern of microchipping (feather step terminating scars) and rounding degree (high) is observed on the experimental replicas utilised to process fresh hide (see Chapter III). Together this evidence allow pushing further the functional interpretation proposed for the Quina scrapers of Roc de Marsal, suggesting their nearly exclusive use to scrape medium materials, identifiable as hide.

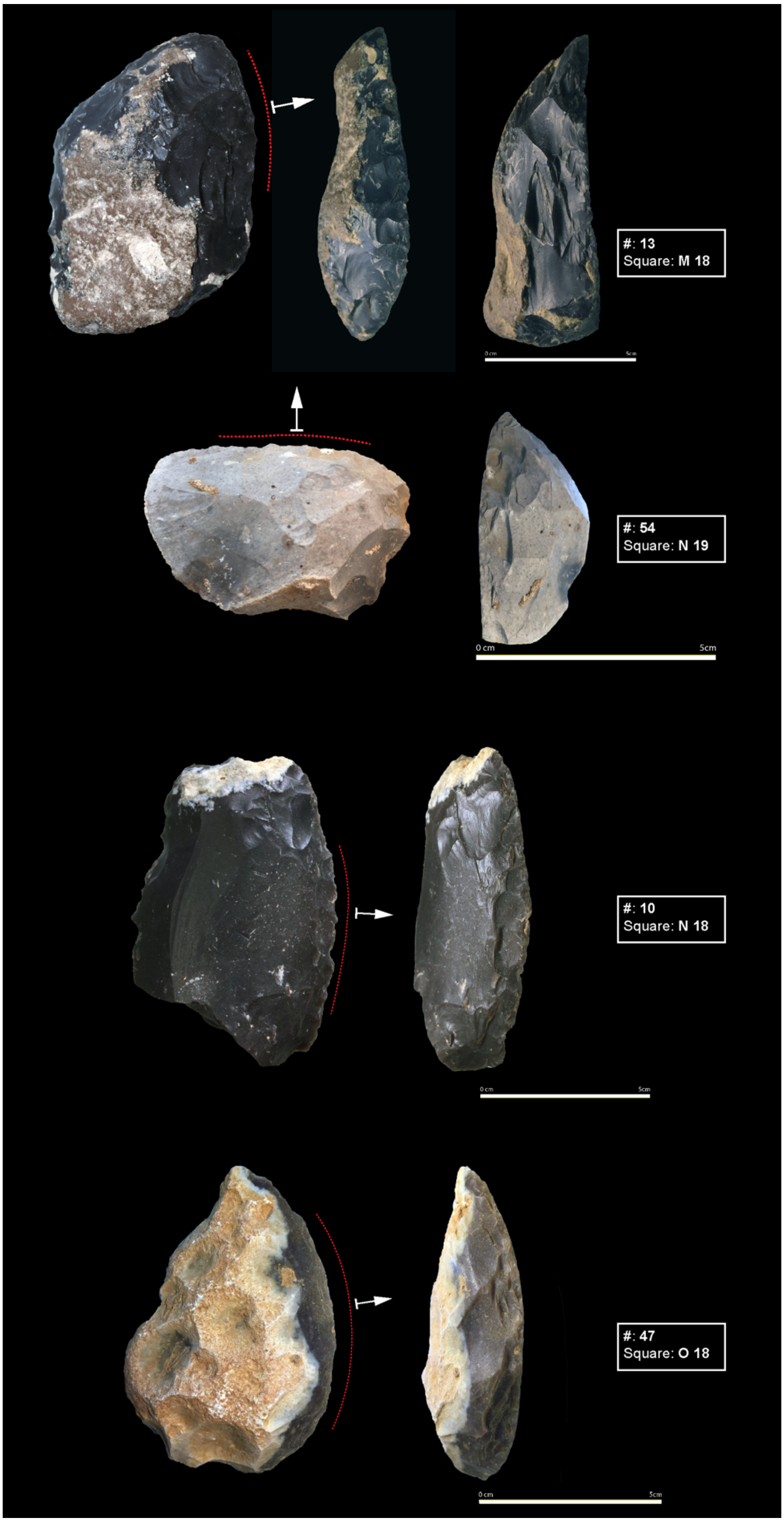


Figure 58. Sample of Quina (#13_M18; #54_N19) and demi-Quina (#10_N18; #47_O18) scrapers coming from Level 2 of Roc de Marsal on which it was possible to identify microwear associated to fresh hide. Red line indicated the location of use wear.

V.4 The Use of demi-Quina Scrapers at Roc de Marsal (Level 2)

Within the analysed assemblage 13 scrapers out of a total of 30 items comprising the demi-Quina assemblage of Level 2 of Roc de Marsal, exhibit diagnostic traces of use. As previously stated in the case of Quina scrapers, also demi-Quina implements exhibit a high degree of surface patination which make it very difficult to observe diagnostic micro-wear. For this reason, the functional interpretation of the scrapers is mostly based on the analysis of edge damage, apart for four cases (10_N18, 47_O18, 62_L19, 194_L16) in which microwear was identified (Fig. 57).

In the case of these items, a detailed functional interpretation was possible. Two scrapers, namely 194_L16 and 47_O18, are characterized by step scars affecting the dorsal surface of the tools, bearing a transversal orientation and associated with a high degree of edge rounding. A smooth domed polish with a tight linkage band is visible over the ventral surface of the edge, along with a high degree of surface micro rounding.

In both cases, the combination of edge damage and microwear allows suggesting the use of these tools to process fresh hide through a scraping activity.

The combination of edge damage and microwear was possible also for scrapers 62_L19 and 10_N16. In the former case, feather and step scars are close regularly distributed over both the ventral and dorsal edge surfaces of the tool. The initial portion of the scars is cone, and they are associated with a low to medium degree of edge rounding. Micro polish with a smooth texture and a granular to domed topography is visible over both the ventral and dorsal surfaces of the tool's edge along its outer portion. In this latter case, polish is visible both on the ridges and the inner part of the retouch scars. Edge damage and polish exhibit an oblique unidirectional orientation suggesting the of the tool for a cutting/slicing activity. The features exhibited by both edge damage and micro polish allow suggesting the use of the tool to process soft materials identifiable as animal substances (e.g. meat and soft tissues). The last item, within the demi-Quina assemblage, for which it was possible to analyse both edge damage and microwear is item 10_N18. Step and hinge terminating scars are visible over the edge dorsal surface, bearing a close regular distribution and a transversal orientation.

The edge exhibits a very high degree of rounding. Small spots of polish are visible on the ridges of the retouching scars over the dorsal surface of the edge. Polish texture is smooth, its topography is flat and tight linkage, surface micro rounding is very high. Given the morphological characteristics of edge damage and microwear, it is possible to propose the use of the tool to scrape medium-hard material (Fig. 58).

Going further into details concerning the functional interpretation of the tool, comparing the identified traces to the experimental ones, is possible to hypothesise the use of scraper 10_N18 in de-fleshing activities, namely the removing of meat from bones. Furthermore, given the flat topography exhibited by the micro polish in several portions of the edge, it is possible to assume that the amount of meat on the bone was not so high, resulting in frequent contacts between the tool and the bone surface.

The use of the remaining ten items composing the demi-Quina assemblage was interpreted solely on the base of edge damage, given the high degree of surface alteration.

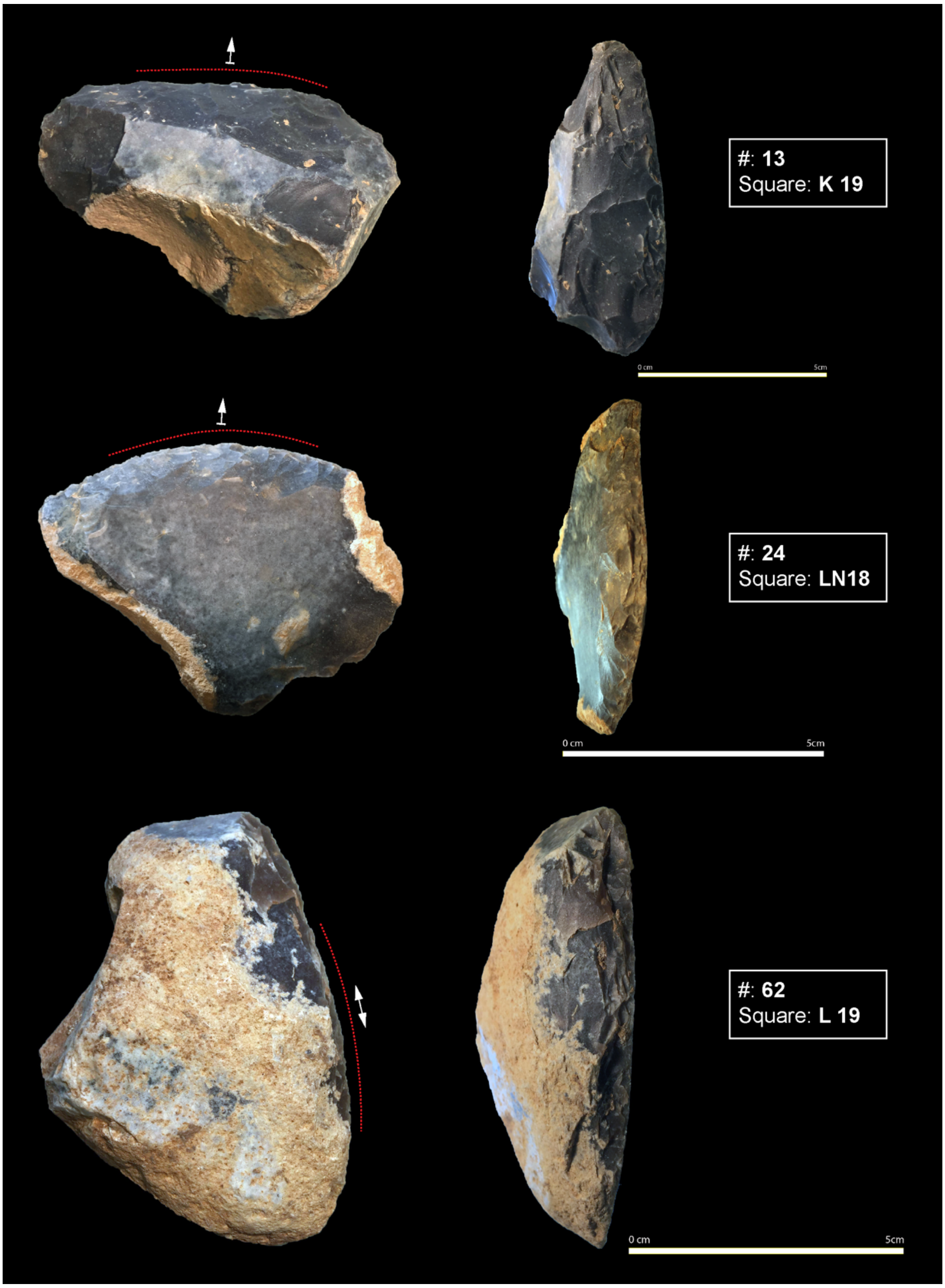


Figure 59. Sample of Quina and demi-Quina scrapers exhibiting edge damage associated with the processing of materials of medium hardness which can be associate to hide. Red line indicated the location of use wear.

4 out of 9 tools (13_K19, 24_N18, 12_N18, 34_L19) are characterised by the presence of step terminating scars, often bearing a cone initiation. Microchipping always affects the dorsal surface of the edge and is associated with a high degree of edge rounding. Most of the recorded edge damage exhibit a transversal orientation apart for one tool, 34_L19, for which a mixed-orientation is recorded. These patterns suggest that all of the tools, exclusion made for item 34_L19 for which mixed motions

can be proposed, were utilised to perform scraping activities. Regarding the hardness of the processed materials, the rounding and the termination of the use-related scars indicate medium substances.
The edge damage observed on these four demi-Quina scrapers is identical to the one identified on the majority of Quina scrapers from Level 2, allowing to hypothesise the use of these tools to process hide. Contrary to what has been observed on the Quina assemblage, this pattern is not exhibited by the majority of the used tools comprising the demi-Quina assemblage of Level 2 of Roc de Marsal. Indeed, the remaining six items (40_K19, 29_P18, 59_P18, 195_L16, 464_O18) show different characteristic in terms of edge damage. Feather terminating scars, associated with a cone initiation are visible on the dorsal surface of the edges along with a low to medium degree of edge rounding. Edge damage orientation is transversal most of the times, indicating a scraping activity, exception made for item 40_K19 where an oblique unidirectional orientation is recorded, suggesting motions associated with a cutting/slicing activity. The termination of the micro scars (feather) along with the low degree of edge rounding point towards the use of these tools to process soft or at the most medium-soft materials. Overall, if a comparison is to be made between the Quina and demi-Quina scrapers from Level 2 of Roc de Marsal, bearing in mind the limited number of utilised items, it is possible to assume that on the one hand the use of Quina scrapers was more specifically oriented towards the scraping of medium materials, identifiable as hide, possibly in a fresh state as indicated by the two items where diagnostic microwear was identified. On the other hand, the use of demi-Quina scrapers was a slightly more varied, in terms of activities and worked materials, given the identification of edge damage and microwear suggesting cutting/slicing motions and soft materials processing.

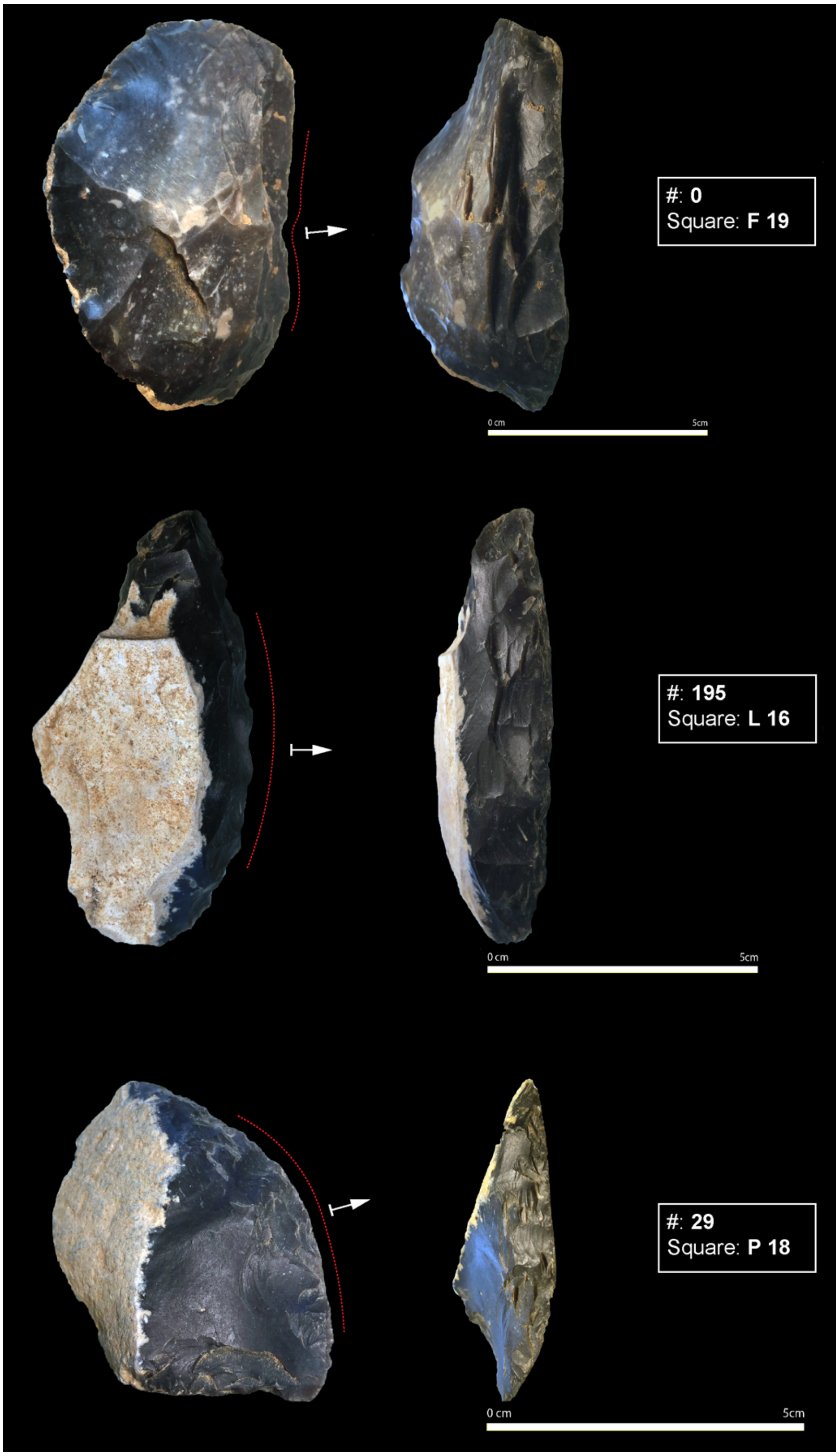


Figure 60. Sample of Quina and demi-Quina scrapers exhibiting edge damage associated with soft materials. Red line indicated the location of use wear.

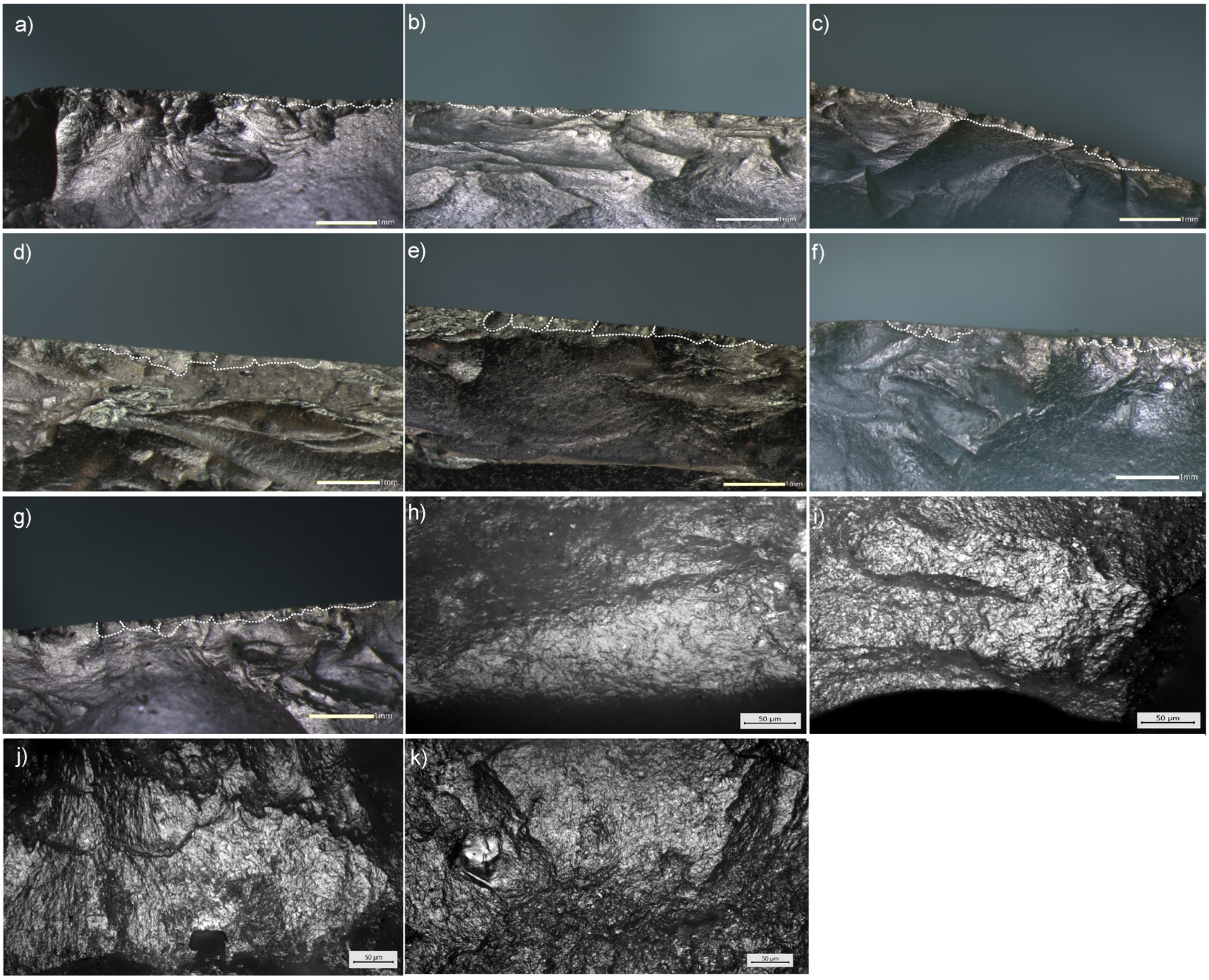


Figure 61. Example of edge damage identified on Quina and demi-Quina scrapers from Roc de Marsal (Level 2). a-c) edge damage associated with the scraping of soft materials; d-f) edge damage related to the processing of medium materials; g-k) edge damage and microwear related to the processing of fresh hide. Pictures of edge damage are taken at 12x. Microwear pictures are taken at 200x.

Quina						
	n.		*Activity*	n.	*Worked Material*	n.
Used	12		Cutting	1	Soft	2
Not Used	/		Scraping	10	Medium	2
Not Diagnostic	3		Mixed	1	Medium/Fresh Hide	3
Altered	2				Medium/Soft	1
					Medium/Hard	1
					Indeterminable	3
1/2 Quina						
	n.		*Activity*	n.	*Worked Material*	n.
Used	13		Cutting	3	Soft	2
Not Used	11		Scraping	10	Medium	4
Not Diagnostic	1		Mixed		Animal Tissues/Fresh Hide	1
Altered	6				Fresh Hide	1
					Medium/Hard	1
					Indeterminable	5

Table 21. Summary of the use-wear interpretation of the Quina and demi-Quina scraper sample of Roc de Marsal (Level 2).

V.5 Cueva de El Esquilleu (Spain)

The site of El Esquilleu is located in Cantabria, Northern Spain, 20 km from the coastline, within the mountainous environment of the "Picos de Europa" region (Fig. 61). Excavation at the site started in 1997 and yielded a considerable amount archaeological, zooarchaeological, anthropological and palynological evidence. For this reason, Cueva de El Esquilleu can be defined as one of the most interesting Mousterian contexts discovered in the last decade.

The cave located 280 asl. in the Liébana Valley, is part of a territory characterized by a high concentration of different biotopes and given the orography of the area is relatively isolated from the surrounding valleys and the coastal corridor (Baena Preysler et al. 2019). One of the most interesting features characterising El Esquilleu is the early start of its occupation, around 55.000 years ago. Indeed, an occupation earlier than 50 kyr is relatively uncommon in the Cantabrian region, where most of the identified Middle Palaeolithic sites are chronologically associated with the end of the Mousterian (Baena et al. 2012; Baena Preysler et al. 2019).

Overall, excavation at the cave yielded a total of 41 archaeological layers, virtually covering the entire MIS 3 chronology (Uzquiano et al. 2012; Mallol, Cabanes, and Baena 2010). The human occupation at the cave has been divided into 3 phases based on the identified technocomplexes (Baena Preysler et al. 2019; Baena et al. 2012). Within the stratigraphic sequence levels, **3 to 5** represent ephemeral occupations of the site, level **6 to 14** are evidence of an important Neanderthal occupation of the cave characterized by Quina Mousterian technology, finally levels **15 to 30** are associated with Levallois and Discoid technology along with occasional Quina evidence (Yravedra and Uzquiano 2013; Uzquiano et al. 2012). Finally, Levels **30 to 36** are still under analysis, while level **37 to 41** represent sterile deposits originated by low energy processes (De Los Terreros et al. 2014). Two patterns of raw material catchment strategies have been identified at the site. Cuartero and colleagues (Cuartero et al. 2015) proposed two different models, the first associated to the Quina and Levallois productions of levels 17 and 13 where high-quality quartzite coming from medium to long-distance sources were exploited, and a second one related to the later upper levels were nearby quartzite sources were exploited in the production of an expedient Discoid technology.

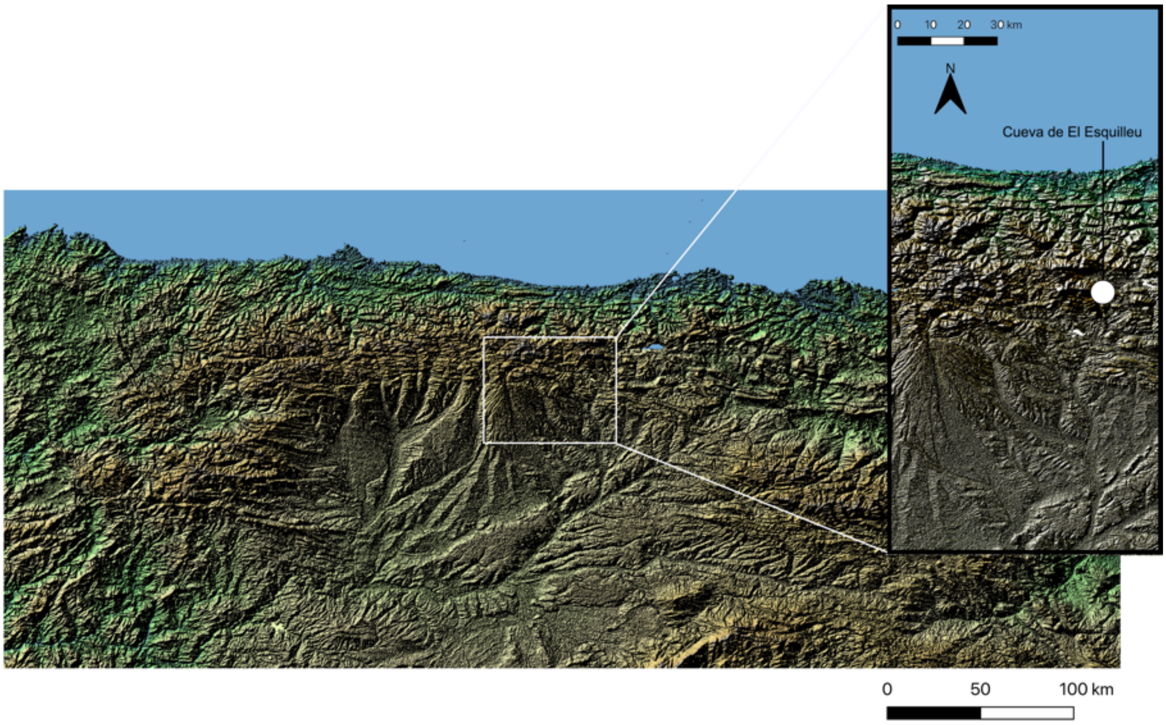


Figure 62. Map showing the localisation of Cueva de El Esquilleu in the NW Cantabrian region of Spain.

V.5.1 Environmental and Archaeozoological Settings

The paleoecological setting of Cueva de El Esquilleu is characterised by scattered shrubs and a Mediterranean climate (Baena et al. 2012). Palynological analysis indicates the presence of *Pinus* along with herbaceous plants. Moreover, aquatic and riverbank plant taxa are present as well (Uzquiano et al. 2012). Pollen analysis allowed to identify three environmental phases happening at the site:

Phase 1 (ca. 53-51 la BP; Levels 30 to 20) characterised by an open landscape including Asteraceae, Poaceae and Chenopodiaceae along with a significant representation of *Pinus* and Cupressaceae and *Betula*.

Phase 2 (ca. <53-51 ka BP; Levels 19 to 14) presence of *Pinus, Betula,* Cupressaceae and Asteraceae.

Phase 3 (ca. 39 – 34.3 ka BP; Levels 13 to 5) moisture conditions indicated by the presence of mesophilic plant taxa and with *Pinus*.

A detailed analysis of the subsistence strategies characterizing the Neanderthal groups of Cueva de El Esquilleu have been performed from the study of the 70.717 faunal remains found within levels 3-30 of the cave (Fig. 62). Iberian ibex (*Capra pirenaica*) and chamois (*Rubicapra rubicapra*) dominate the faunal assemblage of El Esquilleu, indicating patterns of specialised hunting among the Neanderthal groups occupying the site (Yravedra et al. 2014). Large animals as *Bos* and *Bison* are sporadic (Yravedra et al. 2014). The assemblage is dominated by remains of adult specimens, which make it difficult to assess possible seasonality patterns (Yravedra et al. 2014). To this matter, relevant insights have emerged from the analysis of the tooth remains found at the cave. Observing patterns of tooth eruption and wear, Yravedra and colleagues (2014) suggest that the majority of the animals were brought to El Esquilleu during summer and autumn, thus indicating an occupation of the site in a specific time of the year. However, as also the authors suggest, the presence of numerous remains of adult and elderly ibex (>60% of the sample) in levels 11 and 13, may indicate the occupation of the site also during other times of the year (Yravedra et al. 2014).

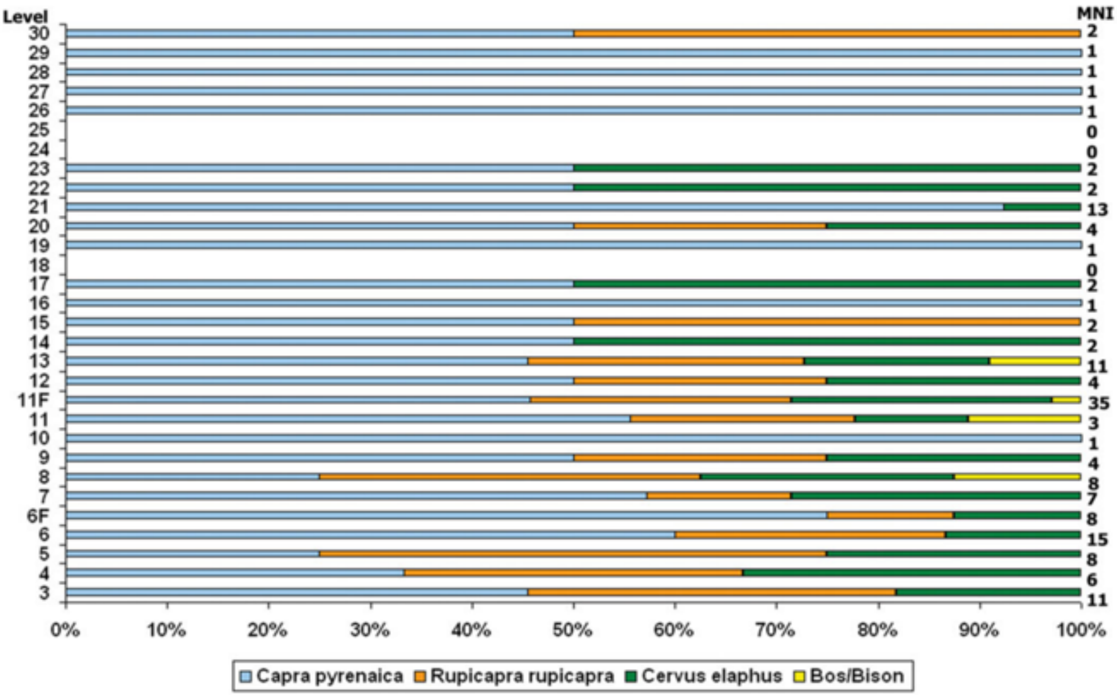


Figure 63. Percentage of MNI of the principal preys at Cueva de El Esquilleu. From Yravedra et al. 2014 pp. 1039.

Moreover, the analysis of the skeletal elements found at the site, hint towards the transport to the cave of specific anatomical parts, precisely legs, of ibex and chamois (Yravedra et al. 2014). A different pattern is recorded in levels 11 and 13 where portions of the entire skeletons are found indicating that mostly complete ibex and chamois carcasses were brought to the site and processed (Yravedra et al. 2014). From the analysis of bone surfaces, both cut marks and percussion marks have been identified. In particular, cut marks are more abundant than percussion marks which are present on less than 10% of the bones found in levels 11 and 13. The morphological characteristics and spatial distribution of the identified cut marks are associated to skinning activities, involving mostly the bases of horns and phalanges. In contrast, cut marks related to de-fleshing activities are found on long bones, ribs, scapulae and pelvises. Furthermore, marks associated with evisceration are found in the ventral surfaces of ribs, while dismembering marks are typically observed over the articulate areas of long bones (Yravedra et al. 2014). Burnt and charred bones are common within the faunal assemblage of El Esquilleu. Such a high frequency of burnt bones may lead to hypothesise the use of bones as fuel. However, this behaviour can be excluded at Esquilleu. Indeed, the bones generally utilised as combustion fuel are lacking from the burnt bone assemblage found at the cave. Moreover, the pollen and charcoal analysis revealed the presence within the surrounding environment of plants highly suitable to feed hearths (Uzquiano et al. 2006). This suggests that bones were intentionally tossed into the fire not only to keep predators away from the cave but also to maintain an appropriate hygienic condition enhancing the living conditions of the Neanderthal groups occupying the cave at the end of the Middle Palaeolithic (Yravedra & Uzquiano 2013; Uzquiano et al. 2012).

V.6 The Quina and demi-Quina Scraper Assemblage of Cueva de El Esquilleu (Level XIII)

The entire Quina and demi-Quina scraper assemblage of Level XIII, composed of 49 Quina and demi-Quina specimens made of fine-grained quartzite was investigated through use-wear analysis (Tab.

21). All of the items come from Level XIII of the site, dated to 39.000 ± 300 BP. The analysed assemblage is composed of 27 Quina and 22 demi-Quina scrapers. Most of the Quina scrapers coming from Level XIII of El Esquilleu are characterised by a single complete cycle of Quina retouch and fall into TMFG III (n.16). Nine (9) items are characterized by multiple overlapping lines of retouch and fall into TMFG II. Only in two cases, a Clactonian notch is present on the edge of the tools suggesting their re-use as cores, allowing to include these latter within TMFG I. Within the demi-Quina sample, 16 out of 22 scrapers fall into TMFG IV and are characterised by a scaled-stepped retouch affecting only a part of their edges. Six (6) implements within the analysed assemblage are characterised by a steeper partial retouch of their edges, which make them fall into TMFG V.

	n.	*%*		*n.*	*%*	Total
Quina	27	55,1%	**1/2 Quina**	22	44,9%	
TMFG I	2	7,4%	*TMFG IV*	13	59,1%	
TMFG II	9	33,3%	*TMFG V*	9	40,9%	
TMFG III	16	59,3%				
						49

Table 22. Composition of the Quina and demi-Quina assemblage from Level XIII of Cueva de El Esquilleu.

The blanks utilised in the production of both Quina and demi-Quina scrapers of El Esquilleu are always primary, with no evidence of recycled specimens. The flat morphology of the striking platform characterising the majority of the specimens (n.16) indicates a minimum degree of preparation. Cortical striking platforms are present as well on 2 Quina scrapers and three demi-Quina scrapers, while in 27 cases the striking platform morphology results indeterminable. The use of hard hammerstones during the primary phases of blank production is suggested by the presence of prominent bulbs of percussion (n.19) characterising the tools. Three examples, 2 Quina and one demi-Quina scraper exhibit a diffused bulb of percussion, while in 27 this latter was not determinable. A possible explanation of this pattern, not uncommon in the case of tools made on quartzose raw materials, can be the hardness of raw material itself and its capacity to absorb the strength exerted by the knapper's blows. This property may affect the force propagation across the tool's surface, resulting in diffused or in indeterminable bulbs of percussion.

Regarding the dimensions of Quina and demi-Quina scrapers, these are overall small (avg. length 52mm; avg. width 36.2mm; avg. thickness 18.1mm), with any significant difference when the two scrapers categories are compared.

Regarding edge morphology, the most common edge delineation characterising Quina and demi-Quina scrapers is convex (n.30). Tools exhibiting a straight edge delineation are also present within the analysed assemblage (n.18), mostly Quina scrapers (n.11), while an irregular edge delineation characterizes only one demi-Quina implement. Any significant difference in edge profile is present within the two scraper categories, with only one example of a convex edge profile recorded against the remaining 48 instances of straight ones. In terms of edge cross-section, most of the analysed tools (n. 39) are characterised by a Straight-Straight cross-section. A straight-convex cross-section is present on five (5) Quina and two (2) demi-Quina scrapers. Finally, one (1) Quina scraper exhibits a concave-convex edge cross-section, while one (1) Quina and one (1) demi-Quina scrapers are characterised by multiple cross sections (straight-straight and straight-convex).

Blank Morphological Features			Edge Morphology		
	n.	%		n.	%
Bulb of Percussion			**Edge Delineation**		
Prominent	19	67.4 %	*Straight*	18	36.7 %
Diffused	3	6.1%	*Convex*	30	61.2 %
Scaled	0	0.0%	*Irregular*	1	<1%
Indeterminable	27	55.1 %	**Edge Profile**		
Striking Plattform			*Straight*	38	77.6 %
Flat	16	32.7 %	*Convex*	1	<1%
Cortical	5	10.2 %	*Concave*	0	0.0%
Indeterminable	27	55.1 %	*Irregular*	0	0.0%

Table 23. Morphological characteristics Quina and demi-Quina scrapers blanks and edges.

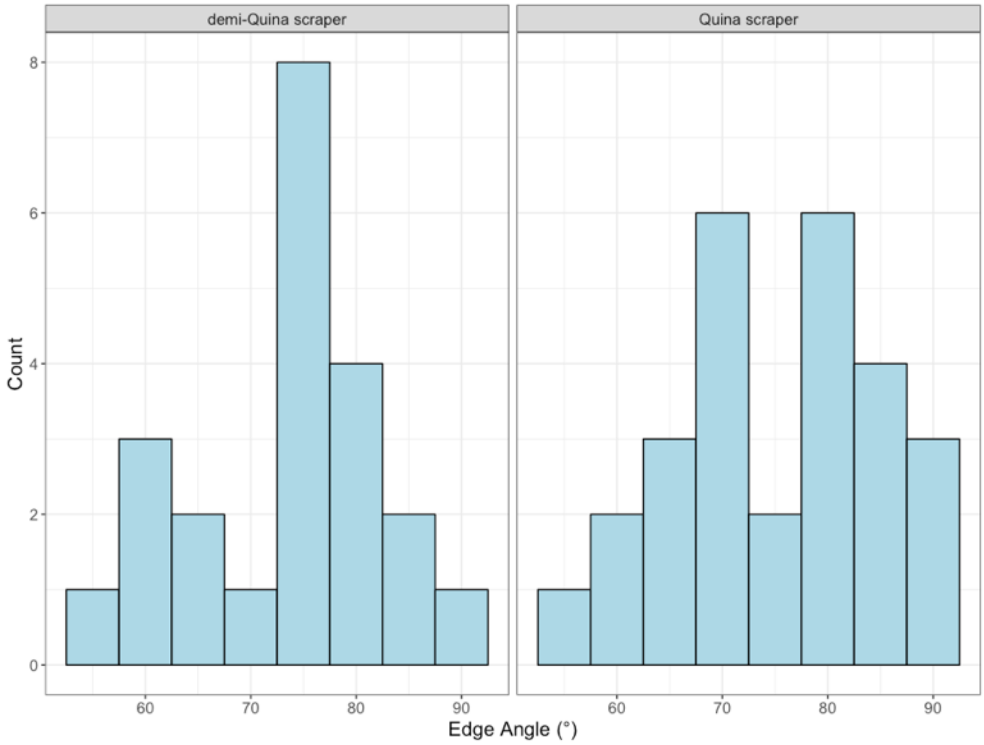


Figure 64. Edge angle comparison between Quina and demi-Quina scrapers at Cueva de El Esquilleu (Level XIII).

Further, no significant difference is recorded in terms of edge angle (Fig. 63). Both Quina and demi-Quina scrapers exhibit similar edge angle measures, ranging from a minimum value of 55° to a maximum of 90°, with a mean value of 75.1° in the case of Quina implements and 74.3° in the case of demi-Quina scrapers. As it emerges from the analysis of their techno morphological features at El Esquilleu, Quina and demi-Quina scrapers share very similar patterns. As will be demonstrated in the upcoming paragraph, such a lack of relevant techno-morphological differences may also hint towards a low rate of diversification within the activities performed using these tools at the cave.

V.6.1. State of Preservation and Post Depositional Modifications affecting the Quina and demi-Quina Assemblage of Cueva de El Esquilleu (Level XIII)

Overall, the Quina and demi-Quina scrapers from Level XIII of El Esquilleu are well preserved (Fig.64). Out of the 49 analysed items, 37 tools are characterised by well-preserved surfaces, which allowed a detailed analysis of use wear, using both Low and High magnifications.

Within the altered specimens (n.12), the most recurrent type fo PSDMs are mechanical, with only one example of chemical alteration (ESQ_434). The most common kind of recorded mechanical alteration results in the corrosion of the surface, suggesting some sort of movement of the objects within the sediments after their deposition. Generally, the degree of surface corrosion is low and is only visible at high magnifications, where the crystals within the quartzite matrix appear abraded over their surface along with numerous irregular cracks affecting their edges. In several cases, where the degree of alteration resulted more severe, at low magnification, the edges of the tool appear heavily rounded and impeded the identification of diagnostic edge damage. Moreover, the fracturing of the edge,s which may be due to trampling or to pedogenetic processes (Burroniet al.l 2002), is rare.

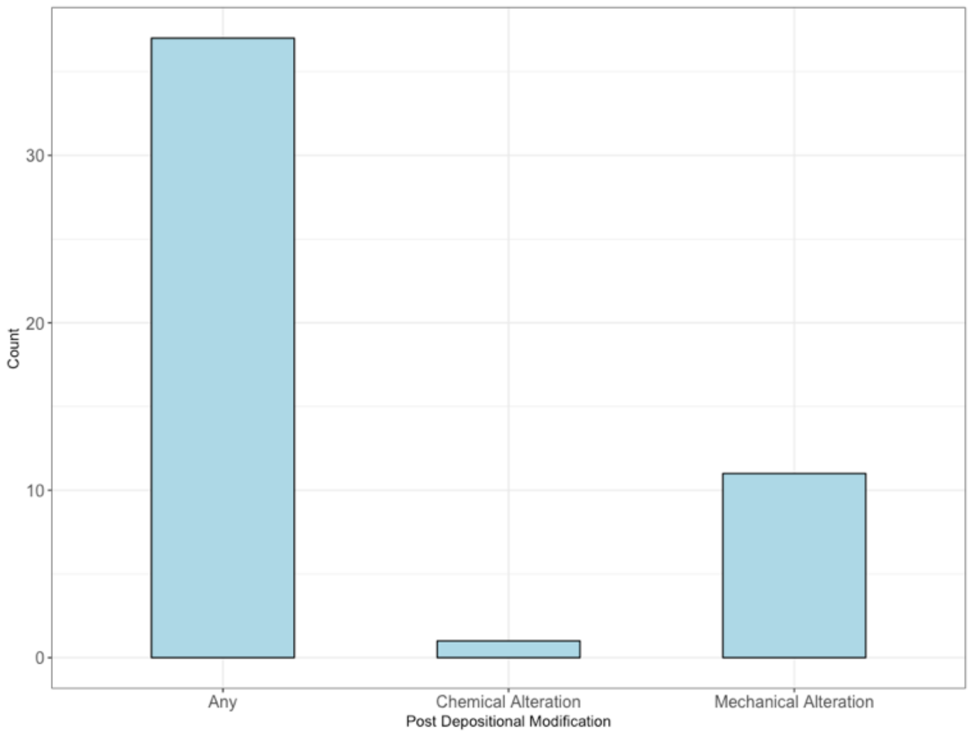


Figure 65. Barplot showing the type of PDSM affecting the tools from Cueva de El Esquilleu (Level XIII).

V.7. The Use of Quina scrapers at Cueva de El Esquilleu (Level XIII)

V.7.1 Animal Substances

Hide Processing

The majority of implements (n.4) within the Quina sample of El Esquilleu (Level XIII) exhibit use wear associated with the processing of fresh hide. Only in one case (ESQ_154) traces related to a mixed activity involving the contact with both fresh hide and animal tissues have been identified (Fig. 65). At low magnifications, the most common feature recorded is represented by edge rounding, which generally ranges from medium (n.2) to high (n.4). High-reflective materials, as quartzite are known for the difficulties related to the identification of edge scarring due to the dimensions of the crystals which can affect the development of edge removals (Pedergnana & Ollè 2017, 2018). However, the fine-grained matrix characterising the Quartzite exploited at El Esquilleu allowed, in several cases the identification of small use-related scars, which in the case of tools used to process fresh hide exhibit feather and step terminations. In two instances (ESQ_726; ESQ_451) the scars exhibit a transversal orientation and are localised over the dorsal surface of the tool's edge, suggesting a scraping activity.

An oblique unidirectional orientation is instead recorded for the use-related scars identified on artefacts ESQ_94 and ESQ_257, hinting towards the use of the tool in cutting activities.

At high magnifications, a smooth domed polish is visible over the quartzite inter-granular spaces, also affecting the edges of the quartz crystals. Polish distribution is continuous along the edge of the tool and is characterized by a tight linkage. In one case (ESQ_726), several linear features (striations) are visible over the surface of the quartz crystals. These are short, shallow and narrow, their orientation is transversal and their bottom matte. Worth of mention is the fact that linear features were not recorded within the use-wear features characterising the replicas of the quartzite Quina scrapers used in the experimental trials devoted to the processing of fresh hide. This, along with their low number, leads to hypothesise that they most probably originate by the presence of soil particles adhered to the hide during its processing rather than by the intentional use of additive (e.g. ochre). Further strengthening this latter assumption is the lack of linear features over the crystals' surface of experimental quartzite Quina scrapers used to process tanned hide (see Experiment #31 Chapter III). Observed at magnifications over 500x using an ESEM, both the matrix within the inter-granular spaces and the crystals themselves result affected by use and appear heavily rounded.

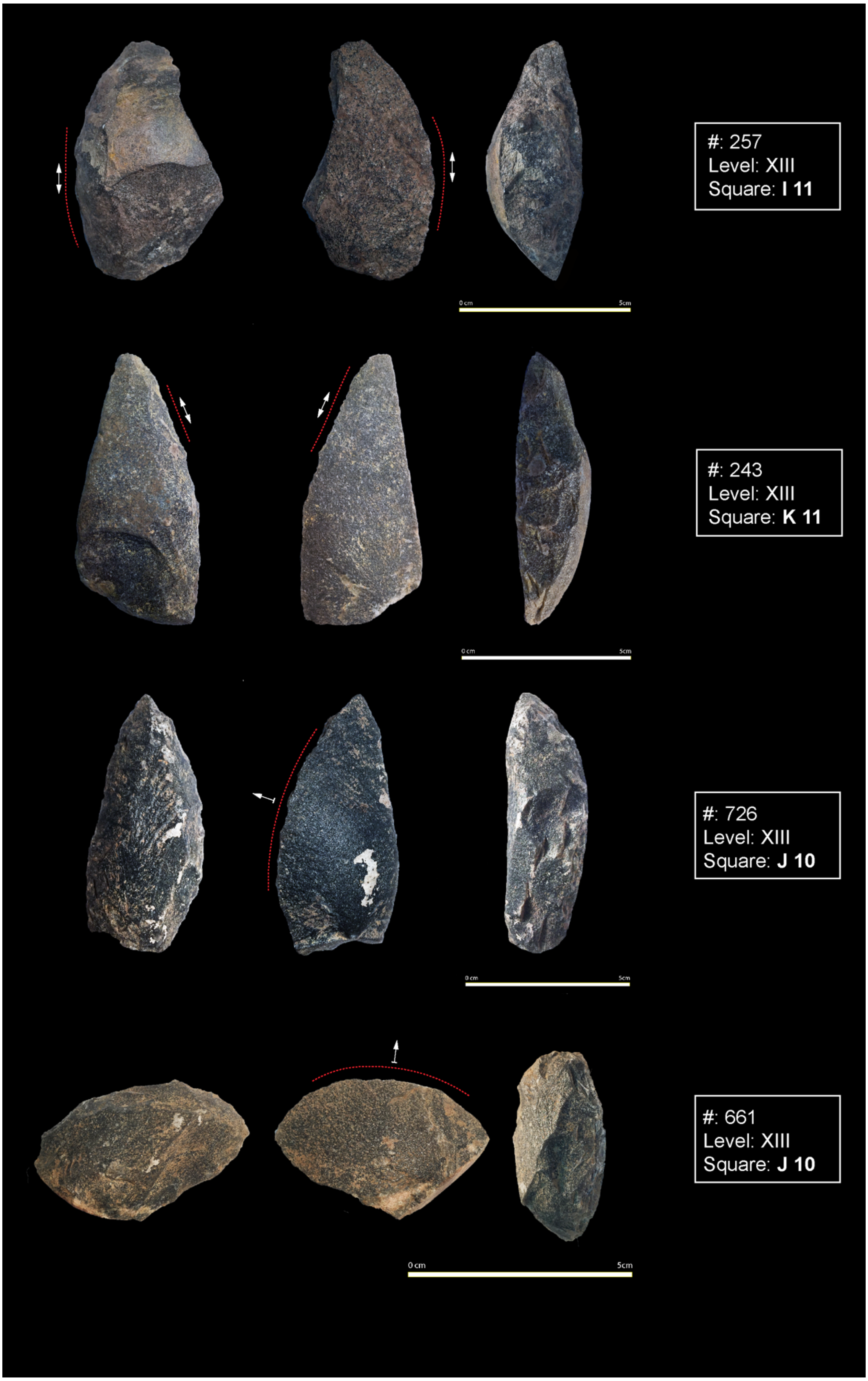


Figure 66. Sample of Quina (#257, #726) and demi-Quina (#243,#661) scrapers utilised to process fresh and dry hide. Red line indicated the location of use wear.

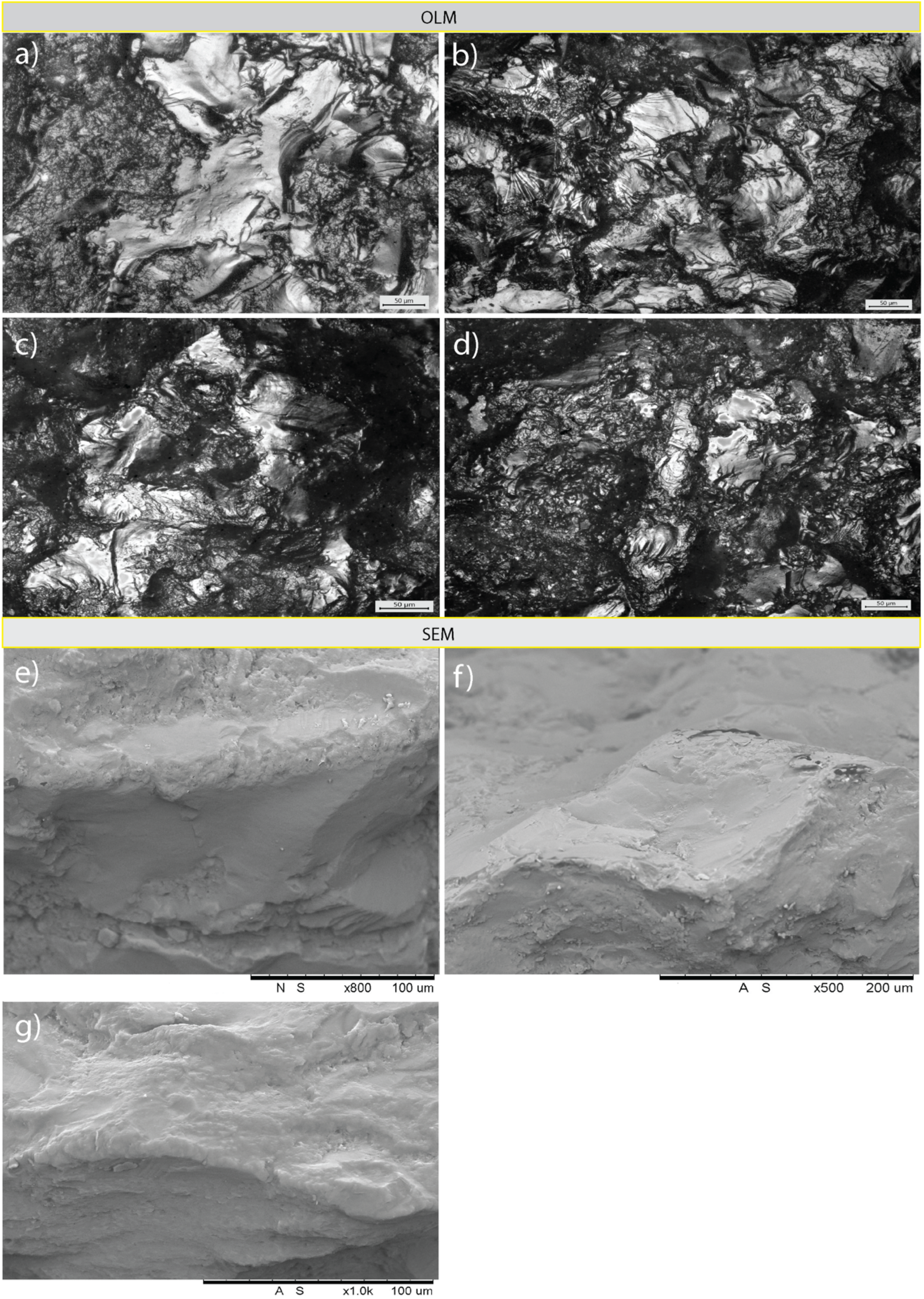


Figure 67. a-d microwear identified over the edges of Quina and demi-Quina scrapers and associated with the processing of fresh (a,b,c) and dry (d) hide. e-g sample SEM pictures of the edges of tools #257 (e), #726 (f) and #243 (g). a) # 257; b) #726; c) #243; d) #661. Microwear pictures were taken at 400X.

Animal Tissues

One Quina scraper (ESQ_479) coming from Level XIII of El Esquilleu exhibits use wear associated with the processing of animal tissues (e.g. skin, meat) (Fig. 67). At low magnifications feather terminating scars along with snaps are visible over the dorsal surface of the edge, in relation to a medium to a high degree of edge rounding. Such a combination (feather and snaps) of edge damage, suggests they use of this tool to process soft material (e.g. meat), and its occasional contact with a harder substance (e.g. bone). At high magnifications, a well-developed rough granular polish affects the matrix within the inter-granular spaces, along with the corrosion of the quartz crystals surfaces. Both the micro polish and corrosion exhibit an oblique bi-directional orientation which suggests a longitudinal motion associated with cutting activities. At magnification higher than 500x the protruding portion of the crystals result to be affected by use in the form of localised heavily rounded areas.

V.7.2 Vegetal Materials Processing

Wood

Two Quina scrapers within the analysed assemblage exhibit use wear related to the processing of wood. Quina scrapers ESQ_457 and ESQ_586 are both characterised by feather and step terminating scars developed over the dorsal surface of their edges (Fig.69). The micro scars are small in dimension, exhibit a transversal orientation and are associated with a medium degree of localised edge rounding. Micro polish is visible over the matrix within the inter-granular spaces. This is characterised by a smooth texture and a reticulated topography. As in the case of edge damage, also the polish orientation is transversal. The overall surface micro rounding is medium.

The crystals' surface is affected by use as well. Indeed, short, deep and narrow linear features are visible over the surfaces. Their bottom is pointed resembling the striae observed over the experimental quartzite replicas used to process dry wood. Further, the orientation patterns of both the polish and striations suggest the use of the tool in scraping activities.

At higher magnifications (>500x) the motion of the performed gesture is even more evident with the edges of the crystals appearing rounded, resembling the patterns observed on the experimental replicas.

Medium Material Processing

6 out of the 27 analysed Quina scrapers coming from Level XIII of Cueva de El Esquilleu exhibit use wear associated with the processing of medium materials. In these latter cases, the observation of microwear was not possible due to the state of preservation of the surfaces, which resulted abraded by PSDM. Feather and step terminating scars are visible over the edges of the tools along with a medium degree of edge rounding. In 5 out of 6 cases, edge damage orientation is transversal, suggesting a scraping activity. Only in one case, ESQ_330, edge damage orientation is oblique bi-directional indicating a possible cutting activity. Overall, micro scars termination and the degree of edge rounding hint towards the processing of medium materials, which if compared with the experimental use-wear collection might be of vegetal nature (e.g. wood).

Figure 68. Sample of Quina (# 479, #154) and demi- Quina (#717, #481) utilised to process animal materials. Red line indicated the location of use wear.

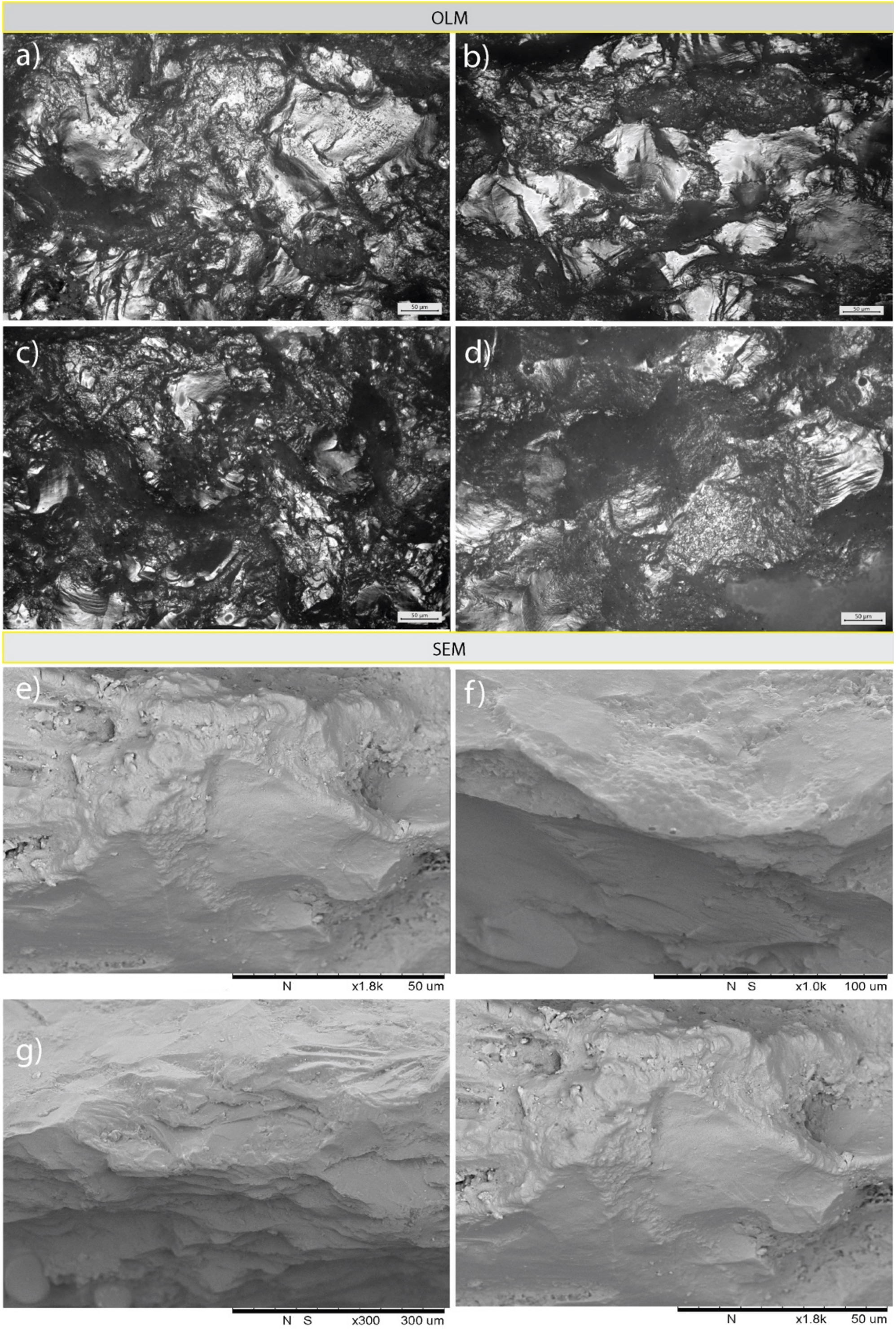


Figure 69. a-d: microwear identified on Quina and demi-Quina scrapers and associated to the processing of soft animal materials such as a) animal tissues; b) bone; c) soft animal tissues and fresh hide; d) meat. e-f: SEM photographs of the used edges of tools e) #479; f, g) #717; #481. Microwear pictures were taken at 400x.

V.8. The Use of demi-Quina Scrapers at Cueva de El Esquilleu (Level XIII)

V.8.1 Animal Substances

Hide processing

5 out of 11 scrapers within the analysed demi-Quina assemblage from Level XIII of El Esquilleu exhibit use wear related to the processing of hide (Fig. 65). In 4 out of 5 cases (ESQ_325; ESQ_243; ESQ_622; ESQ_322), the identified wear refers to the working of fresh hide, while one artefact (ESQ_661) was used to process dry hide.

Small step and feather terminating scars are identified over the dorsal surface of the tools and are associated with a high degree of edge rounding. In two cases (ESQ_243; ESQ_322), the oblique orientation of the micro scars suggests the use of the tool in cutting activities. In particular, in the case of artefact ESQ_243, the mixed-orientation patterns observed on both edge damage and microwear may suggest several changes of motion during the use of the tool.

On artefacts ESQ_325 and ESQ_622, the identified edge damage patterns are the same (feather and step terminating scars associated to a high degree of edge rounding) exception made for the orientation of the micro scars, which in this case is transversal, suggesting the use of the tools in scraping activities. The identified microwear consists of a smooth domed polish developed within the inter-granular spaces and also affecting part of the quartz crystals' surfaces. Micro polish exhibits a tight linkage and a continuous distribution along the edge. On the one hand, in the case of the tool's used to cut (ESQ_243; ESQ_322) polish developed on both the dorsal and ventral edge surfaces while in the case of the tools involved in scraping activities (ESQ_325 and ESQ_622) this affected the ventral surface of the edges.

In all cases, the polish extended on the edge of the tools. However, in the case of artefact ESQ_622, a more developed polish is visible over the inner area of the edge rather than on its outer portion. This may indicate that the tool was subject to a re-sharpening episode during its use, leading the obliteration of the microwear developed over the outer area of the edge. Moreover, another peculiar

trait of scraper ESQ_622 is given by the identification of linear features. These are localised over the ventral surface of the tool, are short, narrow, shallow and feature a transversal orientation along with a polished bottom. As hypothesised in the case of Quina scraper ESQ_726, these may be generated by soil particles adhering to the hide during its processing and not to tanning substances. At magnification higher than 500x, the crystals resulted heavily rounded, in particular over their edges. Several microfractures are visible as well, along with the polishing of their inner surface (Fig. 66).
Use wear related to the processing of dry hide were recorded only in one case, ESQ_661. Edge damage consisted of a very high degree of edge rounding, while any diagnostic micro scar was identified. At high magnifications, polish with a smooth texture and flat topography is visible within the inter-granular spaces of the matrix. The quartzite crystals do not show any diagnostics feature exception made for some small fractures over their edges. Polish distribution appears continuous over the ventral surface of the edge and is associated with a very high degree of surface micro rounding.
The microwear identified on artefact ESQ_661 exhibits features very similar to the ones observed on the experimental replica (#31) used to process a dry hide tanned with ochre. The same smooth and flat polish identified on artefact ESQ_661 is recorded on Experiment #31, which allows assuming that the processed hide was treated with some sort of additive, possibly mineral before being worked (Fig. 66d).

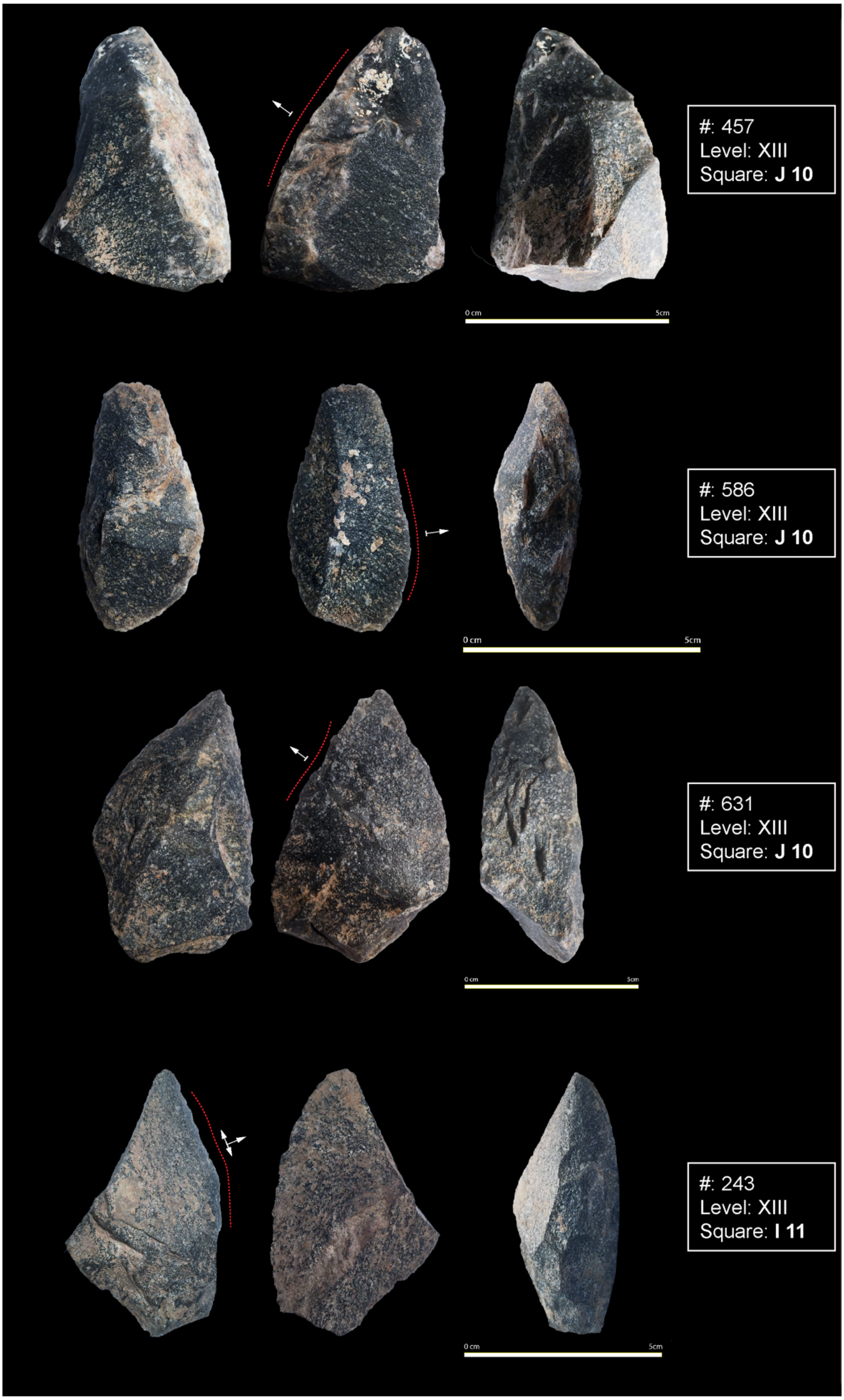


Figure 70. Sample of Quina (#457, #586, #631) and demi-Quina (#243) scrapers utilised to process wood both at a fresh and dry state. Red line indicated the location of use wear.

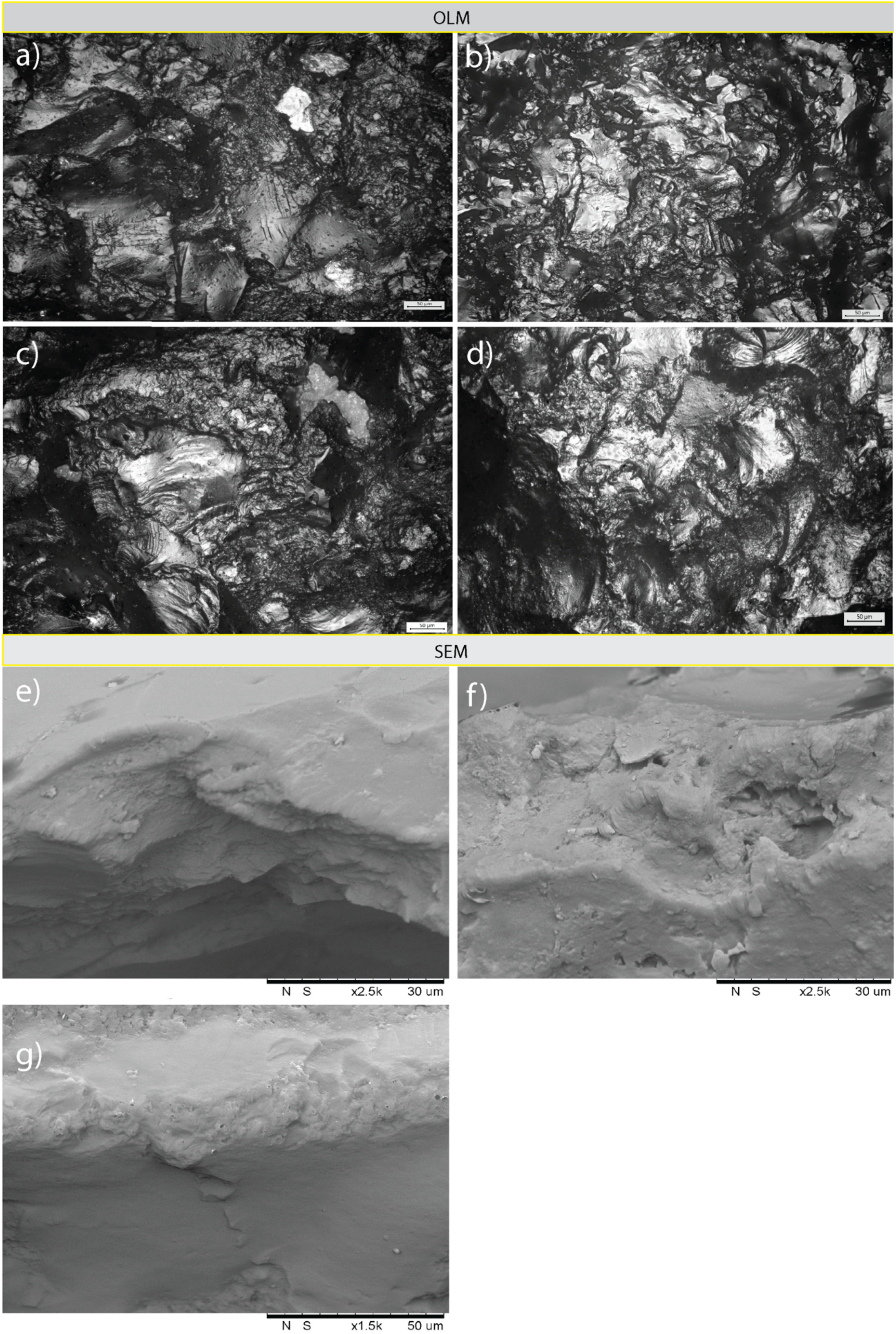


Figure 71. a-d microwear identified over the tool's edge and associated with dry wood (a,b) and fresh wood (c,d). e-g SEM photographs of the used edges of tools e) #457; f) # 566; g) #243. Microwear pictures are taken at 200x.

Animal Tissues

Within the demi-Quina scrapers coming from Level XIII of El Esquilleu, two items exhibited use wear related to the processing of animal tissues (Fig. 67). At low magnifications scrapers, ESQ_152 and ESQ_443 display small feather terminating scars over their ventral and dorsal surfaces. The scars are characterized by an oblique unidirectional orientation and are associated with a medium degree of edge rounding. On artefact ESQ_152, both edge damage and microwear are localised over the tip of the tool resulting in the more exploited area of the edge. Moreover, it is worth mentioning that this portion of the edge corresponds to its “more Quina” part.

In both cases, the orientation of the identified edge damage points towards the use of the tools in cutting activities. Microwear consists of rough polish with a granular topography affecting the matrix within the inter-granular spaces. Polish is mostly developed over the outer portion of the tool, and its orientation is indeterminable. Furthermore, surface micro rounding is low. Overall the crystals' surfaces are not profoundly affected by use.

Bone Processing

Use wear associated with the processing of hard animal materials (e.g. bone) have been identified on one demi-Quina scraper coming from Level XIII of El Esquilleu. Small step terminating scars, and few snaps are visible on the edge dorsal surface of artefact ESQ_717. The orientation of the micro scars is transversal, and the overall edge rounding degree is high. At high magnifications, smooth flat polish, affecting both the high points of the matrix and the quartz crystals surface is visible. Polish distribution is continuous along the edge, and its orientation is transversal. The overall surface micro rounding is high.

Linear features have been identified as well over the crystal's surface. These are short, narrow, deep, and their bottom is matte. Their transversal orientation mimics the one characterising both the identified micro polish and edge damage. At magnification higher than 500x overall, the edge of the tool results heavily rounded with the presence of several microfractures and a very high rounding of the crystal's edges (Fig.68 f,g).

V.8.2 Vegetal Substances

Wood

Use wear related to the processing of dry wood have been identified on one (ESQ_243-I11) demi-Quina scraper coming from Level XIII of Cueva de El Esquilleu (Fig. 69). At low magnifications, both step terminating scars and snaps have been identified, along with a medium to a high degree of edge rounding. Micro scars are localised over the dorsal surface of the edge and exhibit a transversal orientation, indicating a scraping activity. At high magnifications, a smooth reticulated polish is visible within the intergranular spaces over the ventral surface of the edge. Polish distribution is continuous, its linkage if half tight and its orientation transversal.

Moreover, a medium degree of micro rounding is present as well. Linear features have been identified over the surfaces of the crystal. These latter are short, shallow and narrow and feature a transversal orientation along with a pointed bottom. It is worth underlining that the orientation of the identified striations is not completely transversal, as it features some degree of obliqueness suggesting that the scraping activity performed also involved some more "curved" gestures.

Medium Materials Processing

Edge damages associated with the processing of medium materials have been identified over the edges of tools ESQ_133-J11 and ESQ_416-J10. Both tools are characterised by the presence of small step terminating scars associated with a high degree of edge rounding. The orientation of the micro scars is transversal on both items and suggests their use in scraping activity. Of particular interest is artefact ESQ_133-J11. Indeed, the identified wear seems to be associated with the last use of the tool before being discarded. The edge is characterised by a large Clactonian notch, indicating the change or role of the scraper from tool to core. To further strengthen this hypothesis is the fact that the edges of the notch is sharp and does not present either micro scars or localised rounding. In contrast, the identified edge damage is located over the portion of the edge yet characterized by scale stepped retouch.

Quina						
	n.		*Activity*	n.	*Worked Material*	n.
Used	12		*Cutting*	5	*Fresh Hide*	4
Not Used	2		*Scraping*	6	*Dry Wood*	2
Not Diagnostic	9		*Mixed*	1	*Animal Tissues*	1
Altered	4		*Indeterminable*	15	*Medium*	2
					Indeterminable	14
Total	**27**					
1/2 Quina						
	n.		*Activity*	n.	*Worked Material*	n.
Used	11		*Cutting*	3	*Fresh Hide*	4
Not Used	2		*Scraping*	4	*Animal Tissues*	3
Not Diagnostic	6		*Mixed*	3	*Bone*	1
Altered	3		*Indeterminable*	1	*Dry Hide*	1
					Fresh Wood	1
					Medium/Hard	1
Total	**22**					

Table 24. Summary of the use-wear interpretation of the Quina and demi-Quina scraper sample of Cueva de El Esquilleu (Level XIII)

The use-wear data emerged from the analysis of the Quina, and demi-Quina scrapers of Cueva de El Esquilleu provided interesting insights regarding the use of these tools at the site. Concerning the performed no significant differences in the use of Quina and demi-Quina scrapers. Indeed, in both cases, scraping and cutting are the most represented gestures carried out. Regarding the processed substances, also in this case, no significant variations are observed between Quina and demi-Quina scrapers. Fresh hide results to be the most exploited substance, followed by animal tissues and vegetal matter. Although the small dimension of the analysed assemblage, several points can be raised. It can be suggested that at El Esquilleu, contrary to what observed at Roc de Marsal, Quina and demi-Quina scrapers could be defined as multi-purpose tools, utilised on different kind of materials and for both scraping and cutting activities. Such a pattern, may indicate a change in the use of Quina implements by the end of the middle Palaeolithic, possibly been driven by different causes, from environmental constraints to geographical or behavioural traits characterising the last Neanderthal groups of the Iberian Peninsula.

Chapter VI

Discussion

Quina and demi-Quina scrapers represent one of the most relevant characteristics of the Levantine Acheulo Yabrudian cultural complexes (AYCC). However, despite being well represented in the majority of late Lower Palaeolithic AYCC contexts across the Levantine region, thus far only a handful of studies have focused on the study of these tools from a technological or functional perspective. This analysis of the Quina and demi-Quina scraper assemblage of Qesem Cave (n=145) therefore represents the first attempt to analyse in detail the techno-morpho-functional characteristics and the use of these tools, providing for the first time a detailed dataset regarding the role they played in the life of the early human groups that inhabited the site for some 200 kyr during the Late Lower Palaeolithic. This study draws attention to the fact that Quina and demi-Quina scrapers were used in specific activities and, from a functional point of view, suggests several differences between Quina and demi-Quina scrapers; this, in turn, has provided new and relevant insight into the behavioural traits of the hominin groups that inhabited the site for some 200,000 years.

Furthermore, given the nearly identical morphological characteristics of the retouch featured on Quina and demi-Quina scrapers from the Levant and from later Western European Middle Palaeolithic contexts, a preliminary comparison in terms of use was essential for the assessment of the possible existence of such similarities also from a functional perspective. To achieve this goal, an analysis of two Quina scraper samples from the sites of Roc de Marsal Level 2 (Dordogne, France) and Cueva de el Esquilleu Level XIII (Cantabria, Spain) was conducted. This provided some interesting insight: first, the dataset that emerged from the analysis of the two European samples permitted a preliminary hypothesis regarding the labeling of Middle Palaeolithic Quina scrapers as task-specific tools devoted to hide processing. Secondly, the analysis of the two European scraper samples led to the identification of a certain degree of variation in the utilisation of Quina and demi-Quina scrapers within the two sites, thus providing interesting insight into the ways in which

Neanderthals exploited the functional potential of Quina and demi-Quina scrapers. These results will be unpacked in detail below and compared to the results obtained from the Qesem Cave sample.

VI.1 The Quina and demi-Quina scraper assemblages from Qesem Cave

Raw Material Selection Patterns: The Choice of Specific Flint Types in the Production of Quina and demi-Quina scrapers

At Qesem Cave, the majority (74.0%) of stone tools are made of Turonian flint that originated in the outcrops of the Bi'na Formation (Agam & Zupancich *in press*; Wilson et al. 2015). Quina and demi-Quina scrapers, however, do not entirely follow this trend. Indeed, even though Turonian flint types are well represented within the flint types utilised to produce Quina and demi-Quina scrapers, Campanian and Cenomanian/Turonian flints coming from outcrops located relatively far from the site appear to have been consistently exploited as well.

Analysing in more detail the data concerning the selection of flint types for the production of Quina and demi-Quina scrapers, it was possible to outline differences in the flint between the two scraper types. These relate specifically to the choice of flint sources, which differ from the ones primarily exploited for the production of other types of tools (e.g. blades and NBKs) at the site (see Chapter IV for details). The most exploited type (20%) in the production of Quina scrapers is a homogeneous dark brown semi-translucent flint (Type AF) originating from Campanian outcrops, along with a homogeneous chocolate brown flint (Type AU) (14.7%) coming from a yet-to-be-identified outcrop (Agam & Zupancich *in press*). Demi-Quina scrapers, on the other hand, are made utilising an opaque fine textured flint, characterised by a color ranging from pink to light brown (Type S; 13.7%) of Cenomanian/Turonian origin (Agam& Zupancich *in press*) (see figure 27 in Chapter IV).

Generally speaking, the evidence related to raw material selection highlights the existence of important technological traits characterising the production of Quina and demi-Quina scrapers at Qesem Cave:

- a clear selection, diverging from what appears to be the common trend observed at the site (exploitation of local resources near the site), of specific flint types and flint sources for the production of Quina and demi-Quina scrapers.
- the importance given to flint homogeneity and flint texture in the selection of flint type for manufacturing Quina and demi-Quina scrapers.

The points listed above reflect two relevant behavioural characteristics of the inhabitants of the cave. First of all, despite the presence of high-quality flint sources in the surroundings of Qesem Cave (Wilson et al. 2015), specific flint types from outcrops located 12-15 km from the site were preferred for the production of Quina and demi-Quina scrapers. This indicates a sophisticated level of knowledge with regards to the properties of the raw materials, as well as the environment surrounding the site and its resources. This pattern also indicates that the hominin groups of Qesem Cave enjoyed a certain level of mobility across their environment, which leads us to a potential common feature shared with the Western European Middle Palaeolithic Quina techno complex. Indeed, with necessary caution, we can assume this trend resembles the high logistic mobility that emerged from the analysis of the techno-economic models and raw material transport patterns observed in Middle Palaeolithic French Quina productions, which was proposed by Delagnes and Rendu (2011) and by Turq and colleagues (2017).

Moreover, an association between specific flint type and each scraper type emerges from the analysis of raw material types at Qesem Cave. As mentioned above, homogeneous flint types are exploited in the production of both Quina (80.0%) and demi-Quina scrapers (69.9%). However, it seems that fine textured flints, in particular, were preferred for Quina scrapers (74.7%) over demi-Quina implements (61.7%). Such a preference for finer textured flints for Quina scrapers reflects a technological choice that is directly related to the life cycle of the tool.

Indeed, Quina scrapers are considered to be tools with long life cycles, during which numerous edge resharpening and retouching episodes occur (Bourguignon 1996; Lemorini et al. 2016). These interventions are not limited to simply resharpening the tool's edge, but often involve the complete obliteration of the old edge in order to produce a new one. To this effect, utilising a very predictable raw material characterised by a high degree of homogeneity and a fine texture would considerably lower the risk of knapping accidents, which could lead to a premature disposal of the tool. This hypothesis is further supported by the data on the use of Quina scrapers at Qesem. As will be discussed below, these tools were mostly utilised to process hide, and they are characterised by at least two retouching cycles and very well-developed use wear. Such data suggests the high efficiency of Quina scrapers in this particular activity, a characteristic also confirmed by the experimental activities performed for this research project. However, during the experimental trials a rapid decay in the sharpness of a Quina scraper edge, especially during fresh hide processing, has also emerged. This inevitably leads to frequent episodes of edge resharpening, essential for maintaining a high degree of tool efficiency during the entire activity. In this regard, predictable raw material of high quality has numerous advantages, such as lowering the risk of unexpected knapping accidents, which is a particularly relevant issue to take into consideration in the case of a demanding and time-consuming activity such as hide working.

If the exploitation of homogeneous fine-textured flint was found to be of importance in the production of Quina scrapers, the same does not apply for demi-Quina scrapers, where coarser flint types were also utilised. Again, this evidence might be explained by the function of these tools at Qesem Cave. Compared to Quina scrapers, demi-Quina implements were selected for a broader spectrum of activities and processed a greater variety of substances, ranging from hide to both animal and vegetal substances. Moreover, given the fact that the thinness of the utilised blank (avg. thickness 15.3mm) does not allow for multiple stages of edge retouch, and none of the analysed demi-Quina implements exhibits such evidence, it is possible to assume that demi-Quina scrapers had a shorter life cycle overall than Quina scrapers. This assumption is further strengthened by the number of demi-Quina specimens found at the cave (n=126), which nearly doubles the number of their Quina counterparts (n=88). These factors, particularly the impossibility of frequent edge retouching due to the morphological characteristics of the exploited blanks, might have influenced the choices regarding raw material selection, allowing for the exploitation of less homogeneous and coarser textured flints than the ones utilised in the production of Quina scrapers.

Even if still preliminary, the data regarding the selection of specific flint types (often coming from distant outcrops) highlights the significant degree of technological knowledge and selectivity of the hominin groups inhabiting Qesem Cave during the late Lower Palaeolithic. In particular the combination of flint characteristics and the actual use of Quina and demi-Quina scrapers has demonstrated the existence of an ongoing correlation between the scraper, its use, and the choice of flint; this provides for the first time a body of information suggesting the important role played by these tools, which is further strengthened by the evidence coming from such features as blank selection and tool use that characterise the Quina and demi-Quina scraper assemblage of Qesem Cave.

<u>Blank Variability as a Response to Technological Needs Deriving from the Functional Role of Quina and demi-Quina Scrapers at Qesem Cave</u>

The techno-morpho-functional analysis of the scrapers indicated several patterns related to the production of the tools that, once combined with the use-wear analysis results, allowed for a thorough definition of the Quina phenomenon at Qesem Cave.

Furthermore, thanks to the functional analysis that has already been performed on other artefact categories from Qesem Cave (*e.g.* for blades and recycled items see Lemorini et al. 2006; Venditti et al. 2019), a comparison of the evidence from these categories with that of Quina and demi-Quina scrapers has shed light on the role of these tools within the lithic assemblage, thus enhancing our knowledge of the behavioural traits characterising the hominin groups that once inhabited the site.

From a technological perspective, the absence of the complete *chaine operatoire* for the production of Quina and demi-Quina scrapers at Qesem Cave makes a detailed analysis of their production strategies (e.g. core morphologies, blank production) impossible. However, the fact that only finished objects have been found at the cave demonstrates that the blanks and tools were *brought* by the Qesem Cave hominins, which provides the first indication of the role that Quina and demi-Quina scrapers played within their toolkit. The application of a techno-morpho-functional approach instead permitted the identification of relevant technological features, particularly with respect to the manufacturing of these tools. These imply the presence of several technological differences between the two scraper types, which in turn suggest that specific choices were made related to the production of both Quina and demi-Quina scrapers.

One of the technological differences between Quina and demi-Quina scrapers is blank morphology. While more flexibility is evident in the selection of blanks for demi-Quina implements, the choices in terms of blank size and shape are more selective for Quina scrapers. Indeed, the blanks utilised to produce demi-Quina scrapers exhibit a higher degree of variability in their morphology and also include elongated blade blanks. The ones utilised in the production of Quina scrapers appear more standardised in their form; thick, wide blanks are preferred, and are morphologically more similar to their Western European Middle Palaeolithic counterparts.

The differences recorded in the blank morphology of Quina and demi-Quina scrapers raises the question of the "concept" of Quina retouch at Qesem Cave. Indeed, it can be assumed that hominins at Qesem Cave were aware of the high functional potential of a tool's edge obtained with the Quina technique and intentionally disregarded the type and morphology of the exploited blank, especially in the case of demi-Quina implements. It must be emphasised that this does not indicate a lack of technological skill as this tendency is not observed in the case of the Quina scrapers, where instead a more rigorous and standardised blank selection can be observed. This selective behaviour must have been intended as a proper technological feature of the scraper assemblage and reflects the different functional purposes of the tools. Quina scrapers were generally long-lasting and utilised principally in activities devoted to the processing of hide; this resulted in frequent edge retouching and resharpening, and often involved the complete obliteration of the old Quina edge to make way for the production of a new one. Conversely, demi-Quina scrapers were utilised in a more varied manner, including the processing of different kinds of substances in a range of activities, and were probably discarded immediately after use as suggested by the absence of evidence related to multiple uses.

The designated use, and in particular the overall life cycle of the tool, might explain the variability in blank type and morphology recorded in demi-Quina scrapers and the near absence of such characteristics in Quina implements. The characteristics of the blanks exploited to manufacture Quina scrapers are directly correlated to the technical need of frequent edge retouching during the life cycle of these tools, and are designed to minimise the risk of knapping accidents. In the case of demi-Quina scrapers, where multiple retouch cycles are not apparent, blank selection is unimportant as it does not need to satisfy any specific technological demand; this allows for the exploitation of diverse blank types, as indicated by the degree of variability characterising the Qesem Cave demi-Quina scraper sample.

VI.2 The Use of Quina and demi-Quina Scrapers at Qesem Cave

Quina scrapers: Task-Specific Tools Devoted to Hide Processing

The excellent state of preservation of the Quina and demi-Quina scrapers found at Qesem Cave allowed for a detailed investigation of their use. This data originated from the functional analyses performed on the the scraper sample, which provided not only a definition of the tool's function but also new and relevant evidence related to the behaviours and skills of the hominins that occupied the cave 400-200ka. Use-wear analysis largely revealed that most of the Quina scrapers were utilised in scraping activities related almost exclusively to the processing of hide. Most hide was found to have been in a fresh state, but evidence also surfaced for the scraping of dry hide. Regarding the latter, in several cases the characteristics of the identified use wear suggest the likely involvement of additives during hide processing.

In light of the results obtained from the functional dataset of the Qesem Cave Quina sample, two main points may be proposed :

- A sophisticated degree of knowledge concerning the processing of hide characterises the inhabitants of Qesem Cave
- The incipient task-specific role played by Quina scrapers

On the whole, features such as the high degree of edge rounding and the extension of the polish (also reaching the inner portions of the edge surface), as well as the several retouching episodes identified over the edges, are all evidence of the long life cycles of these tools.

Given the age of the site, the data emerging from the analysis of the Qesem Cave Quina scraper assemblage that concerns the use of these tools in hide processing indicates that the hominin groups of Qesem Cave possessed a very high degree of proficiency and skill in the processing of hide. As underlined by numerous works focusing on ethnographic evidence, hide processing is an activity requiring an advanced know-how, both in terms of toolkit and length of time of the intervention. Indeed, although hide is a readily-available material as it is a by-product of hunted prey, its processing is essential in order to make it useful. In particular the correct execution of the first stage of hide working, in which the subcutaneous fatty layer is removed, represents a crucial step for impeding the growth of bacteria and slowing down the process of decay (Harris and Veldmeijer 2014). The subcutaneous fat has to be thoroughly removed from the skin of the animal with extreme care so as to not accidentally cut or pierce the hide, thereby ruining it. In order to avoid such accidents, which may result in a premature discarding of the animal skin, good manual dexterity and an adequate toolkit are essential. Here is where the high level of efficiency of Quina scrapers in hide processing must be taken into account. As the experimental trials performed within this research framework have demonstrated, Quina scrapers are particularly efficient in fresh hide processing. Indeed, as described in Chapter I, an edge retouched with the Quina technique is thin and strong. Outlined below are the two morphological aspects characterising a Quina edge that make it extremely efficient in hide processing:

- First, the sharp and thin edge area that comes in contact with the material being worked enables the user to easily cut through and remove the subcutaneous fatty layer.
- Secondly, the limited width of the edge area in contact with the skin prevents deep penetration, lowering the risk of unintentional tearing. These characteristics enable a great amount of "control" and "predictability" of the scraper edge, two functional features that are very important in activities such as hide working. In all likelihood hominins at Qesem Cave were fully aware of the technological advantages obtained through Quina retouch, as testified by the sheer number of hide processing implements that were found at the site. As seen in Chapter IV, the morphological features of the observed micro polish have demonstrated that the state of the worked hide was most often fresh. In a few cases (n.9) the identified wear has been interpreted as dry hide processing, and in only two cases the observed micro wear suggests the use of an additive substance identified as ash.

The paucity of evidence within the analysed sample related to the use of Quina scrapers on dry hide indicates that after a first processing stage devoted to the removal of the subcutaneous fatty layer from the skin, the hide was not further processed utilising these tools. Furthermore there is no evidence at the site of Quina scrapers being used to work hide treated with any kind of tanning substance (e.g. ochre). The absence of such evidence does not indicate a lack of knowledge in hide working. On the contrary, as stressed by numerous ethnographic studies (Beyries 2002, 2008; Beyries and Rots 2008), the careful removal of the subcutaneous layer of a skin represents one of the most important steps in its processing and requires a great amount of accuracy. Indeed, the rotting of a skin due to inaccurate de-fleshing inevitably leads to its disposal, representing a loss of time and energy. On this point, further evidence of the sophistication of the Qesem Cave hominins in terms of hide treatment was observed in detail in two specific Quina scraper specimens; these exhibit micro wear with characteristics pointing to the presence of ash over the worked hide. Even though these kinds of traces have been recognised on only two specimens thus far, this evidence has important behavioural implications. It is important to stress that the two Quina scrapers bear micro wear very similar to the ones developed on the experimental replicas used to scrape a drying hide preserved with ash, and the scrapers come from a specific area of the cave (the Deep Shelf) where no evidence of fire has yet been found. The absence of fireplaces in proximity to the area where the two Quina scrapers were unearthed allows us to propose the idea of an intentional covering of the treated hides with ash, a hypothesis that is also strengthened by the recent findings of similar use wear on other items at the site (Lemorini et al. submitted). Ash has great antibacterial properties and to this day is exploited by communities to preserve and treat both vegetal and animal substances (Hakbijl 2002). Therefore with necessary caution it is possible to assume that the two Quina scrapers associated with the scraping of ash-covered hide are a reflection of the sophisticated level of knowledge of the Qesem inhabitants, who were aware of the properties of ash and utilised it to inhibit the proliferation of bacteria and store fresh hides to possibly be worked at a later time.

Overall, the relevant role of hide treatment in the behavioural traits of the Qesem Cave hominins and its strict relationship with Quina scrapers is also clear on the basis of the number of Quina implements utilised in hide working: 59% of Quina scrapers employed in scraping activities were used on hide, representing 48% of the entire sample of Quina implements exhibiting diagnostic traces. This data is clear evidence of the fact that hominins at Qesem understood the functional advantages provided by the techno-morpho-functional characteristics of Quina scrapers, especially in regard to hide working. This does not (yet) allow for the classification of the Qesem Quina scrapers as *task-specific* tools devoted exclusively to the processing of hide, given the fact that their use in the processing of other kinds of materials (such as wood or bone) has also been identified (see Chapter IV). However, evidence for the latter represents 36% of the Qesem Quina scrapers on which diagnostic use wear has been observed; this amount is significantly smaller than the percentage of specimens utilised to scrape hide, a datum that makes the correlation between hide processing and Quina scrapers at Qesem Cave undeniable.

Demi-Quina scrapers: evidence of the versatility of the Quina retouch

At Qesem Cave, demi-Quina scrapers (n. 126) are more numerous than their Quina counterparts (n.88). Apart from their higher frequency within the analysed assemblage, demi-Quina scrapers also exhibit several peculiarities in their use, which may provide significant evidence related to the behaviours of the Qesem Cave hominins. Whereas Quina scrapers were mostly utilised in hide scraping, demi-Quina scrapers encompass a broader spectrum of processed materials and performed activities.

Before discussing the functional peculiarities characterising demi-Quina scrapers, it is essential to underline the fact that fresh hide remains the most frequent substance processed, specifically through scraping. As discussed earlier in this chapter with regards to Quina scrapers, this highlights the strong link between these tools and hide processing at Qesem Cave. However, while hide scraping represents the most performed activity in the case of Quina implements, this is not the case for demi-Quina scrapers. Indeed, demi-Quina scrapers used for cutting activities are well represented (n.22; 38.6% of the assemblage) and slightly outnumber those used exclusively for scraping (n.21; 36.8%). Along with similar occurrences of both longitudinal and transversal motions, a relevant functional trait related to demi-Quina scrapers is the notable presence of soft materials, such as animal tissues and vegetal substances, within the processed substances. The latter do also appear among the processed materials associated with Quina scrapers, but in significantly lower numbers.

The high frequency of demi-Quina scrapers employed in cutting activities other than hide working (in particular their utilisation in butchering and plant processing tasks), along with the wide range of processed substances, indicates that these scrapers had a more "multifunctional" nature than Quina scrapers. From a broader perspective, this also underlines the high functional potential of Quina retouch both in scraping and cutting activities. Its high efficiency has been proven by the experiments performed for the scope of this research, which, conversely, have also identified its functional limitations. Out of the experimental activities performed, cutting proved to be a particularly difficult task to execute with Quina scrapers. Difficulties were encountered due to the thickness of the tool, which could not completely penetrate the processed substance, especially in the case of medium and medium-hard matter like wood or bone. This issue was not encountered when demi-Quina scrapers were used. Indeed, their reduced blank thickness allowed a proper cut to be performed and did not impede the completion of the task. Moreover, through the trials performed it was also possible to appreciate how the general dimensions of the tool favoured a firm grasp, allowing the user to exert a decent amount of strength during the cutting; this detail is essential when processing hard materials such as wood or bone.

These arguments can also explain the exploitation of demi-Quina scrapers at Qesem Cave for activities where longitudinal motions were predominant, as well as their use in the processing of materials other than fresh hide, such as plants, wood, bone and soft animal substances. Furthermore, through the experiments performed it was possible to identify another interesting pattern characterising the functional potential of demi-Quina scrapers: the possibility of performing precise cutting tasks, which are difficult to carry out using a Quina scraper. As mentioned earlier, the main challenge encountered when using Quina scrapers for cutting tasks was related to the overall thickness of their blank, which did not permit a complete cut through medium hard materials. It has already been explained how this is not an issue for demi-Quina scrapers, which are instead modelled utilising thinner blanks. However, there is another factor that makes precise cutting tasks difficult with Quina scrapers: the low “visibility” of the active area of the edge during its use. Indeed, the thickness of the tools and the subsequent retouched lines “hide” the portion of the edge that comes in physical contact with the worked material. This does not represent a major problem in the case of scraping tasks, but it become more relevant in the case of cutting when more accuracy is needed; during specific butchering tasks, for example, it is essential to know exactly where the edge of the tool is acting. To this point the morphology of demi-Quina scrapers, their relatively low thickness, and their single retouch lines all leads to more control over the edge. This provides a clear visual of the area in contact with the processed material, and in turn enables the user to perform high precision tasks such as carcass dismembering or the removal of meat from bones. This, in a way, allows us to explain the presence of demi-Quina scrapers in parts of Qesem Cave where Quina scrapers are totally absent (as in the Hearth area), despite their complementary functional role with Quina scrapers that has been observed in other areas of the cave (e.g. Shelf and Deep Shelf). From the functional analyses performed on the lithic assemblage of the Hearth area (Lemorini et al 2005; Venditti et al 2019), it emerged that butchering represents one of the most relevant activities performed in this area of the cave. To this point, the analysis of the faunal remains found in the Hearth area and in other parts of the cave suggests the practice of sophisticated cutting tasks, such as the processing of metapodials (Blasco et al. 2015; Ran Barkai et al. 2017). The presence of demi-Quina scrapers and their use in the processing of soft animal materials indicates that the Qesem hominins were fully aware of the functional potential of these tools in cutting tasks where a certain degree of precision was needed.

While the morphology of the blank utilised to produce demi-Quina scrapers made the tools suitable for cutting activities, it also affected the duration of their life cycle. Indeed, in most cases the overall thinness of the blanks does not allow for more than one sequence of Quina retouch. This means that once the edge lost its sharpness the tool was discarded without further resharpening, as observed on other tools in the Qesem Cave lithic assemblage (Lemorini et al. 2006). To a certain extent this explains the large number of demi-Quina scrapers found at Qesem Cave. In a broader sense, the very low instances of later European Middle Palaeolithic demi-Quina scrapers employed in cutting activities introduces one of the main differences observed between the use of Quina and demi-Quina scrapers in the Levant and Europe.

VI.3 Roc de Marsal and Cueva de El Esquilleu: the Use of Quina and demi-Quina Scrapers in Western Europe during the Middle Palaeolithic

The analysis of the Quina samples from Level 2 of Roc de Marsal and Level XIII of Cueva de El Esquilleu led to the formation of a preliminary dataset concerning the use of these tools in Western Europe during the Middle Palaeolithic. The study of these two assemblages shed light on the functional role played by Quina implements in Neanderthal groups, and for the first time made a comparison with the evidence recorded at Qesem Cave possible. From the analysis of the techno-morphological characteristics of the scrapers it was possible to identify specific features (blank morphology and edge delineation) that reflect manufacturing strategies strongly associated with the use of Quina and demi-Quina scrapers. These strategies were most likely developed in order to enhance the functional potential of the scrapers in specific activities such as hide working.

Concerning blank morphology, at Roc de Marsal both Quina and demi-Quina scrapers are made on blanks characterised by similar morphologies. The blanks are always asymmetrical in section and exhibit similar dimensions, whilst some degree of variation is observed in blank thickness and edge angle (resulting slightly higher in the case of Quina scrapers). This consistency in blank morphology is a direct consequence of specific production strategies devoted to the manufacturing of flakes with distinct characteristics (Bourguignon 1997; Turq 2000; Hiscock and Clarkson 2015).

At Cueva de El Esquilleu, despite the exploitation of a different raw material (quartzite), a similar regularity in blank morphology in Quina and demi-Quina scrapers is also observed, with no major variations in the dimensions of the utilised blanks. The only differences recorded between the two scraper types are in blank thickness and, in the case of Quina scrapers, a higher edge angle.

Furthermore, it is important to underline another common techno-morphological aspect shared between the two analysed Western European scraper samples: the convex delineation of the edge. This techno-morphological feature is particularly relevant as it represents:

- the main technological characteristic clearly related to the task-specific role played by Quina and demi-Quina scrapers in Western Europe during the Middle Palaeolithic.
- One of the few techno-morphological differences recorded between the Levantine and European Quina productions.

Before describing in detail the relationship between scraper edge delineation and its task-specific role, the data concerning the use of Quina and demi-Quina scrapers at Roc de Marsal and Cueva de El Esquilleu needs to be discussed.

At both sites, scraping represents the most commonly performed activity. At Roc de Marsal in particular, 20 out of 25 scrapers exhibiting diagnostic use wear were utilised to perform tasks involving transversal motions. At Cueva de El Esquilleu, scraping is likewise the most frequent activity (n.9), although cutting is also well represented (n.7).

Regarding the specific materials processed, a thorough comparison between the two assemblages was not possible given the difference in tool preservation of the two samples. The analysis at low magnification of the edge damage identified on Quina and demi-Quina scrapers of Roc de Marsal indicates the tools were used to process substances characterised by a medium hardness. Given the strong resemblance between edge damage patterns observed on the archaeological specimens and the ones developed over the modern replicas utilised to process fresh hide, it was possible to advance a more detailed functional interpretation and define the observed traces as a direct result of hide processing (see Chapter V).

By contrast, the better state of preservation of the materials from Level XIII of Cueva El Esquilleu made it possible to investigate in greater detail the use of Quina and demi-Quina scrapers at this site. Fresh hide was found to be the most-represented worked matter, along with several instances of soft animal substances and vegetal materials such as wood. With regard to the activities performed, the scenario seems to be more varied than at Roc de Marsal. Both transversal and longitudinal motions are well represented in the identified activities and are equally performed using Quina and demi-Quina scrapers.

Overall, the analysis of the samples from Cueva de El Esquilleu and Roc de Marsal underline how, despite the geographical and chronological gap and the exploitation of different raw materials, the techno-morphological characteristics of the analysed Quina assemblage are similar. From a functional perspective, hide scraping is the most recognised activity performed at the two sites utilising Quina and demi-Quina scrapers. However, while at Roc de Marsal scraping is almost exclusively performed with these tools and is thus evidence of their task-specific role, at Cueva de El Esquilleu the scrapers are also employed in cutting activities, thereby indicating a more multifaceted role.

Quina and demi-Quina Blank Morphology: a Technological Response to Favour Edge Retouching

During the experimental trials related to hide processing, another relevant feature of Quina and demi-Quina scrapers surfaced alongside their high efficiency: the need for the edge to be frequently resharpened. Hide working is indeed a very "demanding" activity in terms of edge durability, particularly in the case of Quina retouched edges given both their very low thickness and the limited extension of the edges. On the one hand these morphological characteristics enable greater efficiency in activities such as hide scraping, but on the other they lead to a fast rounding of the edge, resulting in a loss of overall cutting performance and thus requiring retouching. In the case of Quina and demi-Quina scrapers this means the obliteration of the old edge through the manufacturing of a new sequence of convexities and concavities. In this regard, the morphological characteristics of the blanks used in the manufacturing of Quina and demi-Quina scrapers can be defined as a technological solution developed specifically to facilitate the application of Quina retouch, thereby fully maximizing the available blank surface. More specifically, the asymmetric cross section of a Quina blank eases the realization of new sequences of convexities and concavities along the scraper's edge.

This is an important detail in the case of hide working, when fast edge decay demands its resharpening not only because of the activity performed, but also for the delineation of the edge itself. In the case of convex delineations, in fact, the portion of the edge that comes in contact with the worked material is small and needs frequent retouching. This might explain the development of a specific Quina *debitage* in the Western European Middle Palaeolithic, which is not recorded in the Levantine Acheulo Yabrudian. That being said, it is legitimate to question why such an abundance of Quina and demi-Quina scrapers with convex edges is recorded in Western European Middle Palaeolithic contexts, despite their potential functional limits (e.g. rapid decay and need for frequent resharpening)? A possible answer to this question lies in the efficiency granted by a convex edge in hide scraping activities.

<u>Edge Delineation: Evidence of the Task-Specific Role Played by Quina and demi-Quina Scrapers in Western European Middle Palaeolithic Contexts</u>

As mentioned earlier, the majority of Quina and demi-Quina scrapers analysed at the sites of Roc de Marsal and Cueva de El Esquilleu are characterised by a convex edge delineation. It has already been discussed how specific blank morphology may have developed to facilitate the recurring need to resharpen Quina and demi-Quina edges. Also, it has been argued that edge resharpening occurs more frequently in the case of scrapers with a convex margin compared to straight ones due to the difference in the amount of edge area actually in contact with the processed substance. However, even though a convex margin does present such "functional limits", its morphology results in extremely efficient hide scraping, particularly in the removal of subcutaneous fat. During the experimental trials dedicated to hide scraping, where modern scraper replicas with both straight and convex edges were utilised, it was clear how the tools with convex edges performed better than their straight-edged counterparts in the removal of *subcutis*. Moreover, it was noted that when fresh hide was processed with a Quina scraper bearing a straight edge, the action was frequently interrupted by the need to remove the accumulation of fat on the tool's edge, which at a certain point prevented the edge from coming into contact with the hide. Interestingly, this problem did not occur when fresh hide was worked utilising Quina scrapers with a convex edge. In this case, the activity was continuous, with significantly fewer interruptions because the tool's edge remained firmly in contact with the hide. This resulted in a faster and more accurate cleaning of the hide, without any instances of unintentional tearing or piercing, contrary to what was experienced when a Quina scraper with a straight edge was employed[3].

Concerning the latter, Baena and colleagues (2003) have underlined that unintentional damage to the hide is less likely to occur in the case of a convex edge because it does not have sharp angles at its extremities like a straight one does (Fig. 71a,b). Moreover, the convex delineation of the edge provides another important advantage: it favours the sideways displacement of residues, rather than the frontal displacement seen with a straight edge (Fig. 71 e, f). This allows the portion of the scraper edge that comes in contact with the hide to remain clean, thereby decreasing the instances when the activity has to be interrupted to remove the fat accumulated over the scraper edge. This functional peculiarity characterising convex edges proves extremely useful when hides with thick subcutaneous fat layers are processed. Regarding this point it is very important to underline the relationship between Quina scrapers and the exploitation of large animals by Middle Palaeolithic Neanderthal groups (Discamps, Jaubert, and Bachellerie 2011; Discamps and Royer 2016; Terlato et al. 2019; Castel et al. 2017). Evidence has emerged from the analysis of the faunal remains found in Western European Quina contexts that large animals (e.g. reindeer) were exploited by Neanderthals; this, along with the use wear results pointing to the nearly exclusive use of Quina and demi-Quina scrapers to process hide, all indicates that the convex edge delineation is further evidence that the Western European Middle Palaeolithic Quina and demi-Quina scrapers can be defined as task-specific tools.

[3] A single individual (A.Z.) was employed in the working of fresh hide using experimental replicas with both straight and convex edges. This indicates that the differences in efficiency recorded between the two delineations was not related to the level of skill of the operator.

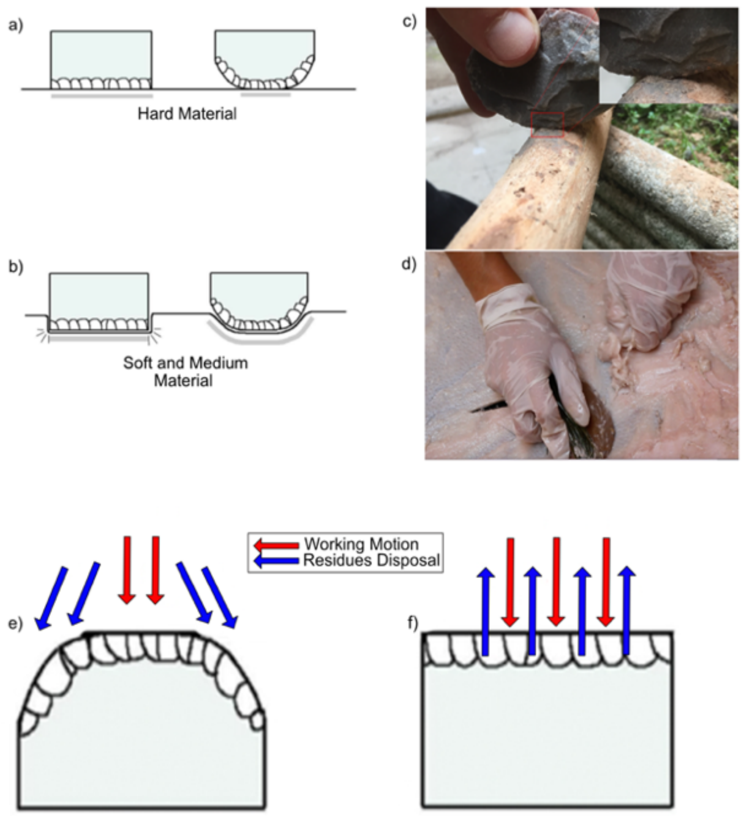


Figure 72. Comparison between straight and convex edge delineation. a, c) the use of edge to process hard materials. Notice the very small area of edge surface actually in contact with the worked substance (c); b, d) the use of edge to process hard materials. Residue disposal according to edge delineation. e) convex edge delineation: residues are disposed laterally to the portion of the margin in contact with the worked matter; f) straight delineation: residues disposed in front of the portion of the edge in contact with the worked substance.

In addition to describing the potential of convex edges, it is also important to stress the functional limits that such edge delineation poses on Quina and demi-Quina scrapers. As mentioned earlier, in the case of convex delineations only a small part of the edge is in contact with the worked substance. This is not an issue when medium soft materials such as fresh or semi-dry hides are worked. Instead, it poses some serious limits when the material processed is hard and when the gestures performed are related to cutting. Indeed, the delineation of the edge does not allow the user to maximize the entire edge surface, making it difficult to perform a proper cut. Conversely, in the case of straight margins it is possible to take advantage of the entire available edge length, thus maximizing the efficiency of a Quina edge in scraping and cutting tasks and enhancing its multitasking potential. This might be the reason behind one of the main recorded differences between the Levantine Acheulo Yabrudian and the Western European Middle Palaeolithic Quina assemblages: the near absence of Quina and demi-Quina scrapers with convex margins at Qesem Cave compared to the abundance of Quina implements with straight edges.

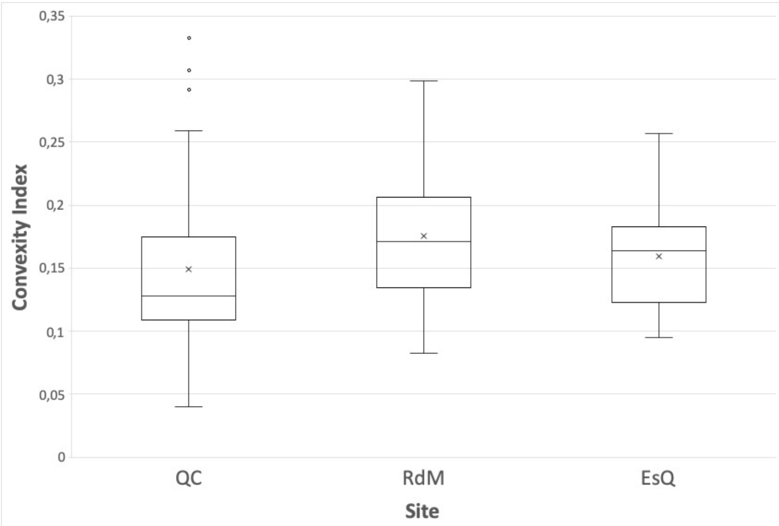


Figure 73. Boxplot showing the differences in edge convexity recorded at Qesem Cave, Roc de Marsal (Level 2) and Cueva de El Esquilleu (Level XIII).

<u>From Multipurpose to Task Specific to Multipurpose Again: the Evolution of Quina and demi-Quina scrapers from the Levantine Acheulo Yabrudian to the Western European Middle Palaeolithic.</u>

As mentioned several times in this work, despite the chronological and geographical gaps the Quina and demi-Quina scrapers found in AYCC Levantine and Western European Middle Palaeolithic contexts are nearly identical in terms of techno-morphological features. The use-wear analysis performed on the scraper assemblages of Qesem Cave, Roc de Marsal (Level X) and Cueva de El Esquilleu (Level XIII) also does not indicate any major functional differences. However, combining both the techno-morphological characteristics and the results obtained through functional analysis it was possible to isolate specific patterns, both in terms of technology and of use, which contribute to outlining the possible transition of Quina scrapers from multipurpose to task-specific tools. Such an *"evolution"* is related to the approach that Palaeolithic Neanderthals adopted for the Quina retouch. In terms of function, the results that emerged from the use-wear analysis indicate that both in the Levant and in Europe hide scraping represents the main activity in which Quina and demi-Quina scrapers were involved. That being said, it is important to underline that the association *"Quina – Hide Working"* at Qesem Cave involves Quina scrapers in particular. Indeed, demi-Quina scrapers appear to be more multifunctional at this site as they were utilised to process various substances other than hide, such as plants and soft animal tissues, not only through scraping but also through cutting activities. Such behaviour is not recorded at Roc de Marsal, where instead both Quina and demi-Quina implements were employed almost exclusively in scraping activities. Interestingly, the functional patterns identified at Cueva de El Esquilleu are more similar to what was observed at Qesem Cave than at Roc de Marsal. Here the association between hide processing and Quina and demi-Quina scrapers appears less direct, especially in the case of demi-Quina implements, which were employed in cutting activities and in the processing of animal tissues, wood and plants.

In the data gathered so far it appears clear that in the Levant early hominins were well aware of the functional potential of the scaled stepped retouch. Strengthening this assumption is the lack of evidence at Qesem Cave concerning the search for, or the design of, specific blank morphologies, especially in the case of demi-Quina scrapers where the Quina retouch was applied whenever possible despite the morphological characteristics of the blank. This, added to the fact that Quina and especially demi-Quina scrapers were often utilised in activities other that hide scraping, reflects the high functional relevance of these tools, and in particular of the Quina retouch, at Qesem Cave. Another characteristic that can be identified as an indicator of the functional importance of the Quina retouch at Qesem Cave is the edge delineation of the Quina and demi-Quina scrapers found at the site. Indeed, it is possible to assume that straight edges were preferred over convex ones not only because of their great efficiency in both scraping and cutting activities, but also because a straight margin provided a larger exploitable edge area than its convex counterpart (Fig. 73).

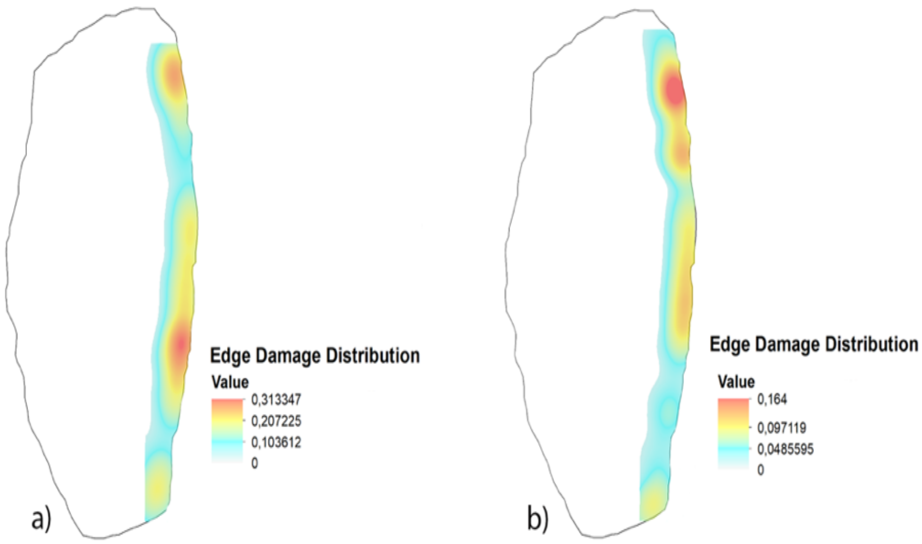


Figure 74. Spatial distribution of edge damage related to a) scraping and b) cutting identified over the Quina and demi-Quina scrapers of Qesem Cave. The density maps clearly show how the entire edge area was exploited despite the activity performed.

Moreover, the fact that animals with a thin subcutis layer, such as fallow deer, represent the main hunted prey at Qesem Cave could have also influenced the choices regarding the preferred delineation of the scraper edge.

In the Levantine AYCC between 400,000 and 200,000 years ago, the main focus of the Qesem Cave inhabitants appears to have been the exploitation of tool functionality through the application of the Quina retouch. Minimum importance was given to the morphological features of the blank. This applies in particular to the demi-Quina scrapers where different kinds of blank morphologies were exploited, comprising old patinated ones (n.18), a phenomenon recorded to a lesser extent in the case of Quina scrapers (n.10).

Later during the Middle Palaeolithic in Western Europe we observe a different behaviour. At this time specific technological solutions were developed (blank production and edge delineation) in order to enhance the functional potential of Quina scrapers in a specific activity like hide scraping. This resulted in the production of specific blanks, characterised by morphological traits that fulfilled the need for frequent edge retouching, during the manufacture of Quina and demi-Quina scrapers,. Moreover, the convex edge delineation was preferred to a straight one due to its higher performance in hide scraping activities involving animals with a thick layer of subcutaneous fat. Contrary to what is recorded at Qesem Cave during the AYCC, in Western Europe during the Middle Palaeolithic an entire “tool system” made of specific blank types and edge delineation was developed around the Quina retouch in order to enhance its potential in a specific activity, that is hide scraping. This model fits particularly well with the evidence gathered at Roc de Marsal and other Middle Palaeolithic contexts, such as La Combette, where most of the Quina and demi-Quina scrapers were utilised to process hide (Lemorini 2000).

Toward the end of the Middle Palaeolithic another variation in the use of Quina and demi-Quina scrapers emerges from the analysis of the Quina assemblage of Level XIII of Cueva de El Esquilleu. Here, despite maintaining the techno-morphological features typical of Western European Quina assemblages (i.e. convex margins and asymmetrical blanks), the use of Quina and demi-Quina scrapers is more varied in terms of motions and processed substances, resembling in part what has been recorded at Qesem Cave. From the data collected so far, which is in need of expansion as it is currently limited to two contexts, it would appear that Quina implements may have lost their task-specific role within the toolkit of the late Western European Neanderthal groups, just as they did towards the end of the Middle Palaeolithic. Interestingly such a transition from task-specific to multipurpose tools coincides with a variation in the subsistence strategies adopted by the Neanderthals (Fig. 74).

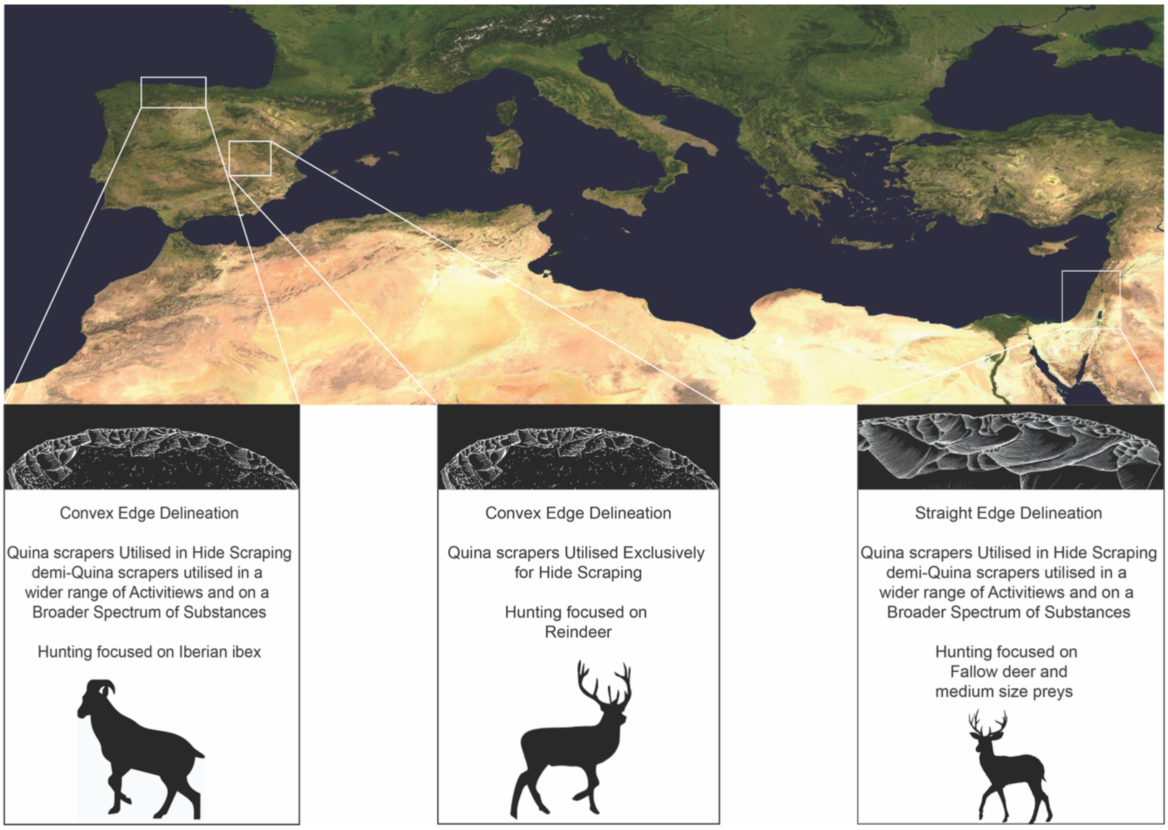


Figure 75. Description of the main features characterising the Levantine and Western European Quina contexts.

This underlines a very important aspect of the Quina system, that is its *functional flexibility*. The differences identified in both the manufacturing and use of Quina and demi-Quina scrapers at Qesem Cave, Roc de Marsal and Cueva de El Esquilleu are evidence of how the Quina retouch could be adapted based on different behavioural needs, whilst maintaining its prominent role in hide scraping. At Qesem Cave, the high cutting potential of the Quina retouch was exploited; aside from hide scraping, demi-Quina scrapers were also employed for cutting activities involving the processing of vegetal materials, such as woody plants, and soft or hard animal materials such as meat and bone. Moreover, the possible limitations imposed by the need for frequent resharpening were overcome by the manufacturing of scrapers with straight edges, providing a larger usable edge surface and granting the efficiency of the tool in multiple tasks. During the Middle Palaeolithic in Western Europe, as seen at Roc de Marsal, specific technological solutions such as blank morphology and edge delineation were developed to accommodate the role played by Quina and demi-Quina scrapers as task-specific tools devoted to hide processing. These were adopted to enhance the efficiency of Quina implements in processing hides characterised by a thick subcutaneous fatty layer, such as those of reindeer. Furthermore, as seen at Cueva de El Esquilleu, the functional potential of Quina and demi-Quina scrapers were exploited to perform and process a broader spectrum of activities and substances, resembling to some extent the much earlier evidence from Qesem Cave.

The results of this research underscore one, if not the only, characteristic that can help explain the chronological and geographical diffusion of the Quina phenomenon across the Levant and the Old World. Quina and demi-Quina scrapers featuring similar techno-morpho-functional characteristics are indeed found in Levantine AYCC contexts dated between 400,000 and 200,000 years ago, Palaeolithic sites in the Balkan region dated to ~300,000 years ago (Mihailovic 2014), and Western European Middle Palaeolithic contexts dated between 200,000 and 35.000 years ago (Bourguignon 1997; Delagnes and Meignen 2006; Turq 2000; Adler et al. 2014). At this stage, it is too ambitious to label the longevity and geographic spread of these tools, as well as the near absence of major changes in tool form or function, as proper evidence for defining the Quina phenomenon as a cultural entity. In light of the results presented in this research, it would be more appropriate to interpret the phenomenon as the consequence of the great *techno-functional flexibility* that characterises the Quina retouch, which can be defined as the main characteristic of a given technology, granting its geographic diffusion and longevity among ancient human groups.

Conclusions

The results obtained from this research present new data from technological and functional points of view regarding the Quina phenomenon in the Levant and in Western Europe. For the first time it was possible to develop a detailed dataset concerning the use of Quina and demi-Quina scrapers in a Levantine Acheulo Yabrudian context. The data achieved from the techno-morpho-functional and use-wear analyses performed on the Qesem Cave scraper assemblage allowed for a detailed investigation into the use of these tools. The strong association of these tools with hide processing, particularly in the case of Quina scrapers, has been demonstrated. At Qesem Cave, the use wear identified on these tools proves their near-exclusive use in hide processing activities, with little evidence pointing towards the exploitation of Quina scrapers in other activities or worked substances. Conversely, the use wear identified on demi-Quina implements indicates more varied patterns of use, both in terms of activities and in the substances processed. Indeed, while hide is still recognised as one of the more frequently worked matters, traces related to other animal materials (e.g. meat and bone) and vegetal substances such as wood, woody plants, and USOs have been identified. Moreover, in term of gestures demi-Quina scrapers appear to have been used in a variety of actions, including cutting or **mixed** [mixing?] activities; these were not identified on Quina scrapers, suggesting that different functional roles were played by the two scraper types at the site. Furthermore, the analysis of the demi-Quina implements demonstrated how the functional potential of a Quina edge was also exploited in a variety of tasks, providing the means to assume the multipurpose role played by these tools at Qesem Cave and potentially in other Levantine AYCC contexts. Use-wear and residue analyses were able to be combined thanks to the [excellent?] state of preservation of the materials; organic (e.g. adipocere, lignin) and inorganic (*hydroxilapatite*) substances have been identified on several of the analysed tools, enriching the data concerning the use of these tools at the site.

A different scenario can be proposed on the basis of the functional data gathered by the analysis of the Quina Mousterian contexts of Roc de Marsal (Level X) and Cueva de El Esquilleu (Level XIII).

The results of the techno-morpho-functional and use-wear analyses performed on the two samples suggest that different roles were played by Quina and demi-Quina scrapers at the two sites. Indeed, the identified techno-morphological patterns clearly indicate the development of specific technological solutions aimed at enhancing the role of Quina and demi-Quina scrapers as task-specific (hide-working) implements. In this way the experimental trials performed for this research permitted an evaluation of how features such as blank morphology and especially edge delineation can be identified as solutions clearly adopted to enhance the efficiency of Quina and demi-Quina implements in the processing of hide. While the role as task-specific tools devoted to hide scraping appears clear regarding the analysed Quina sample of Level X of Roc de Marsal, the same cannot be said concerning the Quina and demi-Quina scrapers coming from Level XIII of Cueva de El Esquilleu. Here, even though the tools share the same technological characteristics seen at Roc de Marsal, such as distinct blank production and convex edge delineation, the identified use-wear patterns point toward a more generic use, not exclusively related to hide scraping but involving a broader range of activities and substances.

The evidence emerging from the analysis of the Quina and demi-Quina samples of Qesem Cave, Roc de Marsal and Cueva de El Esquilleu provides an initial dataset from which a possible evolution of the Quina phenomenon in the Levant and Western Europe could be outlined. From both the techno-morpho-functional and use-wear results it has emerged how the *functional flexibility* of Quina and demi-Quina scrapers allowed the latter to serve different roles (from multipurpose to task-specific tools) in the analysed context, without losing their primary purpose as tools devoted to hide scraping. This great flexibility is perhaps the reason for such a wide chronological and geographical spread of Quina and demi-Quina scrapers, ranging from the Late Lower Palaeolithic of the Levant 400,000 years ago to the latest stage of the Middle Palaeolithic in Western Europe approximately 35.000 years ago.

The results of this research, especially regarding the data concerning the Western European Quina evidence, needs to be strengthened by further studies. Indeed, future research on the matter should focus on expanding the data regarding the use of these tools through the analysis of a wider range of Western European Quina collections. In particular, to enhance our knowledge on Quina and demi-Quina scrapers it will be essential to focus on specific regions such as the Balkans, Greece and Turkey, where the Quina context has recently been found and dated to approximately 300,000 years ago. The analysis of the assemblages coming from these regions will fill the existing geographical and chronological gap in the Quina evidence in the Levant and Western Europe. This represents an essential step not only to enhance our knowledge regarding the technology and use of Quina and demi-Quina scrapers, but also to gather new evidence that will shed light on the emergence and diffusion of these tools across the Levant and Europe and will allow us to define Quina scrapers not simply as a phenomenon, but possibly as evidence of a proper culture.

Overall, the results of this research have enriched our knowledge regarding the use of Quina and demi-Quina scrapers, especially concerning the Levantine Acheulo Yabrudian. The combination of techno-morpho-functional and use-wear analyses allowed us to investigate in great detail the ongoing relationship between the design of these tools and their actual use. Moreover, the set of experiments performed permitted the testing of the efficiency of these tools, and allowed us to assess their potential and limits in relation to different worked substances and/or activities investigating different handling solutions. Even though the study was limited to two assemblages, the comparison between the techno-morpho-functional and use-wear data of the Qesem Cave assemblage with the assemblages of Roc de Marsal and Cueva de El Esquilleu provided important clues for tracing the evolution of the Quina phenomenon in the Levant and the Old World and its relevent role in ancient human adaptation and behavior.

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Appendix A – Qesem Cave Analysed Quina and demi-Quina scraper sample

Item Id	Area	Initial Elevation	Final Elevation	Context	Typology	Group	Status	Lenght	Thickness (mm)	Width (mm)	Weigth (gr)	Edge Shape	Edge Angle	Cortex %	Activity	Worked Material
E8a+c_1	E8	825	825	Deep Shelf	demi-Quina scraper	V	Used	68	15	35	43	St.	70	25	Mixed	Medium - Soft
E8b_2	E8	850	850	Deep Shelf	demi-Quina scraper	IV	Not Used	52	18	34	278	St.	43	25		
E8d_1	E8	865	865	Deep Shelf	demi-Quina scraper	IV	Used	57	12	31	317	St.	48	25	Mixed	Dry Hide
E7b_3	E7	895	895	Deep Shelf	demi-Quina scraper	V	Not Used	48	13	30	21	Cx.	52	50		
E7b_2	E7	905	905	Deep Shelf	demi-Quina scraper	IV	Altered	58	16	76	66	St.		5		
E8b_1	E8	950	950	Deep Shelf	demi-Quina scraper	IV	Used	62	15	38	399	St.	56	50	Cutting	Bone
D7b_1	D7	985	985	Deep Shelf	demi-Quina scraper	V	Used	68	12	34	403	St.	58	50	Cutting	Dry Wood
D7c_2	D7	1015	1015	Deep Shelf	demi-Quina scraper	V	Altered	57	26	48	556	Irr.	80	25		
D7d+b_1	D7	950	950	Deep Shelf	demi-Quina scraper	IV	Used	64	16	43	588	Cv	60	75	Scraping	Fresh Hide
D7d_1	D7	1010	1010	Deep Shelf	demi-Quina scraper	IV	N. Diagn.	62	19	37	542	St.	47	5		
D7b+d_2	D7	1030	1030	Deep Shelf	demi-Quina scraper	IV	Used	69	22	41		St.	53	0	Scraping	Fresh Wood
D7b+d_3	D7	1030	1030	Deep Shelf	demi-Quina scraper	IV	Not Used	59	12	36		St.	48	75		
D6b+d_1	D6	1035	1035	Deep Shelf	demi-Quina scraper	IV	Used	50	12	60	473	Cx.	51	0	Scraping	Fresh Hide
D7d_2	D7	1035	1035	Deep Shelf	demi-Quina scraper	V	N. Diagn.	85	17	32	704	Cx.	55	50		
C7c+d_1	C7	1040	1040	Deep Shelf	demi-Quina scraper	IV	Used	59	16	36	534	St.	49	0	Scraping	Fresh Hide
D7c+d_4	D7	1040	1040	Deep Shelf	demi-Quina scraper	IV	Used	78	24	53	957	St.	60	90	Scraping	Bone and Animal Tissues
D7c+d_1	D7	1040	1040	Deep Shelf	demi-Quina scraper	IV	Not Used	45	8	28	126	St.	44	50		
D7c+d_3	D7	1040	1040	Deep Shelf	demi-Quina scraper	IV	N. Diagn.	75	14	33	466	St.	53	5		
D7c+d_2	D7	1040	1040	Deep Shelf	demi-Quina scraper	V	N. Diagn.	75	22	45	656	St.	89	0		
D6d_1	D6	1065	1065	Deep Shelf	demi-Quina scraper	IV	Used	67	14	31	351	St.	68	0	Mixed	Soft
D7d_5	D7	1065	1065	Deep Shelf	demi-Quina scraper	IV	Altered	51	17	30	21	Cx.	44	50		

D7b _10	D7	1075	1075	Deep Shelf	demi-Quina scraper	V	Used	78	12	46	36	Cx.	47	25	Scraping	Fresh Hide
D7b _9	D7	1075	1075	Deep Shelf	demi-Quina scraper	IV	Used	60	12	30	338	Irr.	65	0	Scraping	Fresh Hide
D7d _9	D7	1075	1075	Deep Shelf	demi-Quina scraper	IV	Used	62	15	32	455	Cx.	66	75	Scraping	Fresh Hide
D6d _7	D6	1085	1085	Deep Shelf	demi-Quina scraper	IV	Altered	64	14	38	266	St.	50	0		
D7d _6	D7	1085	1085	Deep Shelf	demi-Quina scraper	V	Used	70	20	51	781	St.	75	90	Scraping	Fresh Wood
D7b _6	D7	1085	1085	Deep Shelf	demi-Quina scraper	IV	Altered	62	12	44	516	St.	39	0		
D6b _3	D6	1090	1090	Deep Shelf	demi-Quina scraper	IV	Not Used	55	16	35	395	Irr.	39	0		
D6d _8	D6	1090	1090	Deep Shelf	demi-Quina scraper	IV	Altered	44	18	40	218	Irr.	69	0		
D7c _5	D7	1090	1090	Deep Shelf	demi-Quina scraper	IV	Used	38	14	62	457	St.	53	0	Scraping	Fresh Hide
D7b _3	D7	1100	1100	Deep Shelf	demi-Quina scraper	IV	Altered	44	11	30	336	St.	70	5		
C7d _2	C7	1105	1105	Deep Shelf	demi-Quina scraper	V	Used	78	27	39	83	St.	66	75	Cutting	Dry Hide
D7d _7	D7	1105	1105	Deep Shelf	demi-Quina scraper	IV	Altered	55	7	33	167	St.	42	75		
D7b _12	D7	1105	1105	Deep Shelf	demi-Quina scraper	V	Altered	90	24	39	114	St.	70	90		
D7d _10	D7	1105	1105	Deep Shelf	demi-Quina scraper	V	Altered	47	11	30	46	St.	60	75		
D6b _1	D6	1115	1115	Deep Shelf	demi-Quina scraper	IV	Not Used	68	23	42	846	Irr.	72	0		
D7d _4	D7	1115	1115	Deep Shelf	demi-Quina scraper	IV	N. Diagn.	72	20	35	634	St.	72	90		
D7b _2	D7	1115	1115	Deep Shelf	demi-Quina scraper	V	N. Diagn.	66	15	48	635	St.	55	5		
D6d _6	D6	1125	1125	Deep Shelf	demi-Quina scraper	IV	Used	61	12	40	423	St.	50	0	Scraping	Fresh Hide
C7_ b+d_ 1	C7	1130	1130	Deep Shelf	demi-Quina scraper	V	Used	58	20	34	438	St.	35	0	Cutting	Fresh Wood
B7d +C7 c_1	B7 +C 7	NA	1050	Deep Shelf	Quina scraper	IV	Used	42	14	75	606	St.	59	90	Scraping	Dry Hide
D7a _1	D7	740	740	Deep Shelf	Quina scraper	II	Used	66	30	35	72	St.	86	75	Scraping	Fresh Hide
E8b +c+d 1	E8	800	800	Deep Shelf	Quina scraper	II	Used	82	16	40	60	St.	65	5	Scraping	Fresh Hide
E7a_ 1	E7	880	880	Deep Shelf	Quina scraper	II	Used	78	25	34	70	St.	81	75	Scraping	Dry Hide
C7_ 1	C7	900	900	Deep Shelf	Quina scraper	IV	Used	76	25	43	1066	St.	62	25		
E7b_ 1	E7	935	935	Deep Shelf	Quina scraper	IV +I I	Used	83	18	63	808	St.	45	75	Scraping	Bone and Dry Hide
C8a_ 1	C8	950	950	Deep Shelf	Quina scraper	II	Used	32	18	66	365	St.	63	0	Scraping	Fresh Hide
D7d _3	D7	1005	1005	Deep Shelf	Quina scraper	I	Altered	54	13	31	226	Cx.	69	90		

D7c_1	D7	1020	1020	Deep Shelf	Quina scraper	IV	Altered	35	14	76	399	Cx.	43	0		
C7d_1	C7	1025	1025	Deep Shelf	Quina scraper	II	N. Diagn.	58	15	26	236	Cx.	66	25		
D7c+d_5	D7	1040	1040	Deep Shelf	Quina scraper	I	Used	73	19	29	574	St.	87	0	Mixed	Bone
D7a_2	D7	1050	1050	Deep Shelf	Quina scraper	I	Altered	46	21	35	264	St.	86	90		
D7b 5	D7	1065	1065	Deep Shelf	Quina scraper	III	Altered	22	11	41	19	St.	74	25		
D7c_4	D7	1080	1080	Deep Shelf	Quina scraper	III	Altered	55	20	25	319	St.	69	25		
D6d 3	D6	1085	1085	Deep Shelf	Quina scraper	I	Altered	52	20	73	798	St.	84	75		
D7b 7	D7	1085	1085	Deep Shelf	Quina scraper	III	Used	59	22	27	412	St.	60	0	Cutting	Bone
D7c_3	D7	1085	1085	Deep Shelf	Quina scraper	III	Used	78	20	34	363	St.	52	75	Scraping	Dry Wood
D7b_8	D7	1085	1085	Deep Shelf	Quina scraper	III	Altered	64	22	30	682	St.	90	0		
D7b+d_1	D7	1085	1085	Deep Shelf	Quina scraper	III	Used	34	18	56	489	St.	56	5	Scraping	Dry Hide
D7a_3	D7	1090	1090	Deep Shelf	Quina scraper	II	Altered	50	20	73	707	St.	84	5		
D6d_2	D6	1110	1110	Deep Shelf	Quina scraper	III	Used	62	18	28	32	St.	77	5	Scraping	Dry Wood
D7b_4	D7	1110	1110	Deep Shelf	Quina scraper	II	Altered	58	18	31	389	St.	90	5		
D6b 2	D6	1115	1115	Deep Shelf	Quina scraper	II	Used	51	21	75	985	Cx.	95	75	Scraping	Medium
D6d_5	D6	1120	1120	Deep Shelf	Quina scraper	II	Not Used	51	15	69	519	Cx.	44	90		
D7d_8	D7	1120	1120	Deep Shelf	Quina scraper	III	Altered	40	21	65	593	St.	77	5		
D7b_11	D7	1125	1125	Deep Shelf	Quina scraper	II	Used	61	27	37	637	Cx.	89	5	Cutting	Bone
I7_1	I7	440	440	Hearth	demi-Quina scraper	IV	Used	35	10	71	285	St.	52	75	Cutting	Vegetable
I7b_4	I7	460	460	Hearth	demi-Quina scraper	I	N. Diagn.	53	22	45	67	St.	60	0		
I7b_1	I7	460	460	Hearth	demi-Quina scraper	IV	Altered	75	12	32	451	St.	56	75		
I7b_3	I7	460	460	Hearth	demi-Quina scraper	V	Used	75	13	40	558	Cx.	47	5	Cutting Scraping	Dry Wood
I7b_2	I7	460	460	Hearth	demi-Quina scraper	V	N. Diagn.	40	9	48	123	Cx.	40	0		
I6a+b_4	I6	460	460	Hearth	demi-Quina scraper	IV	Not Used	64	12	32	442	Irr.	64	5		
I6a+b_1	I6	460	460	Hearth	demi-Quina scraper	IV	Altered	49	23	40	293		0	90		
I6a+b_2	I6	460	460	Hearth	demi-Quina scraper	IV	Altered	75	15	35	405	Irr.	62	0		
I6a+b_3	I6	460	460	Hearth	demi-Quina scraper	IV	Altered	41	7	60	196	Irr.	39	0		
I6c+d_1	I6	510	510	Hearth	demi-Quina scraper	IV	Used	57	15	19	158	St.	0	5	Scraping	Fresh Hide
I7c+d_2	I7	515	515	Hearth	demi-Quina scraper	V	Used	50	11	31	347	St.	59	5	Cutting	Vegetable
I13a_1	I13	575	575	Hearth	demi-Quina scraper	IV	Used	32	9	21	16	St.	44	0	Cutting	Animal Tissues
J13a_2	J13	575	575	Hearth	demi-Quina scraper	V	Altered	56	12	42	41	St.	52	0		

J13b _1	J1 3	590	590	Hearth	demi-Quina scraper	IV	Used	41	10	27	13	St.	52	0	Cutting	Soft
J13a _1	J1 3	600	600	Hearth	demi-Quina scraper	V	Used	65	16	32	40	St.	50	0	Cutting	Soft
E12b _3	E1 2	NA	NA	Not Assign ed	demi-Quina scraper	IV	N. Diagn.	68	14	48	507	St.	50	75		
O12 c+d_ 1	O1 2	145	145	Not Assign ed	demi-Quina scraper	IV	Altered	83	21	49	1023	Irr.	58	25		
O12 a_1	O1 2	155	155	Not Assign ed	demi-Quina scraper	V	Not Used	70	24	45	793	St.	66	5		
L8a_ 1	L8	365	365	Not Assign ed	demi-Quina scraper	IV	Used	64	10	23	178	St.	48	5	Mixed	Soft
J7d_ 2	J7	450	450	Not Assign ed	demi-Quina scraper	IV	Used	65	11	37	383	Cx.	41	75	Scraping	Bone
H9c _1	H9	507	507	Not Assign ed	demi-Quina scraper	IV	Used	60	15	35	292	St.	70	25	Mixed	Vegetable
C15 d_3	C1 5	560	560	Not Assign ed	demi-Quina scraper	V	N. Diagn.	72	13	40	33	St.	55	25		
C16 b_2	C1 6	565	565	Not Assign ed	demi-Quina scraper	V	N. Diagn.	65	12	38	30	St.	54	0		
H14 d_1	H1 4	568	568	Not Assign ed	demi-Quina scraper	IV	Altered	44	12	27	22	St.	56	0		
D16 a_1	D1 6	570	570	Not Assign ed	demi-Quina scraper	IV	Used	56	39	74	38	Cx.	65	25	Mixed	Vegetable
J14b _2	J1 4	580	580	Not Assign ed	demi-Quina scraper	V	Used	62	14	27	33	St.	47	25	Mixed	Animal Tissues
J14b _3	J1 4	580	580	Not Assign ed	demi-Quina scraper	V	Used	37	17	30	21	Irr.	52	0	Cutting	Animal Tissues
D16 c_1	D1 6	590	590	Not Assign ed	demi-Quina scraper	V	Used	52	13	28	28	St.	45	0	Cutting	Soft
J16b _1	J1 6	590	590	Not Assign ed	demi-Quina scraper	IV	Used	73	14	30	64	St.	69	25	Cutting	Vegetable
C15 d_2	C1 5	595	595	Not Assign ed	demi-Quina scraper	IV	Altered	60	20	31	43	Cx.	76	0		
C15c _1	C1 5	625	625	Not Assign ed	demi-Quina scraper	V	N. Diagn.	53	13	30	223	St.	58	25		
H22 _1	H2 2	625	625	Not Assign ed	demi-Quina scraper	V	Not Used	68	13	43	509	Cx.	51	5		
G6a _1	G6	705	705	Not Assign ed	demi-Quina scraper	IV	Altered	70	14	38	527	St.	50	5		
H21 _1	H2 1	705	705	Not Assign ed	demi-Quina scraper	IV	Used	60	17	30	382	St.	47	5	Mixed	Medium
E10b _2	E1 0	720	720	Not Assign ed	demi-Quina scraper	V	Altered	43	15	52	47	St.	64	75		
E10c _1	E1 0	720	720	Not Assign ed	demi-Quina scraper	IV	Used	52	21	46	51	St.	68	0	Cutting	Medium - Soft
E9b +d_1	E9	730	730	Not Assign ed	demi-Quina scraper	V	Used	40	12	51	361	St.	51	75	Mixed	Dry Hide
G21 _1	G2 1	775	775	Not Assign ed	demi-Quina scraper	V	Used	55	11	30	244	St.	43	25	Mixed	Soft

F8c_1	F8	790	790	Not Assigned	demi-Quina scraper	IV	Altered	64	18	44	49	St.	61	50		
E7a+b+c+d_1	E7	790	790	Not Assigned	demi-Quina scraper	V	Altered	46	18	44	41	Irr.	45	90		
F6a_5	F6	900	900	Not Assigned	demi-Quina scraper	V	Not Used	80	7	42	44	St.	48	50		
C9_2	C9	920	920	Not Assigned	demi-Quina scraper	IV	Used	50	14	71	47	Cx.	34	0	Cutting	Dry Wood
G8a_5	G8	NA	NA	Not Assigned	Quina scraper	II	Used	588	70	40	19	St.	69	25	Scraping	Dry Wood
J7a_1	J7	410	410	Not Assigned	Quina scraper	III	Used	54	15	39	397	St.	64	75	Cutting	Vegetable
I8b_1	I8	415	415	Not Assigned	Quina scraper	II	Used	50	20	29	348	St.	60	75	Scraping	Fresh Hide
H8c_1	H8	432	432	Not Assigned	Quina scraper	III	Altered	43	16	28	20	St.	71	75		
J7b_1	J7	450	450	Not Assigned	Quina scraper	I	Altered	92	22	76	1196	Cx.	72	5		
H7d_1	H7	510	510	Not Assigned	Quina scraper	II	Used	533	15	352	353	St.	67	25	Cutting	Dry Wood
I7c+d_1	I7	510	510	Not Assigned	Quina scraper	III	Used	58	25	35	495	St.	77	75	Scraping	Dry Hide
D13a_1	D13	530	530	Not Assigned	Quina scraper	III	Altered	39	12	55	273	St.	53	90		
C16d_1	C16	560	560	Not Assigned	Quina scraper	III	Altered	42	15	28	13	St.		5		
C16b_1	C16	565	565	Not Assigned	Quina scraper	II	Used	66	21	52	83	Cx.	75	25	Scraping	Dry Hide
I16a_1	I16	580	580	Not Assigned	Quina scraper	I	Altered	60	19	26	208	St.	62	0		
D15c_1	D15	585	585	Not Assigned	Quina scraper	III	Altered	68	18	32	29	St.	55	0		
C16d_2	C16	590	590	Not Assigned	Quina scraper	III	Altered	95	18	61	120	St.	70	75		
C16a_3	C16	590	590	Not Assigned	Quina scraper	III	N. Diagn.	55	14	32	32	Dent.	60	0		
C16c_1	C16	600	600	Not Assigned	Quina scraper	III	Used	54	20	42	41	St. Dent.	79	25	Mixed	Medium
G7b_1	G7	605	605	Not Assigned	Quina scraper	III	Altered	62	21	31	389	Cx.	94	0		
C15d_1	C15	615	615	Not Assigned	Quina scraper	I	Used	50	17	30	231	St.	57	0	Cutting and Scraping	Bone and Dry Hide
F8d_1	F8	615	615	Not Assigned	Quina scraper	II	Used	65	24	40	583	St.	86	50	Scraping	Soft
H16c_1	H16	615	615	Not Assigned	Quina scraper	I	Used	62	20	60	628	Irr.	77	0		
F15d_1	F15	630	630	Not Assigned	Quina scraper	III	N. Diagn.	35	10	12	6	St.	56	0		
G7d_1	G7	630	630	Not Assigned	Quina scraper	III	Altered	63	10	30	21	St.	52	0		

G8c_2	G8	630	630	Not Assigned	Quina scraper	I	Altered	25	13	32	19	St.	62	0		
G7b_4	G7	635	635	Not Assigned	Quina scraper	III	Used	95	12	39	641	St.	50	0	Scraping	Fresh Wood
C17c_1	C17	640	640	Not Assigned	Quina scraper	I	Used	57	21	46	601	Irr.	90	25	Scraping	Animal Tissues
G7b_8	G7	655	655	Not Assigned	Quina scraper	II	Altered	28	18	78		St.	85	25		
G7d_2	G7	655	655	Not Assigned	Quina scraper	III	Used	70	20	45	674	St.	65	75	Scraping	Vegetable
G6d_1	G6	670	670	Not Assigned	Quina scraper	I	Altered	56	22	38	437	Cx.	80	0		
G6c_3	G6	675	675	Not Assigned	Quina scraper	III	N. Diagn.	42	15	62	402	St.	64	25		
G6a+b_3	G6	675	675	Not Assigned	Quina scraper	III	Altered	60	12	32	336	St.	68	0		
G6a+b_1	G6	675	675	Not Assigned	Quina scraper	II	Used	85	20	40	919	St.	86	0	Scraping	Fresh Hide
G6a+b_2	G6	675	675	Not Assigned	Quina scraper	III	Used	45	19	65	464	Cx.	75	50	Mixed	Medium
H22_2	H22	675	675	Not Assigned	Quina scraper	III	Not Used	68	10	32	348	Cx.	49	25		
G6a+b_5	G6	685	685	Not Assigned	Quina scraper	II	Used	61	29	36	737	St.	88	5	Scraping	Dry Wood
F8d_2	F8	690	690	Not Assigned	Quina scraper	III	N. Diagn.	77	14	56	754	St.	51	75		
F6b+G6a_1	F6+G6	755	755	Not Assigned	Quina scraper	II	Altered	60	12	30	266	Cx.	44	75		
F8a_4	F8	785	785	Not Assigned	Quina scraper	III	Altered	55	12	25	18	St.	47	5		
F8a_3	F8	790	790	Not Assigned	Quina scraper	III	Used	82	18	43	47	St.	58	5	Cutting	Animal Tissues and Fresh Hide
F8a_1	F8	795	795	Not Assigned	Quina scraper	II	Used	42	25	91	934	St.	84	5	Scraping	Fresh Hide
F6a_1	F6	880	880	Not Assigned	Quina scraper	III	Altered	62	23	39	51	St.	78	75		
F6a_3	F6	900	900	Not Assigned	Quina scraper	II	Used	73	18	34	57	St.	65	0	Mixed	Medium
F6a_4	F6	900	900	Not Assigned	Quina scraper	III	Used	86	17	48	90	Cx.	73	25	Mixed	Woody Plants
C9_1	C9	940	940	Not Assigned	Quina scraper	III	Altered	74	18	39	72	St.	65	75		
G9b_1	G9	505	505	Shelf	demi-Quina scraper	IV	Altered	61	16	40	296	Irr.	42	75		
G9d_1	G9	505	505	Shelf	demi-Quina scraper	V	Altered	73	11	56	457	St.	58	0		
G8cd_1	G8	530	530	Shelf	demi-Quina scraper	IV	Used	72	16	27	347	St.	66	50	Mixed	Medium - Hard
F11_1	F11	545	545	Shelf	demi-Quina scraper	IV	Used	39	15	62	352	Cx.	64	90	Cutting	Animal Tissues

F11_2	F11	545	545	Shelf	demi-Quina scraper	IV	Not Used	53	10	30	216	St.	38	0		
E12b_4	E12	565	565	Shelf	demi-Quina scraper	IV	Used	68	12	47	413	St.	42	0	Cutting	Dry Wood
E12b_5	E12	570	570	Shelf	demi-Quina scraper	IV	Altered	64	22	30	505	St.	66	0		
G9C_1	G9	575	575	Shelf	demi-Quina scraper	V	Used	84	19	38	682	St.	57	75	Scraping	Dry Wood
E11a_1	E11	590	590	Shelf	demi-Quina scraper	IV	Used	58	12	38	268	St.	59	25	Mixed	Soft
F11c_3	F11	590	590	Shelf	demi-Quina scraper	V	Not Used	55	15	27	314	Irr.	65	5		
G8a_6	G8	590	590	Shelf	demi-Quina scraper	V	Altered	55	14	31	303	St.	48	75		
G8a_2	G8	600	600	Shelf	demi-Quina scraper	IV	Used	60	15	35	411	St.	58	75	Scraping	Medium - Soft
G8o_1	G8	600	600	Shelf	demi-Quina scraper	IV	Used	70	12	35	39	St. Cx.	58	0		
F9d_1	F9	610	610	Shelf	demi-Quina scraper	V	Not Used	62	15	38	31	St.	52	75		
G8a_4	G8	630	630	Shelf	demi-Quina scraper	V	Used	50	36	75	1336	St.	84	0	Scraping	Dry Wood
G8a_7	G8	635	635	Shelf	demi-Quina scraper	IV	Not Used	55	8	33	151	Dent.	44	25		
G7b_3	G7	640	640	Shelf	demi-Quina scraper	IV	Used	60	11	60	48	St.	46	0	Cutting	Fresh Hide and Animal Tissues
G8a_1	G8	640	640	Shelf	demi-Quina scraper	IV	Used	68	15	36	483	St.	35	75	Cutting	Medium - Soft
G6d_2	G6	645	645	Shelf	demi-Quina scraper	V	Altered	68	9	19	235	St.	51	0		
G7b_5	G7	645	645	Shelf	demi-Quina scraper	I	Used	46	8	27	99	St.	28	0	Scraping	Medium and Animal Tissues
F8b_1	F8	650	650	Shelf	demi-Quina scraper	IV	Used	72	18	40	568	St.	77	0	Cutting	Vegetable
G6b_1	G6	660	660	Shelf	demi-Quina scraper	IV	Altered	48	12	38	308	St.	46	25		
G7b_6	G7	660	660	Shelf	demi-Quina scraper	IV	Altered	66	17	40	602	St.	45	5		
E11d_4	E11	665	665	Shelf	demi-Quina scraper	IV	Used	70	13	45	63	St.	52	75	Scraping	Dry Hide
E11c_3	E11	665	665	Shelf	demi-Quina scraper	IV	Not Used	45	25	61	79	St.	64	0		
G9d_3	G9	665	665	Shelf	demi-Quina scraper	IV	Altered	62	9	25	269	Irr.	44	25		
G6a+b_4	G6	670	670	Shelf	demi-Quina scraper	IV	Altered	94	11	35	47	St.	48	5		
G7b_2	G7	670	670	Shelf	demi-Quina scraper	V	Used	91	17	56	1023	St.	62	75	Scraping	Dry Wood
G7b_7	G7	670	670	Shelf	demi-Quina scraper	V	N. Diagn.	52	10	28	222	St.	56	50		

F8b_2	F8	680	680	Shelf	demi-Quina scraper	V	Altered	46	11	27	158	St.	53	50		
F9b_1	F9	680	680	Shelf	demi-Quina scraper	IV	Used	78	16	35	468	Cx.	70	50	Cutting	Dry Hide
G6c_1	G6	680	680	Shelf	demi-Quina scraper	IV	Not Used	69	22	52	802	Irr.	73	0		
G6c_2	G6	680	680	Shelf	demi-Quina scraper	IV	Used	54	22	61	798	St.	84	75	Mixed	Fresh Wood
G7a_1	G7	680	680	Shelf	demi-Quina scraper	V	Not Used	61	22	50	706	St.	57	75		
G9d_2	G9	680	680	Shelf	demi-Quina scraper	IV	Used	61	10	40	411	Cx.	33	5		
E11c_2	E11	685	685	Shelf	demi-Quina scraper	IV	Not Used	62	28	14	25	St.	43	75		
E11d_3	E11	685	685	Shelf	demi-Quina scraper	V	N. Diagn.	46	18	56	39	Cx.	83	5		
G7c_1	G7	690	690	Shelf	demi-Quina scraper	IV	Used	33	15	63	352	St.	59	90	Scraping	Medium
E11b_1	E11	700	700	Shelf	demi-Quina scraper	V	N. Diagn.	65	14	40	46	St.	69	25		
G9a_1	G9	525	525	Shelf	Quina scraper	IV	Used	76	15	40	491	St.	61	25	Scraping	Vegetable
E12b_1	E12	560	560	Shelf	Quina scraper	III	Used	86	21	46	889	Cx.	68	5	Scraping	Fresh Hide
F11a_2	F11	575	575	Shelf	Quina scraper	II	Used	68	21	26	554	St.	81	75	Mixed	Fresh Hide
E12b_2	E12	580	580	Shelf	Quina scraper	III	Used	37	13	60	322	St.	48	25	Scraping	Dry Hide
G9c_2	G9	585	585	Shelf	Quina scraper	III	Used	44	18	57	506	St.	65	5	Cutting	Medium - Soft
F11a_3	F11	595	595	Shelf	Quina scraper	I	Used	55	11	39	403	St.	84	75	Scraping	Dry Wood
F11c_1	F11	595	595	Shelf	Quina scraper	III	Used	54	11	39	268	St.	58	5	Scraping	Fresh Hide
E11d_1	E11	605	605	Shelf	Quina scraper	I	Used	63	24	58	701	St.	66	5	Scraping	Fresh Hide
F11c_2	F11	610	610	Shelf	Quina scraper	I	Not Used	74	12	32	488	St.	66	0		
E11d_5	E11	625	625	Shelf	Quina scraper	III	Used	58	24	35	478	Irr.	76	0	Cutting and Scraping	Medium
E11c_1	E11	665	665	Shelf	Quina scraper	III	Altered	65	10	25	23	Irr.	50	75		
E10b_1	E10	700	700	Shelf	Quina scraper	II	Used	100	29	60	176	St.	89	0	Scraping	Dry Hide
E11a_2	E11	715	715	Shelf	Quina scraper	II	Altered	30	15	56	30	St.	70	5		
E11d_2	E11	715	715	Shelf	Quina scraper	III	N. Diagn.	49	23	72	103	Cx.	95	75		
I14d_1	I14	570	570	S. of Hearth	demi-Quina scraper	IV	Used	67	10	39	29	Cx.	47	25	Cutting	Dry Hide
I15_1	I15	570	570	S. of Hearth	demi-Quina scraper	IV	Not Used	55	16	46	407	St.	62	38		
I14d_2	I14	585	585	S. of Hearth	demi-Quina scraper	IV	Not Used	48	11	36	21	St.	47	42		
I15c_1	I15	580	580	S. of Hearth	Quina scraper	III	Altered	41	12	22	15	St.	59	49		
J14b_1	J14	595	595	S. of Hearth	Quina scraper	III	Altered	38	17	35	241	St.	64	5		

Appendix B – Roc de Marsal (Level 2) Analysed Quina and demi-Quina Scraper Sample

Item Label	Area	Level	Group	Typology	Edge Shape	Length(mm)	Thickness(mm)	Width(mm)	Edge Angle	Activity	Worked Material
00	P18	X	V	demi-Quina scraper	Cx.	42	16	66	61		
1	K19	XI	IV	demi-Quina scraper	St.	74	26	41	62		
1	O18	XI	V	demi-Quina scraper	Cx.	52	13	61	66		
10	N18	XI	V	demi-Quina scraper	Cx.	53	10	38	45	Scraping	Medium Hard
11	M18	XI	V	demi-Quina scraper	St.	57	24	40	71		
11	H19	X	V	demi-Quina scraper	Cx.	76	26	40	68		
12	N18	XI	V	demi-Quina scraper	Cx.	42	25	74	86	Scraping	Medium
13	K19	X	V	demi-Quina scraper	St.	59	26	90	44	Scraping	Medium
15	M18	XIa	IV	demi-Quina scraper	Cx.	77	15	56	53		
194	L16	X	IV	demi-Quina scraper	Cx.	59	16	73	28	Scraping	Fresh Hide
195	L16	X	V	demi-Quina scraper	Irr.	71	11	40	33	Scraping	Soft
24	N18	XI	IV	demi-Quina scraper	Cx.	66	18	55	48	Scraping	Medium
28	O19		IV	demi-Quina scraper	Cx.	41	8	75	62		
29	P18	XI	IV	demi-Quina scraper	Cx.	47	15	55	44		
31	M17	XII	V	demi-Quina scraper	Cx.	37	14	48	68		
33	K19	X	V	demi-Quina scraper	St.	58	18	36	58		
34	L19	XIa	IV	demi-Quina scraper	St.	81	25	42	61	Scraping	
37	N19	XI	V	demi-Quina scraper	Cx.	59	18	41	44		
38	L18	X	IV	demi-Quina scraper	Cx.	94	16	40	48		
40	K19	XI	IV	demi-Quina scraper	Cx.	47	16	80	76	Cutting	
464	O18	XI	V	demi-Quina scraper	St.	42	23	61	53	Scraping	Medium Soft
47	O18	XI	V	demi-Quina scraper	Cx.	51	8	36	48	Scraping	Medium
472	L17	XI	IV	demi-Quina scraper	St.	51	20	78	58		
54	P18	XI	V	demi-Quina scraper	Cx.	31	15	54	58		
59	P18	XI	IV	demi-Quina scraper	St.	61	21	39	53	Cutting	
600a	L17	XI	IV	demi-Quina scraper	St.	50	20	41	60		
62	L19	X	V	demi-Quina scraper	St.	64	17	48	44	Cutting	Animal Tissues Fresh Hide
64	M14	XI	V	demi-Quina scraper	Irr.	81	18	50	48		
656		X	IV	demi-Quina scraper	Cx.	45	21	71	28		
663	L17		V	demi-Quina scraper	Irr.	66	19	42	53		
0	F19	X	III	Quina scraper	St.	80	21	58	69	Scraping	Soft
10	M18	NA	II	Quina scraper	Cx.	49	26	56	75	Scraping	
13	M18	XIa	II	Quina scraper	St.	50	15	70	58	Scraping	Medium Fresh Hide
139	L14	XI	II	Quina scraper	Cx.	52	26	80	87	Scraping	
27	K19	X	II	Quina scraper	St.	70	30	95	62	Scraping	Medium Soft
33	P18	XI	III	Quina scraper	Cx.	67	17	40	58		
37	M17	XI	I	Quina scraper	Irr.	28	19	64	76	Scraping	Medium
3a	M18	XIa	I	Quina scraper	Cx.	50	20	40	74	Cutting	Medium Hard
4	P18	XI	III	Quina scraper	Cx.	37	15	65	53		

41	M17	XI	II	Quina scraper	St.	82	19	47	59	Scraping	Medium
428	N18		III	Quina scraper	Irr.	21	15	52	58		
45	L19	XIa	III	Quina scraper	Cx.	81	22	35	51		
53	M17	XI	II	Quina scraper	Cx.	69	20	54	82	Scraping	Medium Fresh Hide
54	J19	X	I	Quina scraper	Cx.	74	21	39	55	Scraping	Soft
54	L19	X	II	Quina scraper	St.	98	24	48	66	Scraping	
54	N19	XI	II	Quina scraper	St.	64	30	70	74	Scraping	Medium Fresh Hide

Appendix C – Cueva de El Esquilleu (Level XIII) Analysed Quina and demi-Quina Scraper Sample

Item Label	Level	Status	Typology	Group	Length(mm.)	Width(mm.)	Thickness(mm)	Edge Angle	Edge Shape	Activity	Worked Material
ESQ_454	XII	Altered	Quina scraper	I	67	20	32	90	St.		
ESQ_434	XIII		Quina scraper	I	39	15	17	71	St.		
ESQ_479	XIII	Used	Quina scraper	II	21	60	16	64	Cx.	Cutting	Animal Tissues
ESQ_443	XIII	Used	demi-Quina scraper	V	47	36	16	77	St.	Cutting	Animal Tissues
ESQ_388	XIII		Quina scraper	II	63	34	16	68	Cx.		
ESQ_451	XIII		Quina scraper	II	57	26	21	86	Cx.		
ESQ_473	XIII		Quina scraper	II	59	49	26	89	Cx.		
ESQ_317	XIII		Quina scraper	II	82	36	23	79	Cx.		
ESQ_154	XIII	Used	Quina scraper	III	72	29	15	76	Cx.	Mixed	Animal Tissues Fresh Hide
ESQ_717	XIII	Used	demi-Quina scraper	IV	56	34	17	76	Cx.	Scraping	Bone
ESQ_86	XIII		Quina scraper	II	55	27	20	90	St.		
ESQ_661	XIII	Used	demi-Quina scraper	V	38	41	20	79	Cx.	Scraping	Dry Hide
ESQ_457	XIII	Used	Quina scraper	II	50	29	21	79	St.	Scraping	Dry Wood
ESQ_543	XIII		Quina scraper	III	64	31	20	81	Cx.		
ESQ_542	XIII		Quina scraper	III	26	50	15	70	Cx.		
ESQ_224	XIII		Quina scraper	III	63	31	22	65	Cx.		
ESQ_392	XIII		Quina scraper	III	59	31	15	64	Cx.		
ESQ_354	XIII		Quina scraper	III	59	37	22	84	Cx.		
ESQ_222	XIII		Quina scraper	III	40	68	24	85	Cx.		
ESQ_586	XIII	Used	Quina scraper	III	51	25	10	57	St.	Scraping	Dry Wood
ESQ_451	XIII	Used	Quina scraper	II	54	17	27	77	Cx.	Scraping	Fresh Hide
ESQ_94	XIII	Used	Quina scraper	II	56	29	13	70	St.	Cutting	Fresh Hide
ESQ_257	XIII	Used	Quina scraper	III	70	42	19	87	Cx.	Cutting	Fresh Hide
ESQ_464	XIII		Quina scraper	III	63	31	19	79	St.		
ESQ_467	XIII		Quina scraper	III	48	29	16	78	St.		
ESQ_444	XIII		Quina scraper	III	51	26	11	58	St.		
ESQ_259	XIII		Quina scraper	III	40	32	25	82	St.		
ESQ_594	XIII	Not Used	demi-Quina scraper	IV	62	31	18	62	Cx.		
ESQ_456	XIII	Not Used	demi-Quina scraper	IV	55	31	13	59	Cx.		
ESQ_232	XIII		demi-Quina scraper	IV	72	47	12	55	Cx.		
ESQ_236	XIII		demi-Quina scraper	IV	61	30	16	79	Cx.		
ESQ_180	XIII		demi-Quina scraper	IV	60	32	12	76	Cx.		
ESQ_726	XIII	Used	Quina scraper	III	54	23	11	58	Cx.	Scraping	Fresh Hide
ESQ_243	XIII	Used	demi-Quina scraper	IV	68	25	13	0	Cx.	Cutting	Fresh Hide
ESQ_325	XIII	Used	demi-Quina scraper	IV	31	59	23	87	St.	Indeterminable	Fresh Hide
ESQ_322	XIII	Used	demi-Quina scraper	V	50	32	12	58	Cx.	Cutting	Fresh Hide
ESQ_622	XIII	Used	demi-Quina scraper	V	59	29	15	76	Irr.	Scraping	Fresh Hide
ESQ_652	XIII	Not Diagnostic	demi-Quina scraper	IV	30	57	20	66	St.		
ESQ_627	XIII		demi-Quina scraper	IV	51	51	20	64	St.		
ESQ_358	XIII		demi-Quina scraper	IV	29	44	18	74	St.		
ESQ_277	XIII		demi-Quina scraper	V	68	45	20	74	Cx.		

ESQ_408	XIII		demi-Quina scraper	V	47	80	25	84	Cx.		
ESQ_631	XIII	Used	Quina scraper	III	56	35	15	70	Cx.	Scraping	Fresh Wood
ESQ_243	XIII	Used	demi-Quina scraper	IV	52	34	18	73	Cx.	Mixed	Fresh Wood
ESQ_152	XIII	Used	demi-Quina scraper	V	51	30	15	70	St.	Mixed	Indeterminable
ESQ_481	XIII	Used	demi-Quina scraper	V	50	29	21	79	Cx.	Mixed	Meat
ESQ_330	XIII	Used	Quina scraper	III	37	49	15	72	St.	Cutting	Medium
ESQ_133	XIII	Used	demi-Quina scraper	IV	24	48	17	78	Cx.	Scraping	Medium
ESQ_416	XIII	Not Diagnostic	demi-Quina scraper	V	33	22	20	90	St.		

תַקצִיר

הקומפלקס התרבותי האשלו-יברודי (AYCC) של הלבאנט הוא השלב התרבותי האחרון של הפליאולית התחתון באזור. הוא מתאפיין בהופעה הראשונה של סט התנהגויות אנושיות חדשות. בין אלה ניתן לציין את הייצור של מקרצפים, עשויים על נתזים עבים, ומתאפיינים בשברור מדורג על הקצה שלהם, הידועים בשם מקרצפי קינה. מקרצפי קינה מתאפיינים בסוג ספציפי של שברור מדורג, המוגדר במחקר כ-"*écailleuse scalariforme*". שברור זה מושג על ידי סדרה של הכאות על הפן הונטרלי של הכלי, המתבטאות בצלקות סדירות ועמוקות. צלקות קצרות יותר ומאוחרות יותר, המסתיימות במדרגה מופיעות על גבי צלקות אלה, יוצרות דפוס אופייני של שכבות שברור טיפוסיות. מקרצפי קינה הם מרכיב המוכר היטב מהתרבות המוסטרית של הפליאולית התיכון במערב אירופה. מעניין לציין כי לא זוהו הבדלים טכנולוגיים או מורפלוגיים משמעותיים בין מקרצפי הקינה של האשלו-יברודית בלבאנט ובין אלה של התרבות המוסטרית במערב אירופה, על אף המרחק הגיאוגרפי, ועל אף מרווח הזמן של כמעט 200,000 שנים.

המחקר המוצג כאן מתמקד במכלול מקרצפי הקינה והדמי-קינה שנמצאו באתר האשלו-יברודי מערת קסם (ישראל). מדגם המקרצפים העומד במרכז עבודה זו נותח על ידי שילוב של ניתוח טכנו-מורפולוגי ופונקציונלי, וניתוח סימני שימוש. שילוב זה איפשר השגת מידע מפורט לגבי הפעילויות שבוצעו באמצעות כלים אלה והחומרים שעובדו באמצעותם, החל מלפני 400,000 ועד 200,000 שנים לפני היום. על מנת להשיג את תוצאות אלה, מסגרת ניסויית ייעודית פותחה כחלק ממחקר זה, בנוסף לשיטות שצוינו מעלה. רפליקות מודרניות של מקרצפי קינה ודמי-קינה שימשו לעיבוד חומרים שונים, מחומרים ממקור חי (עור, בשר ועצם) ומן הצומח (עץ וצמחים). ניסויים אלה איפשרו הערכה של יעילות כלים אלה בביצוע פעילויות שונות, כגון עיבוד עורות, עיבוד עץ ועיבוד בשר, וסייעו בבניית אוסף משווה שיכול לתרום להבנה של סימני השימוש המזוהים על כלים ארכאולוגיים. במסגרת ניסויים אלו, שמתי דגש לא רק על הקצה הפעיל של הכלי, אלא גם על אזור האחיזה. אחיזות שונות ושיטות קיות שונות נבחנו, וסימני השימוש שהתקבלו תועדו. כך התקבל אוסף משווה גם לגבי האופן שבו כלים נאחזו במהלך השימוש, דבר המלמד לגבי ההתנהגות הטכנולוגית והידע של בני אדם קדומים.

במערת קסם רוב המקרצפים שימשו לעיבוד עורות, לרוב במצב טרי, למרות שיש מספר דוגמאות גם לעיבוד עור יבש. בטווח החומרים של חומרים מן החי, נמצאו עדויות גם לעיבוד עצם, בנוסף לעדויות לעיבוד בשר. חומרים מן הצומח, כגון עץ וצמחים אחרים עובדו גם הם באמצעות כלים אלה, כפי שניתן ללמוד מסימני השימוש על מקרצפי קינה ודמי-קינה.

בנוסף לניתוח סימני השימוש, ביצעתי ניתוח שיירים, שהתאפשר בזכות מצב השימור של הכלים. ניתוח זה בוצע באמצעות Micro-FTIR, ובאמצעותו זוהו שיירים של חומרים אורגניים ואנאורגניים שהצטברו על הקצה הפעיל של הכלים. בין החומרים שזוהו, ניתן לציין שרידי עצם שעברו מינרליזציה, קולגן, שומן מן החי, וחומרים צמחיים.

בעוד שעיבוד עור הוא הפעילות השכיחה ביותר שבוצעה באמצעות כלי אלה במערת קסם, כמה הבדלים זוהו לגבי אופן השימוש של מקרצפי קינה ומקרצפי דמי-קינה. אכן, מקרצפי קינה שימשו בעיקר לעיבוד עורות באמצעות פעולת קירצוף, עם מספר דוגמאות לשימוש בפעילויות אחרות (כגון עיבוד בשר). דבר זה אינו מעיד על תפקיד ייעודי אחד ספציפי של כלים אלה באתר, אך כן מציע כי יש אסוציאציה ברורה בין כלים אלה ובין עיבוד עורות. מקרצפי דמי-קינה, לעומת זאת, משקפים מנעד רחב יותר של פעילויות וחומרים מעובדים, דבר המציע שימוש מגוון יותר. הבדלים בתפקיד הפונקציונלי של שני טיפוסים הכלים משתקפים גם במחזורי החיים של מקרצפי הקינה והדמי-קינה, כאשר מקרצפי הקינה מתאפיינים במספר מחזורים של חידוש הקצה הפעיל, דבר המעיד על מחזור החיים הארוך שלהם, אלמנט אשר אינו מופיע בקרב מקרצפי הדמי-קינה, דבר המציע מחזור חיים קצר יותר.

לאור העובדה כי מקרצפי קינה ודמי-קינה מהתרבות האשלו-יברודית של הלבאנט ומהתרבות המוסטרית של אירופה זהים כמעט לחלוטין מבחינת טכנולוגיה ומורפולוגיה, ועל אף המרחק הגיאוגרפי והכרונולוגי, ניתוח של שני מדגמים של מקרצפי קינה ודמי-קינה מאירופה נכללו בעבודת מחקר זו. המדגמים הנבחרים מגיעים משכבה 2 מהאתר המוסטרי רוק דה מרסל (Roc de Marsal) בצרפת, ומשכבה XIII מהאתר Cueva de El Esquilleu בספרד. רוק דה מרסל מתוארך ל-61,000-45,000 שנים לפני היום, ואילו Cueva de El Esquilleu מתוארך ל-39,000 שנים לפני היום. במקרה של מקרצפי הקינה מרוק דה מרסל, נראה כי רוב מקרצפי הקינה והדמי-קינה שימשו לעיבוד חומרים בדרגת קושי בינונית, על ידי תנועות רוחביות, המקושרות עם פעולות קירצוף. לאור הדמיון בנזקים של הקצה הפעיל שתועדו ברוק דה מרסל ובין רפליקות ניסוייות, ניתן להציע כי במידת מסוימת של בטחון כי מקרצפי הקינה והדמי-קינה של רוק דה מרסל שימשו כמעט באופן בלעדי לקירצוף עורות. באתר Cueva del El Esquilleu, מקרצפי הקינה והדמי-קינה בנותחו, אשר עשויים מקוורציט, חולקים דמיון טכנו-מורפולוגי עם אלה מרוק דה מרסל, אך דפוסי השימוש שלהם מעט שונים. רוב סימני השימוש מקושרים לעיבוד עורות, בנוסף לסימנים הקשורים לעיבוד חומרים מן החי, כגון בשר. עם זאת, עיבוד חומר מצחי (עץ) זוהה גם כן. בעוד עור, גם במצב טרי וגם במצב יבש, הוא החומר המעובד ביותר, בדומה למצב ברוק דה מרסל, ב-Cueva de El Esquileu מקרצפי קינה ודמי-קינה שימשו גם לפעילות חיתוך לעתים תכופות. כאשר משווים את האתרים האירופאים למערת קסם, נראה כי יש נקודות דמיון, אך גם הבדלים ראויים לציון. מידע זה תורם להבנה של תופעת הקינה בלבאנט ובמערב אירופה. מבחינה פונקציונלית, התוצאות שהושגו במהלך מחקר זה מדגישות את הקשר הישיר והחד בין מקרצפי קינה ובין עיבוד עורות, כפי שתועד בכל שלושת האתרים הנדונים כאן. עם זאת, ההבדלים בתפקיד הפונקציונלי של כלים אלה בין שלושת האתרים מדגיש את הגמישות הפונקציונלית המאפיינת את שיברור הקינה, דבר המסביר את התפוצה הרחבה של כלים אלה בלבאנט ובמערב אירופה החל מלפני 400,000 שנים, ועד 35,000 שנים לפני היום.

Tel-Aviv University
Faculty of Humanities
The Chaim Rosenberg School of Jewish Studies
Department of Archaeology and Ancient Near Eastern Cultures

תובנות ומשמעויות בנוגע לתופעת מקרצפי קינה בלבאנט ומעבר לו ניתוח סימני שימוש של מקרצפי קינה ממערת קסם, ישראל:

חיבור לשם קבלת תואר דוקטור לפילוסופיה

מאת: אנדראה זופנצ'יץ'

מנחים:
פרופ' אבי גופר
פרופ' רן ברקאי
פרופ' כריסטינה למוריני

הוגש לסנאט של אוניברסיטת תל-אביב

תשע"ט