THE PRODUCTION OF SMALL FLAKES IN THE MIDDLE PALEOLITHIC:

A NEW LOOK AT ASSEMBLAGE VARIABILITY

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A DISSERTATION

in

Anthropology

Presented to the Faculties of the University of Pennsylvania in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

2008

To my grandfather:

Arthur Schurmans: °1914 †1996

ACKNOWLEDGEMENTS

Now that my dissertation has seen the light of day, the pleasant task of thanking the many people that played major and minor roles in making this all happen lays before me. First and foremost, I want to thank Harold Dibble, my advisor. Harold's help has been invaluable in my continued education and transformation from student to colleague. Over the years he has spared neither time nor energy in guiding me and offering ideas based on the many lessons he learned throughout his distinguished career. With the completion of the document before you comes the official end to our student-advisor relationship. While we stopped treating each other as 'student' and 'professor' years ago, I have no doubt that I will continue to learn from his formidable analytical insights and unrelenting drive to improve archaeological methods and practice. Harold, thank you for all you have done over the years. I hope this dissertation provides a humble addition to our understanding of the Middle Paleolithic.

In addition to Harold's guidance, this document improved greatly through the efforts of my other two committee members: Deborah Olszewski and Theodore Schurr. Deb and I go back to the 2000 field season in Jordan's Wadi Hasa. Since that time, she and I have closely worked together on a number of projects. Her professionalism and unmatchable work ethic will continue to inspire. Deb was instrumental in improving the presentation of ideas in this dissertation and provided as careful and close-up a reading as one could possibly hope for. For this and all the good times, thank you. Tad's help also was much appreciated. Despite his busy schedule, he was always ready to listen carefully to my progress and offer advice wherever needed. Furthermore, Tad has been crucial in making the Anthropology department a more lively and engaging place. Rare were the times he did not make graduate colloquia and pushed us with pointed questions and suggestions for ways to improve an argument. He has been an example for us all, thank you.

Throughout my years as a graduate student I learned a lot from my interactions with Shannon McPherron. Shannon was instrumental in laying the intellectual groundwork for what became this dissertation, and he provided valuable assistance whenever I sought his advice. Furthermore, Shannon's leadership in the field is quite remarkable; I have sought to emulate several of his approaches to improve my own archaeological excavations. Gracias amigo.

This dissertation is based on the study of a number of archaeological collections in France, Morocco, and Kenya. Numerous individuals were instrumental in facilitating access to these collections and helped with the logistics of living and working in each of these places. I want to thank the director of the Musée National de Préhistoire in Les Eyzies, Jean-Jacques Cleyet-Merle, for granting me permission to study the Combe Capelle Bas collections. The study of these materials would have been impossible without the valuable assistance from Alain Turq, André Morala, Peggy Bonnet-Jacquement, Bernard Nicolas, and Chantal Fortin. Roland Nespoulet and Laurent Chiotti graciously allowed me to sleep in the rooms of the Musée de l'Abri Pataud. The necessary fun times were made possible with the help of Lucie Braem, Peter Hiscock, Alison Mercieca, Jean-Philippe Faive, Randall White, Hélène Talenton, and many others. Thank you all.

Work on the collections from Roc de Marsal and Pech de l'Azé IV would have been impossible without the help from the many people who meticulously excavated these sites and, subsequently, carefully curated the archeological materials. Thanks to Harold Dibble, Shannon McPherron, Alain Turq, and Dennis Sandgathe to allow me to study these awesome collections. The excellent curation of these materials is due in large part to the meticulous work by Teresa Raczek, Michael McLaughlin, and most recently by the collection manager extraordinaire: Beverly Schmidt. The quality of my stay in Carsac was significantly improved by the wonderful cooking and care of the family Delpeyrat. Thank you.

Permission to study the collections from Contrebandiers Cave were granted by Aomar Akerraz (directeur du Institut National des Sciences de l'Archéologie et du Patrimoine – INSAP), Abdellah Salih (directeur du Patrimoine), Samir Raoui (conservateur de Musée d'Archéologie, Rabat), and Mohammed El Hajraoui (INSAP). Furthermore, I want to thank Roland Nespoulet and André Debénath for introducing me to the wonderful world of Moroccan prehistory. Study of the Contrebandiers materials was made infinitely more fun with the help of Vera Aldeias, Harold Dibble, and Kaye Reed.

Access to the Muguruk material in Kenya was made possible through the permission from the Kenyan government, Sally McBrearty, and Purity Kiura (National Museums of Kenya). Also instrumental was the help of Christian Tryon in selecting this particular collection for study. Assistance during the study of the materials themselves was provided by the helpful personnel of the National Museum in Nairobi. Thanks to Paul, John, Kirwa, and Cecilia. Patrick Thure Oullu and Albert Otieno gave a great tour of the archaeological site near Kisumu. Special thanks go to Purity Kiura who provided a place to live during my time in Nairobi. She as well as Mary Prendergast, Manuel Dominguez-Rodrigo, Susy Cote, Sonia Harmand, Frieda, Susan Chepkemei, and Lars Juergensmann made my stay all the more enjoyable.

Back in Philadelphia, quiet space to write was provided by the 'Dissertation Boot Camp' held in the Graduate Student Center (thank you Linda Kyung-Nan Koh). Afterwards, Janet Monge, supportive and enthusiastic as always, provided a room to work in the University of Pennsylvania Museum. Assistance with the administrative side of working towards a Ph.D. was expertly provided by James Ashmore and Zoe Beckerman. Thanks.

Also thanks to my fellow grad students and friends at Penn for a wonderful time: Radu Iovita, Beverly Schmidt, Steve Schwortz, Michael McLaughlin, Vera Aldeias, Zeljko Rezek, Teresa Raczek, Alex Steenhuyse, Kristen Gardella, Omer Gokcumen, Matt Johnson, Noel Salazar, Olivia Given, Luke Fleming, Aubrey Baadsgaard, Ginny Ebert, Shawn Hyla, Rajeev Kuruvilla, and many others.

Finally, a special word of thanks is due to my family. My parents, Koen and Beatrijs, have stood by me during the many years of college and then graduate school. While they are still mystified by what it is that I do, they have supported me wholeheartedly all along. Thanks for always being yourselves. My best friend, Andi, deserves the most credit for this dissertation. She was the first to tackle the many weird sentences and unintelligible phraseology. With her keen eye toward text restructuring and with other editorial magic, she made the dissertation infinitely more readable. She also gave me the necessary time to put my thesis together by taking the brunt of Oni's care-taking on her shoulders. For this as well as all her love and support over the years, I am grateful beyond words. Oni, too, deserves some thanks for being the good sport that she is. When stress levels rose and things seemed impossible, Oni was always ready to provide comic relief and the necessary perspective. Oni, nen dikke merci!

ABSTRACT

THE PRODUCTION OF SMALL FLAKES IN THE MIDDLE PALEOLITHIC:

A NEW LOOK AT ASSEMBLAGE VARIABILITY

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The Late Pleistocene is pivotal in research on the origins of modern human behavior. In this period, anatomically modern humans are found in Africa and Neanderthals in Europe. Archaeologists have developed theories of human behavior based on the analysis of lithic artifact assemblages associated with these hominins, but few have in fact *compared* the lithic assemblages across these two regions. This dissertation does so by focusing on a specific aspect of lithic technology, the production of small flakes. According to traditional archaeological models, large tools, such as scrapers, are considered the products of intentional human behavior. Flakes—and small flakes, in particular—are usually seen as by-products or debris of the knapping process. This dissertation questions whether or not small flakes were deliberate end-products and attempts to correlate small flake production to other features of lithic assemblage variability, such as raw material utilization.

Typological, technological, and metric attributes from all stone tools, cores, and samples of complete flakes are studied from the Middle Paleolithic sites of Pech de l'Azé IV, Roc de Marsal, and Combe Capelle Bas in France, and the Middle Stone Age sites of Contrebandiers Cave in Morocco and Muguruk in Kenya. Comparisons of scar negatives on tools and cores reveal considerable overlap in their size distribution, platform preparation, scar location, and scar technology. In addition, the African and European sites share general reduction patterns, despite some differences in overall assemblage composition. The implications of these results are both theoretical and methodological. First, analysis of scar negatives suggests that small flakes were intentional. As reduction proceeded on a site, smaller and smaller pieces of raw material (including flakes) were selected for the manufacture of other flakes. Thus, several "tools" described in the Bordian typology are perhaps better interpreted as "cores" for the manufacture of often very small flakes. In lieu of Bordes' construct of "tool," archaeologists might consider scrapers alone or a composite construct, "toolcore," as introduced here. Second, there appears to be no difference in the Middle Paleolithic between how different hominins employed raw material for the manufacture of flakes and the occasional tools.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 2

CHAPTER 3

Chapter 1 INTRODUCTION

For over 150 years researchers have struggled to meaningfully categorize stone artifacts remaining from our deep past. Archaeologists have attempted to make sense of the variability and patterning of lithic forms and techniques in order to understand the behavior of our ancestors. Today there is a rich diversity of approaches to categorizing the thousands of knapped stones we find in the archaeological record. Along with the changing questions we have asked of the Paleolithic, this diversity has been created by two major problems: (1) there are no natural categories that can be applied to stone artifacts like “species” by and large can be to all things living; and, (2) technologies to create the stone artifacts as practiced in the deep past are no longer widely used and thus are completely foreign to the archaeologists trying to understand them.

Thus, methodological diversity in lithic analysis is unavoidable. However, some approaches are better than others, and the more comprehensive the approach the better. That is, ideally our approach to categorizing stone artifacts should be applicable regardless of assemblage variability and geographical location of a site.

By examining the production of small flakes in three sites from the Middle Paleolithic of Europe and two from the Middle Stone Age of Africa, this dissertation suggests such a comprehensive approach to making sense of variability in stone artifacts. The results of the study lead to the suggestion that typology (the study of retouched tools) and technology (the study of flake manufacture) should be merged into a single framework structured by the concept of reduction. Furthermore, from the perspective of reduction, there appears to be little difference in the overall factors underlying lithic assemblage variability in the Middle Paleolithic of Europe, where the makers of the artifacts are Neanderthals, and the Middle Stone Age of Africa, where stone tool makers are anatomically modern humans.

Organization

The dissertation is divided into five chapters. The first reviews the history of the study of assemblage variability and the interpretation of that variability. The introduction chapter also reviews our current knowledge of the production of small flakes and places this knowledge in the larger context of understanding lithic assemblage variability. The second chapter describes the materials and methods used. These include the five sites from which lithic assemblages were examined and a description of the variables and attribute states used in analyzing the material. The third chapter details the results of the analysis for each site. In particular, the general assemblage composition for each layer is described and the technological and metric attributes of flake scars as they appear on cores and tools compared to each other. The fourth chapter discusses the results obtained and places them in the larger context of understanding lithic assemblage variability. The concluding chapter summarizes the research and considers the implications for future work on assemblage variability.

A Note on Terminology: The Middle Paleolithic and the Middle Stone Age

Before examining assemblage variability in more detail, a brief description of the "Middle Paleolithic" (MP) and its relationship to the "Middle Stone Age" (MSA) is in order. The Middle Paleolithic is characterized by the rise of flake-based and prepared core technologies such as Levallois (White and Ashton 2003; Ronen 1982). This designation was originally used to differentiate MP industries from earlier industries dominated by core-tools and later ones characterized by abundant blade reduction technologies (Bar-Yosef 2000; Mellars 1996). We now know that these generalizations are oversimplified (Bar-Yosef 2001; Bar-Yosef and Kuhn 1999; Révillion and Tuffreau 1994; White and Ashton 2003). Nevertheless, there does seem to be long continuity to the industries from the MP and remarkably little variability overall (Klein 1999).

The MP was defined based on research in Europe. However, working independently, researchers in South Africa used their own terminology and identified roughly contemporaneous industries as belonging to the Middle Stone Age (Goodwin and Van Riet-Lowe 1929). Most scholars assumed the Middle Paleolithic and Middle Stone Age were synonymous and merely a historic artifact (Bar Yosef 2001). More recently, however, this assumption has been questioned based on the realization that industries in Europe are manufactured by Neanderthals and those in Africa made by anatomically modern humans. Since there is increasing evidence from genetic, physical anthropological, and archaeological research to suggest that Neanderthals and modern humans were different, there has been a push in certain research circles, particularly those working in Africa, to identify all industries in Africa as Middle Stone Age rather than Middle Paleolithic (Garcea 2004; McBrearty and Brooks 2000).

Others maintain that the two are essentially the same and continue to use the terms Middle Paleolithic and Middle Stone Age interchangeably. While I do not have a particular agenda in this debate, for the purpose of this work I use the term Middle Paleolithic to refer to all industries studied. This practice has been prevalent in North Africa where the use of the term Middle Stone Age is recent and not adopted by the majority of researchers. In any case, research directly comparing the African lithic material and the Eurasian lithic material is rare and until this work is done no meaningful decision can be made either way. By comparing industries from both regions, this dissertation makes a modest contribution to this debate. Based on this study, the similarities between the lithic industries from Europe and those from Africa are extensive, but there are also some differences. For now, however, the interchangeable use of Middle Paleolithic and Middle Stone Age remains justified.

Assemblage Variability

To better understand lithic assemblages this research draws on work in three areas. These are the categorization and interpretation of assemblages in the environmental and social context of the people making them, insights derived from ethnographic work, and the importance of taphonomy in structuring lithic assemblages. The interpretation of Paleolithic assemblage variability and the underlying human behavior is tied to the changing ideas about the categorization of lithics and the corresponding questions asked. The first questions driving researchers in the late 18th until the mid 19th century were the establishment of the human production and antiquity of stone artifacts (Boucher Crevecœur de Perthes 1847; de Mortillet 1869, 1883; Grayson 1983; Heizer 1962; Rodden 1981; Sackett 1981, 1991, 2000; Trigger 1989; Van Riper 1993; Frere 1800). That is, did a human make this, and, if so, when? Variability between assemblages at this stage was of no particular concern. Once researchers established the antiquity of stone artifacts, archaeologists attempted to further divide the artifacts into chronological periods after the model established by Thomsen (1836). The desire to establish chronological units, arguably, reflects the first paradigm in archaeology (Rodden 1981). In Paleolithic research, this paradigm led to the use of the so-called *fossiles directeurs*, that is, stone tools that were thought to represent certain prehistoric periods and archaeological cultures. For example, the handaxe was the artifact of the Acheulian (Lower Paleolithic), the sidescraper belonged in the Mousterian (Middle Paleolithic), and the polished axe typified the Neolithic (de Mortillet and de Mortillet

1881; de Mortillet 1883; Lubbock 1865). In the late 19th century, very specific artifacts, mostly retouched ones, were considered important, and the rest of an assemblage was viewed as waste and was often discarded. A striking example of this approach is the early excavations at Combe Capelle Bas by Ami. He recognized scrapers as meaningful and discarded other “tools” as irrelevant debris (Dibble and Lenoir 1995).

The late 19th century and the first half of the 20th century were characterized by the increased fine-tuning of chronological differences between archaeological assemblages. In France, Breuil, Peyrony, Capitan, and others aimed to further specify the chronological differentiation between Paleolithic and Neolithic assemblages (Breuil 1905, 1913, 1921, 1930, 1932; Breuil and Koslowski 1932; Capitan 1901; Peyrony 1930, 1934a, 1936). These researchers used increasingly careful excavation techniques and continued to focus primarily on the retouched tool component of lithic assemblages. The reasons for patterns in lithic industries, aside from their chronological implications, were not a primary consideration (Sackett 1981, 1991).

Around the middle of the 20th century in France, under the impetus of Bordes, standardized typologies were created, and statistical techniques developed to analyze lithic assemblages (Bordes 1950, 1961; Bosinski 1967; Brézillon 1968; Broglio and Laplace 1966; de Heinzelin de Braucourt 1962; de Sonneville-Bordes and Perrot 1953, 1954, 1955, 1956a, 1956b; Hours 1974; Laplace 1964, 1968; McCarthy et al. 1946; Tixier 1963). Standard typologies were constructed for various periods. The typologies were still dominated by retouched stone tools; only limited attention was paid to flake manufacturing techniques. For the Middle Paleolithic, the most influential typology was the one proposed by Bordes (1961). In his system, major classes of tools were ordered into scrapers, points, notches, and denticulates, while other tools were classified as handaxes, backed knives, stemmed points, bifacial foliates, and backed elements. The originality of Bordes' work consisted in bringing the various tools together in one typology and applying quantitative techniques to characterize assemblages.

Bordes considerably expanded the number of lithic artifacts that were considered meaningful in the interpretation of assemblages. The bulk of these artifacts were formally retouched tools defined as flakes that received secondary chipping or retouch. These retouched tools were interpreted as representing desired end products designed according to mental templates in the minds of their makers. Using his typology Bordes was able to differentiate a number of "facies," or types of Middle Paleolithic industries, in France (Bordes 1950, 1953, 1961; Bordes and Bourgon 1951; Bourgon 1957; Rolland 1981). These facies were identified based on a number of indices Bordes constructed to analyze lithic assemblages. The most important of these is the scraper index (IR) (Dibble 1988). The facies Bordes recognized include the Typical Mousterian, the Denticulate Mousterian, the Charentian Mousterian (subdivided into the Ferrassie and the Quina Mousterian), and the Mousterian of Acheulian tradition (MTA) (Bordes 1961). Bordes interpreted the facies as the material remains of cultural groups living contemporaneously in the Dordogne region of France (Bordes 1972; Bordes and de Sonneville-Bordes 1970).

While a considerable advance in the study of lithic assemblages, the Bordian typology instituted an uncomfortable marriage of retouched stone tools (typology) and unretouched flakes (technology). Some of the types in the Bordian typology, which contains 63 different tools, are retouched, while others are not. For example, the type list includes unretouched Levallois flakes (types 1 and 2) and Levallois points (type 3). To differentiate between retouched and unretouched tools, Bordes maintained two sets of indices, one that incorporates all 63 types (what he labeled the "real count") and another that excluded most unretouched tools ("essential count")(Débenath and Dibble 1994). The fundamental assumption that underlies all types is that each of them represents a desired end product and therefore allows archaeologists to separate these from the undesired waste produced during the manufacture process.

Following the classificatory period of the mid 20th century, French prehistoric research took a turn towards an ethnographic paradigm under the impetus of work by Leroi-Gourhan and his students. They paid increasing attention to the technological aspects in prehistoric research in general and assemblage variability in particular, and the movement known as *chaîne opératoire* began. Leroi-Gourhan was interested in ethnographic analysis and became well known in archaeology for among other things, his work in Pincevent (Audouze 2002; Leroi-Gourhan and Brezillon 1966). His interests lay squarely in the particulars of prehistoric life and the reconstruction of prehistoric activities.

Today, *chaîne opératoire* analysis focuses on the sequence of events from raw material selection through core reduction to the manufacture of specific retouched tools. A heavy emphasis is placed on experimentation, spatial analysis, refitting, raw material variability and selection, and the techniques and technology of stone tool knapping (Audouze 1999, 2002; Audouze and Leroi-Gourhan 1981 ; Bodu et al. 1990; Boëda 1986, 1988, 1993, 1994, 1995; Geneste 1985; Geneste et al. 1990; Inizan et al. 1995; Karlin et al. 1991; Karlin and Newcomer 1982; Sellet 1993; Tixier et al. 1980). Although the emphasis in stone tool analysis has shifted considerably towards the fluid nature of the knapping process, there still remains a teleological aspect to the technological schemas proposed by proponets of a *chaîne opératoire* approach. Indeed, stone tool types still are assumed to reflect desired end products of prehistoric flintknappers. This assumption is potentially problematic because, if the end product is incorrectly identified, the entire schema loses its footing. Despite this emphasis on end products, archaeologists who adopted a *chaîne opératoire* approach paid much more attention to unretouched debitage (particularly when these pieces aid the reconstruction of tool production). As a result, *chaîne opératoire* contributed significantly to our understanding of prehistoric technologies.

While the particulars and scope of lithic analysis in France have changed considerably, the interpretation of variability has remained remarkably stable. Various Mousterian facies (now largely characterized by the combination of technology and typology) are still interpreted as some sort of tradition associated with particular prehistoric populations (Clark 1993, 1997). The uncomfortable marriage between technology and typology remains with the difference that technology became, in essence, the new typology. Particulars of the technological production sequence determine the *chaîne,* and each prehistoric population is identified by a specific *chaîne opératoire*.

In North America, as in Europe, early 20th century studies were characterized by an emphasis on determining chronology and the development of typologies. In the second half of the 20th century in North America, this paradigm was labeled "culture history" by those proposing a new paradigm: processual archaeology (Binford and Sabloff 1982; Binford 1962, 1965). One of the main proponents of processual archaeology, Binford, conducted prehistoric research in the Old World. In his analysis of the stone tools from the Levantine and French Mousterian, Binford (Binford and Binford 1966) proposed an alternative explanation for assemblage variability to that favored by Bordes. He suggested that variability in Middle Paleolithic assemblages represent different functional toolkits and not distinct cultural traditions. This difference of opinion led to the well-known Bordes-Binford debate that dominated Paleolithic research in the 1970s and beyond. For Binford, as for researchers favoring a *chaîne opératoire* approach, chronology was not the main goal. On the contrary, the goal was to understand the behavior and adaptations of prehistoric humans. In this regard, both Leroi-Gourhan and Binford thought that ethnographic work was extremely important. However, neither simply believed that living hunter-gatherers are somehow live examples of prehistoric people (Bernot 1986; Binford 1967). Binford's work did not question the reality of the tools in the Bordian typology itself. Rather, he offered an alternative interpretation to explain the patterning that this typology exposed.

Yet another interpretation of assemblage variability was proposed by Mellars starting in the mid 1960s (1965, 1969). Mellars suggested that some of the Mousterian facies form a time-sequence. For example, the MTA is always late in the Mousterian, and Quina assemblages follow Ferrassie ones when these two occur together in a stratigraphic sequence. However, the chronology and correlation of the various stratigraphic sequences were unclear or simply contradicted this hypothesis (Laville 1973; Laville et al. 1980; Rolland 1981). Like Binford, Mellars offers a different interpretation of MP variability. However, he also did not question the importance and perceived reality of retouched tools as Bordes had defined them.

This situation changed in the late 1980s when the work of two North American scholars, Rolland and Dibble, led to a new synthesis of MP variability (Dibble and Rolland 1992; Rolland and Dibble 1990). Rolland included non-retouched artifacts in his analysis and showed that these artifacts co-varied with the retouched tool component (Rolland

1977, 1981, 1988). This finding led him to propose that differences between industries were the result of the intensity of raw material utilization. Assemblage variations therefore should be viewed as a continuum, not as discrete entities. Differences in the intensity of raw material use, in turn, were correlated with climate and raw material availability, as well as aspects of Paleolithic hunter-gatherer groups, such as mobility, seasonality, and group organization. This type of research fits perfectly in the processual archaeology favored by Binford and other North American scholars. The interpretation of variability is sought in various aspects of hunter-gatherer adaptations that can be best understood in their proper environmental context (Binford 2001).

Dibble (1984a, 1987, 1988, 1995a) added to Rolland's alternative view by demonstrating that increasing tool reduction had a significant impact on the typological structure of an assemblage. Tool reduction particularly affected scrapers, which are of prime importance in distinguishing between the different Mousterian assemblage groups. By adding unretouched blanks to standard archeological analysis, the work of Rolland and Dibble increased the scope and understanding of variability in the MP. Furthermore, it suggested that the Mousterian facies and many of the tool types form part of a continuum and reflect, among other variables, the availability of raw material and the intensity of raw material utilization (Dibble 1995a, 1995b; Dibble and Rolland 1992; Rolland and Dibble 1990).

In addition to changing ideas about the interpretation of Middle Paleolithic assemblages, similar changes in interpretation impacted lithic research in general. In North America, Frison (1968) was able to show the extensive reuse of artifacts using refits, leading Jelinek (1976) to coin the term, the "Frison effect." The fluid nature of artifact use and reuse were incorporated into arguments made by Kelly (1988) and Goodyear (1979) on the use of bifacial technology. Similar arguments also were made for the earliest Paleolithic periods in Africa. Potts (1991) and Toth (1985; 1987; Toth and Schick 1986) argued that the tools Leakey (1971) recognized could be considered cores in various stages of reduction rather than "finished" tools. Another example of such a reinterpretation is the now widely held view that carinated scrapers and burins, Upper Paleolithic types, also can be viewed as cores for the manufacture of bladelets (Olszewski 2007; Belfer-Cohen and Grosman 2007; Chiotti 2003; Almeida 2001)

Based on these studies of the Paleolithic assemblages themselves, it is clear that there are good reasons to study lithic assemblages from a broad perspective and include both stone tools and unretouched flakes in the analysis. It is quite likely in fact that unretouched flakes form a significant portion of what were functionally tools. Evidence that such a comprehensive approach is necessary also comes from the ethnographic study of the few remaining stone using peoples. For example, working with the Gamos'[1] in Ethiopia, Gallaghar documented the use of unretouched obsidian flakes for shaving

[1] Gallagher identifies these people as the "Galla," but more recently these same people are identified as the "Gamos" (Weedman 2002)

(Gallagher 1977). More recently, the study of the Gamos' use of lithic artifacts indicates that informal tools, "tutuma," start their use-life as unretouched flakes (Weedman 2002).

Documentation of the use of unretouched flakes also comes from stone using peoples of Australia (Allchin 1957; Love 1942; Horn and Aiston 1924). The Wardaman, for example, use unretouched flakes as knives (Davidson 1935), and in the Western Desert, Gould reports a similar use of flakes which are retouched "only if the cutting edge needs it" (Gould 1971: 149; see also Gould 1978). The report on the use of stone from New Guinea (White 1967; 1968) is even more striking. White makes two telling points about the assemblages he studied. First, retouch is correlated with areas where raw material is scarce, not with any desire to shape the artifact according to a mental template. Second, in one particular industry "the working edges of these tools are never retouched, and the only secondary retouch in this industry comes from using the tool as a core" (White 1967: 409). The implications of such fluid use of stone resources for the interpretation of lithic assemblage variability are dramatic. These ethnographic insights reinforce the idea that a broad analysis of stone artifacts is necessary and highlights the inability to effectively separate desired artifacts from waste. Unfortunately these insights came at a time when the field perhaps was not ready to explore and/or embrace them. For this reason they may have been largely forgotten in some circles or merely paid lip service to in others.

Together the archaeological and ethnographic scholarship on lithic assemblage variability suggests continuity in reduction among retouched tools, the co-variation of the retouched and unretouched components of assemblages, the re-evaluation of tools in certain contexts as cores, and the realization that unretouched flakes often are used. In addition, significant strides have been made in the understanding of taphonomy and its role in contributing to assemblage variability. Taphonomy can be defined as what happens to artifacts from the moment they enter the archaeological record until archaeologists excavate them. Archaeologists want to interpret patterns observed in the archaeological record that are determined by human behavior, not those resulting from post depositional processes. However, assemblages can be significantly disturbed or even created by post depositional processes (Dibble et al 1997; McBrearty et al 1998; Nielsen 1991; Dibble et al 2006). For example, studies have shown that post depositional processes such as trampling can create artifacts that resemble retouched stone tools (Nielsen 1991; McBrearty et al 1998; Débenath and Dibble 1994). One type of tool that is known to be correlated with artifact damage are flakes with abrupt and alternating retouch (type 46-49). Notches also can suffer from false positives (i.e., they look like tools, but they are due to damage) (McBrearty et al 1998; Verjux 1988; Nielsen 1991).

The research presented here builds on the ethnographic evidence as well as the work on Middle Paleolithic industries that show continuity among classes of retouched tools and co-variation between the retouched and unretouched components of industries. Specifically, one aspect of lithic assemblage variability — small flake production — is examined.

Small Flake Production

Recently, small flake production has received increasing attention in different research traditions (e.g., Bourguignon et al 2004; contributions in Burdukiewicz and Ronen 2003; Henry 2003; McPherron and Dibble 1999; Dibble and McPherron 2006, 2007; Tixier and Turq 1999; Goren-Inbar 1988; contributions in McPherron 2007). However, as discussed below, small flake production has been largely ignored in broader descriptions and resulting interpretations of MP variability. Given that lithic assemblages are one of the few classes of evidence available to attempt to understand hominin behavior, it is striking that a significant portion of that variability may have been overlooked.

That there are small flakes in MP assemblages is not a surprise. In fact, it is well known that any reduction strategy will generate a lot of small flakes (Whittaker 1994). However, small flakes tend not to be retouched and as such have traditionally been regarded as waste produced during the manufacture of larger "desired" flakes. In the traditional view these larger flakes are destined for the manufacture of formally retouched tools. In addition, modern analytical procedures in lithic studies, particularly for Middle Paleolithic assemblages, employ a size cutoff that effectively excludes smaller flakes from the analysis (Villa et al 2005; Dibble and Lenoir 1995; Henry 2003). However, the interpretation that these flakes are all by-products, and thus not tools themselves, can be questioned for a number of reasons.

First, in a number of industries, small flakes seem to be the norm or at least a significant portion of the assemblage. Often these sites are thought to have small flakes because there are no larger raw material nodules available. Therefore the unique characteristics of these assemblages are not considered important and, as a result, these industries have not had a significant impact on the characterization of assemblage variability in the MP. Examples include the Micro-Mousterian of Yabrud shelter I (Rust 1950; Bordes 1984), the Erd Mousterian (Gabori-Csank 1968), the Taubachian (Valoch 1988, 2003; Moncel 2003), the Pontinian (Kuhn 1995), and the Zagros Mousterian (Dibble 1984b; Dibble and Holdaway 1993, 1990).

Second, there are a number of industries that contain very small Levallois cores, which, again, are often considered to be related to the small size of raw material (Antoine 1950; Debénath et al 1986; McPherron and Dibble 1999; Dibble and McPherron 2006, 2007). That the purpose of these cores was the production of small flakes seems unquestioned — yet unemphasized. Assemblages of this type include the Asinipodian recognized by Bordes (1975; McPherron and Dibble 1999) at Pech de l'Azé IV (Pech IV) in France and Aterian assemblages in North Africa (Ruhlmann 1951; Debénath 1992; Wengler 1997; Bouzouggar et al 2002). One of the early authorities on the Aterian, Antoine, even regarded these pieces (he called them pollicidisques) a hallmark of

Aterian industries (Antoine 1950). Later, these pieces were dropped from the definition of the Aterian (Debénath 1992, 1994; Tixier 1967).

Third, in the Near East, truncated-faceted (T-F) pieces (also known as the Nahr Ibrahim Technique — Schroeder 1969; Solecki and Solecki 1970) have been considered cores for the production of small flakes. A T-F piece is an artifact with a truncation and subsequent removals departing from the truncation on the opposite edge (faceting). Studies of T-F pieces and related artifacts led a number of researchers to suggest that they could be cores for the manufacture of small flakes (Nishiaki 1985, Solecki and Solecki 1970; Dibble and McPherron 2006; Dibble 1984b; Goren-Inbar 1988, 1990; Henry 2003). However, the establishment of their function as cores is not entirely unproblematic (Crew 1975; Dibble 1984b; Nishiaki 1985; Solecki and Solecki 1970), as is also the case for similar pieces in Africa interpreted as tools (see Leakey 1931).

Fourth, in Africa, a different technique, Kombewa, was identified in Kenya (Owen 1938). This technique also can be interpreted as generating small flakes (McPherron and Dibble 1999; Dibble and McPherron 2006, 2007; Debénath and Dibble 1994; Tixier et al 1980; Inizan et al 1995). As Kombewa, or Janus, flakes are sometimes considered a by-product of flintknapping, the occasional Kombewa flake occurs in many assemblages (Newcomer and Hivernel-Guerre 1974; Inizan et al 1995; Tixier and Turq 1999; Bourguignon et al 2004). Bordes noticed that Kombewa flakes are common in layer J3, the Asinipodian, at the site of Pech IV. Dibble and McPherron (1999), who re-excavated Pech IV, analyzed the presence of Kombewa and came to the conclusion that these artifacts co-occur with small cores and T-F pieces throughout the sequence. This finding led them to conclude that Kombewa at Pech IV was intended for the production of small flakes and that this production forms an important and overlooked part of MP variability (Dibble and McPherron 2006, 2007).

The research presented here adds to current work by Dibble and McPherron (2006, 2007; McPherron and Dibble 1999) by investigating whether categories of tools other than small cores, truncated-faceted pieces, and Kombewa also should be interpreted as producers of small flakes. Furthermore, the research assesses whether small flakes should be viewed as the continuation of reduction, or as a separate functional class. As such, the research fits in the North American perspective on assemblage variability. From the historical overview presented above and a review of the evidence for small flakes, it is clear that there has been a tendency to consider ever larger sets, including retouched and unretouched flakes, of lithic artifacts as exhibiting meaningful patterns for the archaeologist to interpret. This dissertation fits into this tendency as it proposes that some of the flakes traditionally not examined in standard analyses should be. Perhaps a second tendency in the study of stone artifacts is to consider increasingly “fundamental” factors as structuring assemblage variability. In some ways many early interpretations relied on cultural explanations, whereas, factors beyond human control such as raw material availability, taphonomy, and climate now are considered important in structuring lithic assemblage variability and by proxy the behaviors that led to these stone implements. Again this dissertation mirrors this tendency.

Small flakes intended for use cannot be distinguished from the remainder of the knapping debris found at archaeological sites (exceptions to this rule might be small Levallois flakes [Rust 1950; Bordes 1975] and Kombewa flakes discussed above). Therefore, it is more practical to focus on cores from which small flakes have been detached. Other artifact types suspected of playing a role in small flake production include "cores on flakes," kostienki knives, scrapers with thinning of kostienki type, Clactonian notches, "Clactonian denticulates," splintered pieces (pièces esquillées), scrapers with thinned back, flakes with irregular retouch on the interior, bifacially retouched pieces, rabots, hachoirs, and Mousterian discs.

Cores on flakes are a category discussed by Goren-Inbar (1988), and include T-F pieces and other tools (like flakes with interior retouch) that are lumped together in a larger category. While T-F pieces are regarded as tools typologically (Debénath and Dibble 1994), when categorized as cores on flakes, they are not. In essence, T-F and cores-on-flakes refer to the same phenomenon of small removals from flakes and, therefore, lumping these categories makes logical sense.

A Clactonian notch is a notch formed by a single removal (Bordes 1961; Debénath and Dibble 1994), whereas two or more continuous notches form a denticulate. The notches can be on the interior or exterior of the flake. As Debénath and Dibble (1994) point out, Bordes made very few distinctions among the notches and denticulates. In his analysis of the site of Tor Faraj, Henry (2003) decided not to use Clactonian notches as a "true type." Whether this was motivated by a belief that these artifacts are cores is not clear. However, it is conceivable that the "notch flakes" (i.e., the flakes removed when producing the notch) were usable and, thus, what are often considered as tools — Clactonian notches/denticulates — might be more accurately viewed as cores (Bourguignon et al. 2004). However, given the large variability in the class and the extensive range of possible causes for the creation of notches and denticulates, including natural causes (see Bordes 1961; Debénath and Dibble 1994; McBrearty et al 1998), it is unlikely that a single explanation accounts for all of these types.

Kostienki knives are a particular case of T-F (Debénath and Dibble 1994). This type was defined in Europe, specifically for the Gravettian site of Kostienki in Russia (Otte 1980). They consist of blades with one or two inverse truncation(s) on the proximal and/or distal end. Using the truncation as the striking platform, secondary bladelets are removed from the exterior of the flake. Semenov (1964) considers the lateral portion of the tool the active part. Although present in the Gravettian of Central Europe, Kostienki knives also occur in other industries such as the Aurignacian and the Magdalenian (Otte 1980). This study will regard the Kostienki knife as a special case of T-F and class such artifacts under T-F, as this particular type seems very rare in the MP.

Scrapers with thinning of Kostienki type or "racloirs à amincissement de type Kostienki" were recognized and described for the site of La Pane, Dordogne (Turq and Marcillaud 1976). They consist of single or double scrapers where the proximal and/or distal ends have been inversely truncated. From this prepared surface, secondary flakes are removed. This type, like Kostienki knives, is another special case of T-F. It is interesting to note that the type-site, La Pane, has numerous scrapers with thinned backs, as well (Turq and Marcillaud 1976), suggesting a possible correlation between the presence of scrapers with thinning of Kostienki type and scrapers with thinned back.

Scrapers with thinned back ("racloir a dos aminci") (Bordes 1961) are scrapers whose opposite lateral side has been irregularly retouched, often on the interior surface, sometimes by bifacial retouch. However, this "thinning" is too irregular to be considered a second scraper edge. Transverse scrapers with this type of "thinning" occur in the Quina Mousterian of southwest France (personal observation) and should be classified as transverse scrapers (Debénath and Dibble 1994). This study will classify them as scrapers with thinned back. The thinning has been interpreted as a hafting modification (Mellars 1996), but perhaps it is unrelated to the scraper edge. This alternative interpretation might help explain the rare character of the type as reported by Bordes (1961).

Flakes with irregular retouch on the interior have restricted amounts of discontinuous and irregular retouch on the interior surface (Debénath and Dibble 1994: 112). The type of retouch is no different from that occurring on scrapers with thinned back, except that the opposite edge is not a scraper. They differ from T-F pieces in that there is no truncation. Finally, the retouch is too irregular for the artifact to be considered a scraper on the interior. Again this type could be reinterpreted as a core rather than a separate desired tool class.

Bifaces and cleavers are relatively rare in most MP assemblages. They include bifacial foliates in Africa (Van Peer 1998; McBrearty and Brooks 2000; Wendorf and Schild 1992), small handaxes in the Mousterian of Acheulian Tradition (MTA) (Soressi 2002), and bifacial artifacts in the Micoquian (Bosinski 1967). Because handaxes are not present in the assemblages to be examined, these types will not be explicitly treated here. However, it has been suggested in the North American literature that some bifaces were probably cores first and bifaces only secondarily (Goodyear 1979; Kelly 1985, 1988)

Pebble tools also have been interpreted as cores (Debénath and Dibble 1994). Pebble tools usually do not form a significant portion of MP industries except in certain areas poor in raw material availability and quality. For example, in the Aterian of the Atlantic coast pebble tools are so numerous that Debénath (1992) suggested adding their presence to the definition of Aterian industries.

Pièces esquillées (splintered pieces) are widely used as a category in the European Upper Paleolithic (Demars and Laurent 1989), North America (Shott 1999; Odell 2000), Sub-Saharan Africa (particularly the LSA) (Villa et al 2005), and North Africa (Tixier 1963). Demars and Laurent (1989: 94) define these pieces as “pieces often of rectangular shape showing thin, chisel-like edges with crushing and splintering at opposite ends” (translated in Villa et al 2005: 413). Several authors have commented on the violent aspect of the percussion (de Sonneville-Bordes and Perrot 1956b; Tixier 1963). There has been some ambiguity between bipolar cores, on the one hand, and pièces esquillées on the other, as reported by Hayden (1980; see also Shott 1999; Odell 2000; Villa et al 2005). Some authors view these pieces as tools, and others as cores. Based on illustrations (Hayden 1980; Tixier 1963; Demars and Laurent 1989), some of these might be classified as T-F pieces. It is clear that pieces esquillées exist in the MP and the Middle Stone Age (Villa et al 2005), but, as a class, they were more important in later times (Tixier 1963; Hayden 1980; Demars and Laurent 1989). Most authors agree that the flakes removed from these pieces are too small for use (Tixier 1963). In this sense, they are reminiscent of comments that were made in relation to T-F pieces (see Crew 1975).

Other types that are closely related to types already mentioned are bifacially retouched pieces, rabots, hachoirs, and Mousterian discs. The last should be regarded as exhausted centripetal cores (Debénath and Dibble 1994), which, in turn, are probably part of the larger Levallois or single surface core reduction system (Sandgathe 2005).

The point is that there are many elements in Middle Paleolithic assemblages which may have been used to produce small flakes. Some of these elements are traditionally viewed as cores, others as tools. This dissertation investigates if these elements can be interpreted as cores for the production of flakes and if so, what the implications are for our understanding of MP assemblage variability. Based on an investigation of five sites and a total of eleven separate layers within the sites, the research suggests tools — except scrapers — by and large should be viewed as cores for the manufacture of flakes. The implications for our understanding of Middle Paleolithic assemblage variability are wide-ranging and include a reconsideration of several of the indices that helped distinguish Mousterian facies, as well as a renewed, but considerably altered, marriage between typology and technology structured by the concept of reduction.

Chapter 2 Materials and Methods

Assemblages from a total of five sites are examined as part of this study. These include three sites from the Dordogne region of southwestern France and two African sites, one from the Atlantic coast of Morocco and one near Lake Nyanza (Lake Victoria) in Western Kenya. In this chapter each of the sites is introduced and our current knowledge summarized. In addition, the methodology used in the collection of data is described, as well as the attribute states of each of the variables. The precise description of the methods of data acquisition is important because there are many different ways to record data, and these differences could have a significant impact on the results. For example, flake length can be measured along the axis of flaking, along the longest axis, or any other number of ways. Before considering each of the artifact variables recorded, we turn our attention to the sites from which the artifacts studied here are derived.

Site Selection

The five sites examined in this study are Roc de Marsal, Combe Capelle, and Pech de l'Azé IV in France (

Figure 2.1), Contrebandiers Cave (grotte des Contrebandiers or Smugglers' Cave) in Morocco, and Muguruk in Kenya (Figure 2.2). The sites were chosen to sample both a broad geographic area and to examine in more detail one specific area. Sites from two different continents were selected to determine whether the production of small flakes, presumably made by a different species or at least very distinct sets of populations, occurred in each region. Furthermore, given the likely chronological differences between each of these sites, there is a very broad temporal sampling as well. A set of diverse assemblages, like the ones chosen, also will allow examination of whether processes that help to shape each of these assemblages are similar or different from one another. As a whole, such processes might speak to a certain unity or lack thereof in MP assemblage variability and therefore hominin behavior. The extensive sampling in the southwest of France was done specifically to examine in detail the suspected driving force behind small flake production, namely relative raw material availability.

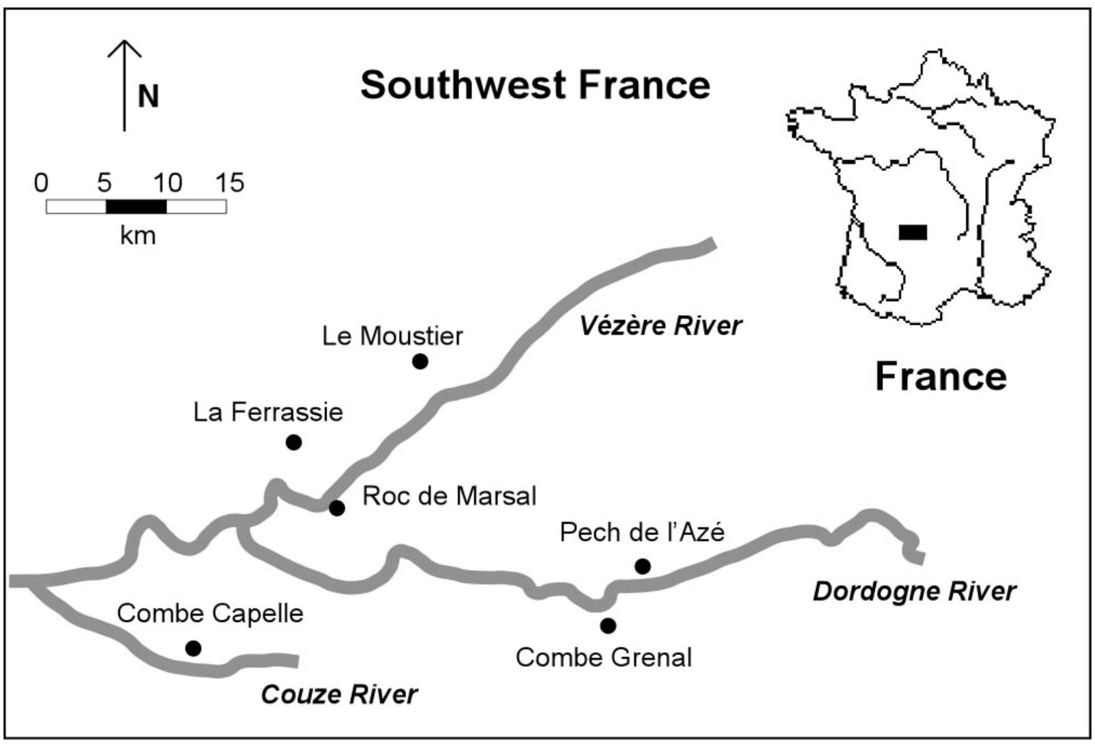


Figure 2.1: Map with important sites in SW France including the three sites studied: Combe Capelle Bas, Pech de l'Azé, and Roc de Marsal.

Figure 2.2: Map with the locations of the three study areas

French sites

The interest of Pech IV for this study comes primarily from the presence of the Asinipodian in the sequence. The Asinipodian industry stands out because it is dominated by the production of small flakes and suggestions have been made this layer does not fit standard models of assemblage variability. Furthermore, the site also allows a comparison with the assemblages from layers with a high incidence of small flake producing technologies to layers where there are few such small flake producing technologies. Such a comparison might provide some insight into the reasons behind the relative frequency of these technologies. Two other sites from Southwest France, Combe Capelle and Roc de Marsal, are included in this study for similar reasons. Combe Capelle is located on a source of stone used in the manufacture of stone tools and, as such, is a perfect case to test the hypothesis that raw material ubiquity is the determining factor for the presence or absence of small flake producing technologies. If sufficiently large raw material blocks are readily available, there is no reason to extensively reduce the assemblage. If, on the other hand, small flake producing technologies exist to fulfill a specific function, then these technologies will vary independent of the presence of raw material at or very near the prehistoric site. Because raw material is readily available at Combe Capelle a low blank to core ratio and many unretouched relative to retouched artifacts (a high flake to tool ratio) are expected.

Roc de Marsal, together with Pech IV, is to some extent the other end of the raw material presence continuum. Raw material is, as elsewhere in the Dordogne region, present close to the site, but the package size is small relative to the material found at Combe Capelle and, in many cases, smaller than the flakes, tools, and cores found at the site itself. Therefore, it would be expected that if raw material is the determining factor, than at Roc de Marsal the presence of small flake producing technologies would be much higher. Together with Pech IV, Combe Capelle Bas and Roc de Marsal should provide ample evidence to closely examine how small flake production varies within one region and how it contributes to lithic assemblage variability in general.

Pech de l'Azé IV

The sites of Pech de l'Azé are located in Carsac along the road to Sarlat (see Figure 2.3). There are four different sites with the name. All of the sites have been extensively excavated over the years. Pech de l'Azé I, a spacious cave site was first discovered and extensively excavated in the 19th century. Original excavations were carried out by Jouannet, then by Abbé Audierne, and findings from the cave were described in the famous *Cavernes du Périgord* volume written by Lartet and Christy (1864). This volume effectively made the Perigord region of southwest France the epicenter of Paleolithic research, a distinction it arguably still carries today. In the 20th century, further excavations at Pech I by Peyrony led to the discovery of the cranium of a Neanderthal child (Capitan and Peyrony 1909). These excavations, together with the extensive episodes of looting at the site, ensured that no sediment remains in the cave. The area in front of the cave at Pech de l'Azé I also saw extensive excavations including work by Vaufrey, Bordes, and Soressi (Vaufrey 1933; Bordes 1954; Bordes and Bourgon 1950, 1951; McPherron and Soressi 2001; Soressi et al. 2002).

Bordes discovered all three remaining sites with the Pech de l'Azé designation — the first, Pech II, in 1948 during the construction of the railroad; Pech III some 30 meters west from Pech II; and finally Pech IV in 1952 along the then access road to the other three sites. A friend of Bordes and amateur archaeologist, Mortureux, initially excavated Pech IV. When large blocks impeded further progress in the trench he opened, the work was suspended until Bordes himself relaunched the excavations in 1970. Excavations by Bordes continued until 1977 with a total of 52 square meter units and a total of 115m^3 of sediment excavated.

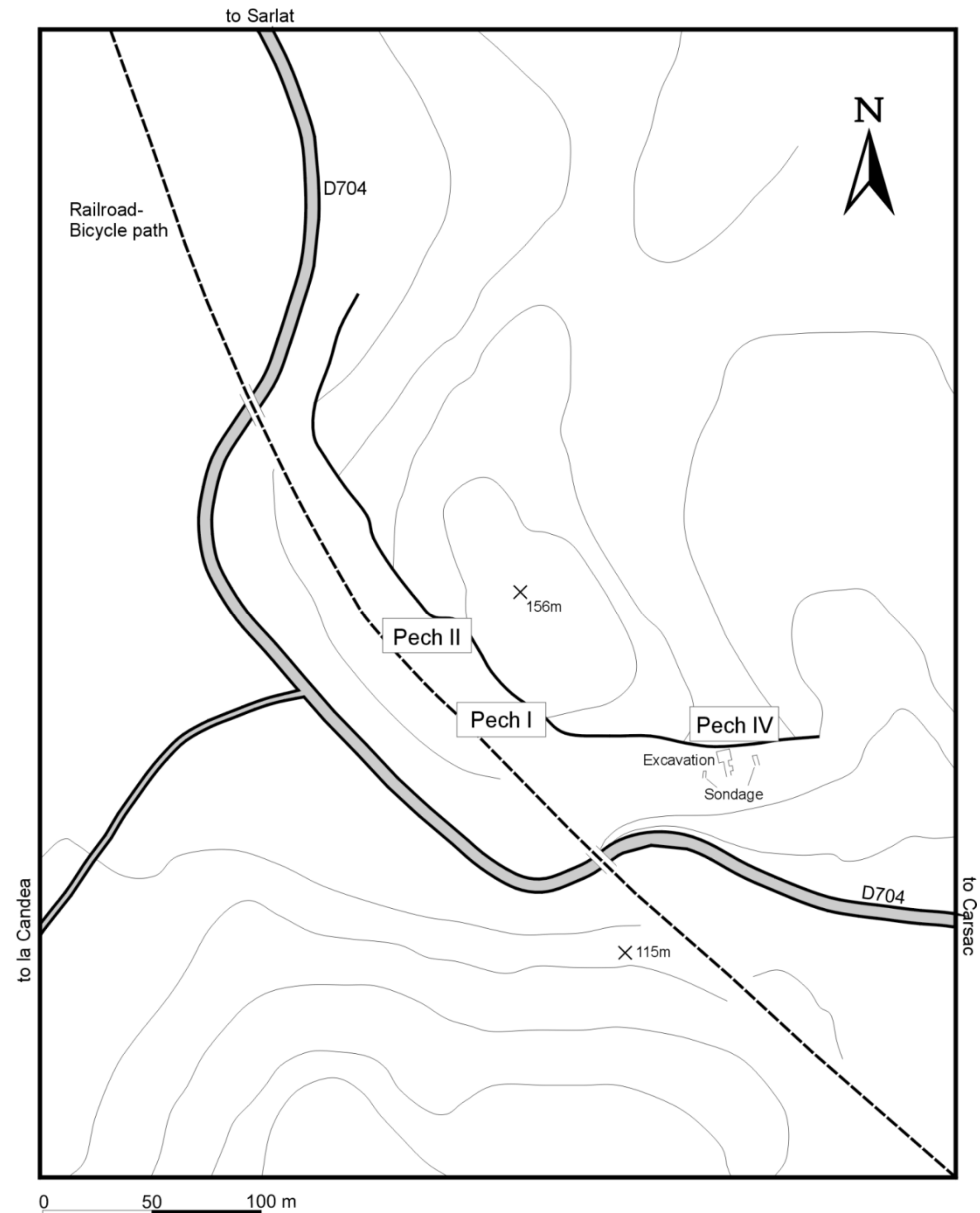


Figure 2.3: Map of the four Pech de l'Azé sites

Recently, McPherron and Dibble (1999) studied the unpublished assemblages from the Bordes' excavations and further excavated the site (Figure 2.4). Pech IV has a rich sequence, which includes Mousterian of Acheulian tradition, Typical Mousterian, and Asinipodian (Bordes 1975, 1981). The Asinipodian industry is of particular interest here. Small Levallois cores and Levallois flakes, numerous truncated faceted pieces, and many Kombewa flakes and cores characterize the Asinipodian. The layer also has numerous denticulates and notches and a fair amount of mostly single sidescrapers.[2] In addition to the Asinipodian from McPherron and Dibble's layer 6A, two other layers are examined in this study. These are layer 8 at the bottom of the sequence at Pech IV and layer 4C towards the top of the stratigraphy (Figure 2.5). Layer 4C corresponds more or less to layer I2 of Bordes, layer 6A to layers J3a-c, and layer 8 to layers X, Y, and Z.

[2] Due to this unusual set of characteristics, Bordes gave the industry a new name. In fact, it is in part this industry that recently led some researchers working in France to posit the production of small flakes as desired products in the Middle Paleolithic (Dibble and McPherron 2006; Bourguignon et al. 2004).

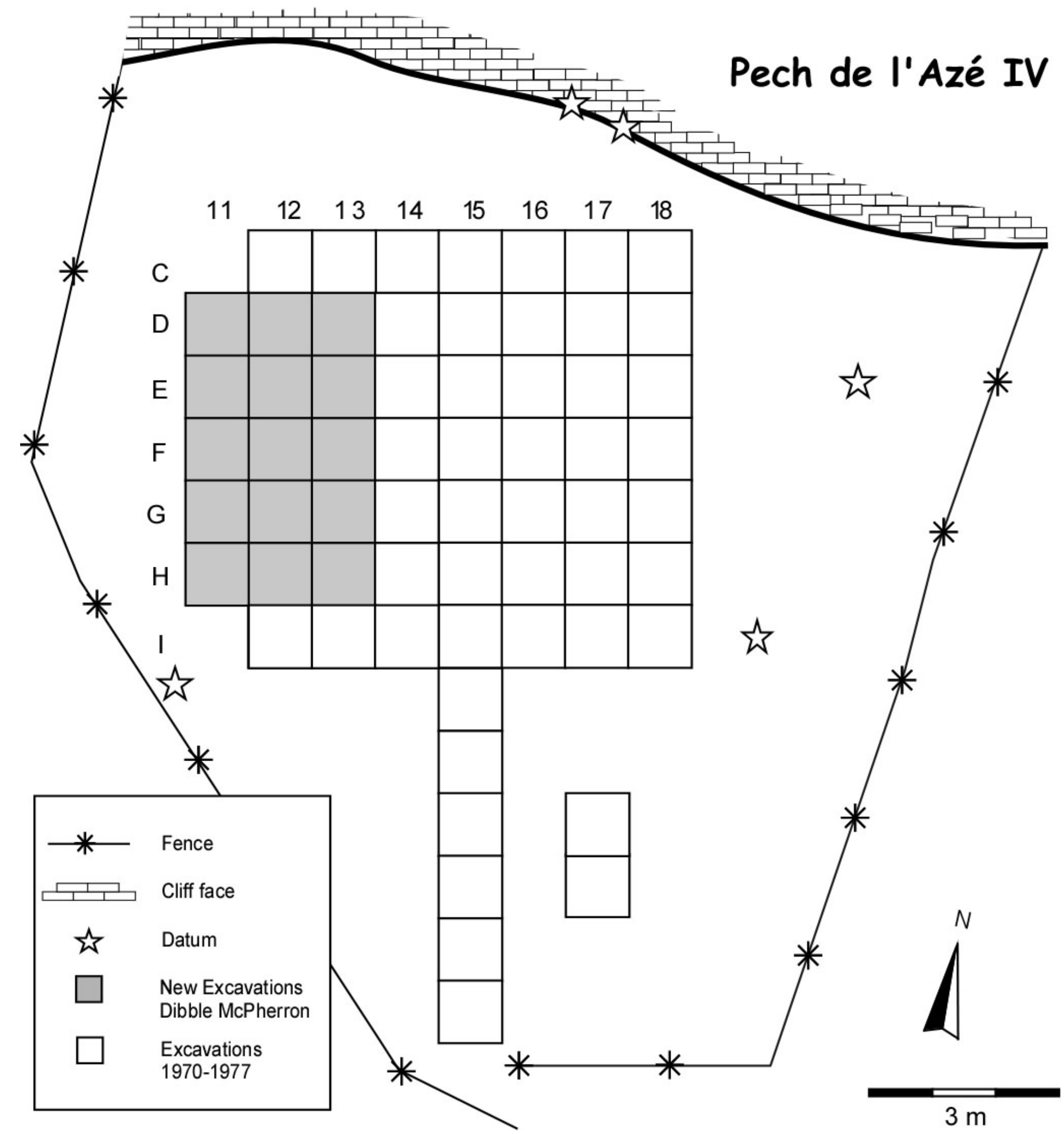


Figure 2.4: Pech de l'Azé IV excavation grid and location of the Dibble McPherron excavations

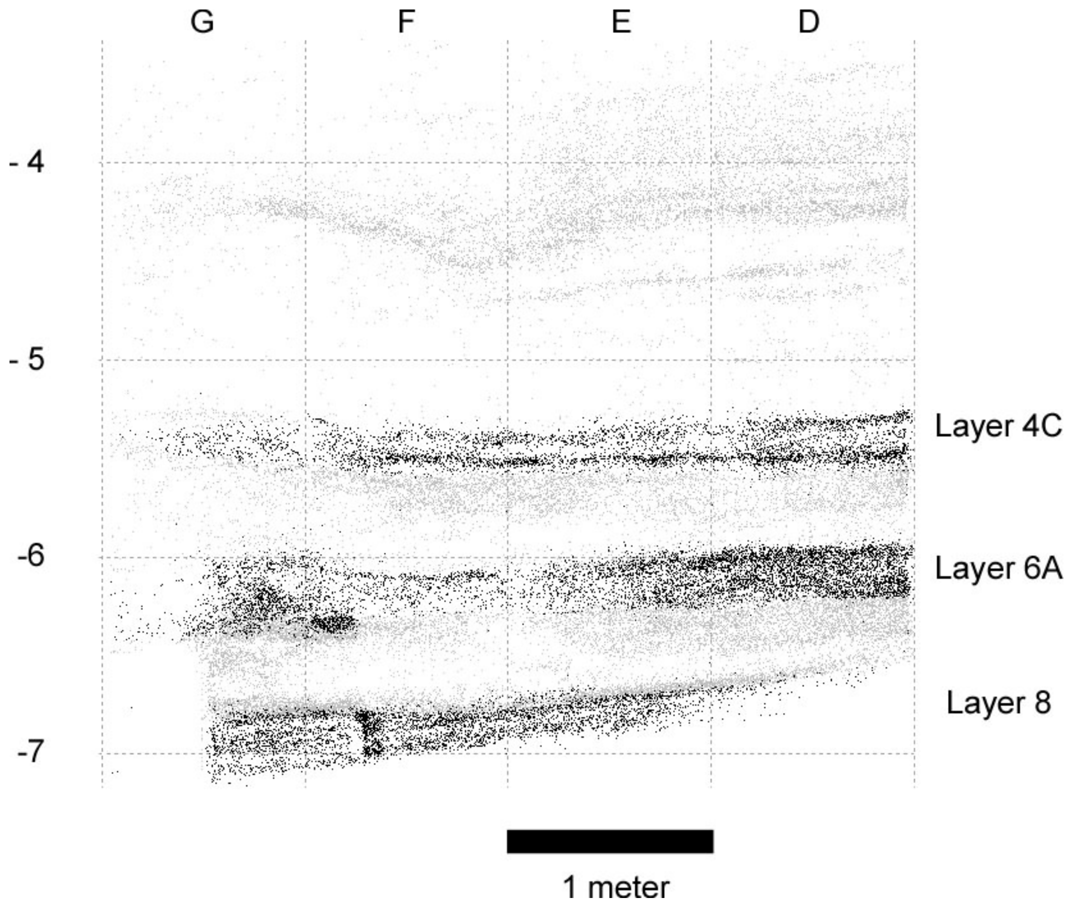


Figure 2.5: Pech de l'Azé IV stratigraphy with the three layers studied here highlighted

Layer 4C has been described as the esthetically most beautiful assemblage from Pech IV (see the description of layer I2 in Bordes 1975). The assemblage is characterized by the highest relative number of scrapers in any of the assemblages at Pech IV. Among the scrapers there are numerous transverse and convergent scrapers. Tool size is the largest, and the use of the Levallois flaking technology is moderate (McPherron and Dibble 1999; Dibble and McPherron 2003). The layer, which in section clearly seems to be made up of two distinct archaeological lenses (McPherron et al. 2005), is characterized by a high number of bones relative to lithic artifacts. There are about six bones greater than 2.5 cm for every stone artifact in the layer (the Asinipodian has about two bones for each lithic and, in the bottom layer, the trend is reversed as there are more lithic artifacts than there are bones, 0.7 bone/lithic).

Layer 8 is characterized by ubiquitous lenses of sediment with an intense darkish to black color. There is ample evidence in this layer for the use of fire at the site, evidence which is almost completely absent from most of the other layers at Pech IV. Such use of fire is present in other sites in the region, notably Roc de Marsal and Combe Grenal (Dibble et al nd; Binford 1992; Mellars 1997). In each of these sites the evidence of fire is found at the bottom of the archaeological sequence. The industry from layer 8 is rich in scrapers and moderate in the presence of the Levallois technique (McPherron and Dibble 1999).

Roc de Marsal

Roc de Marsal is a cave site located on the flanks of a tributary valley to the Vézère River Valley in the Dordogne region (Figure 2.6). The site was first excavated by Jean Lafille from 1957 to his death in 1971 and remains essentially unpublished (Lafille 1961; Turq 1985). In 1961 the skeleton of a Neanderthal child was discovered in what was claimed to be an intentionally dug pit (Bordes and Lafille 1962). As such, the site has contributed significantly to debates concerning the treatment of the dead during the Middle

Paleolithic (Chase and Dibble 1987; Gargett 1999; Riel-Salvatore and Clark 2001; Vandermeersch 1976). However, recent re-excavations at the site by a French-American team led by Dibble, McPherron, Sandgathe, and Turq have called the interpretation of the intentional burial into question (Sandgathe et al. 2005, 2006). These excavations started in 2004, are ongoing, and concentrate on the deposits left by Lafille in the western portion of the cave (Figure 2.7).

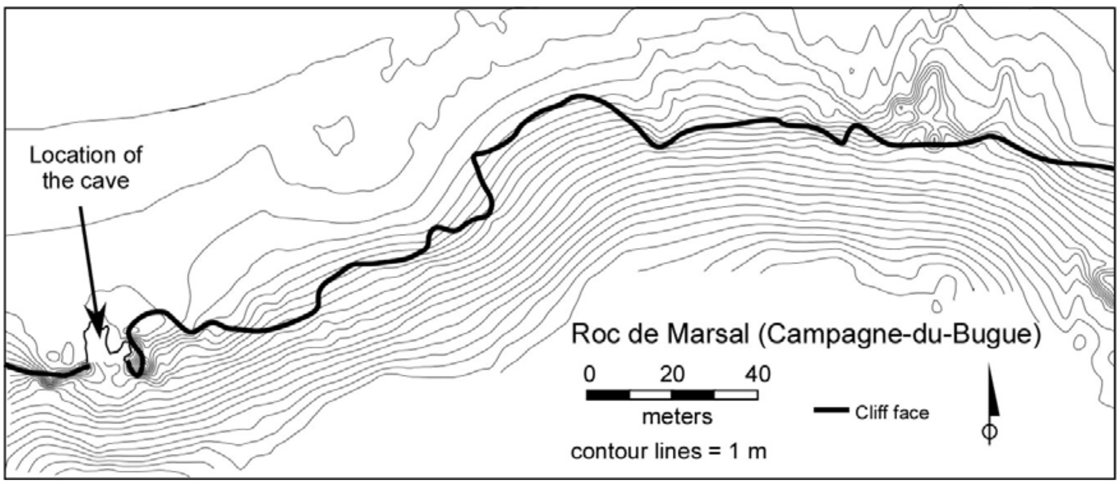


Figure 2.6: Topographic map of the cliff face in which Roc de Marsal is situated

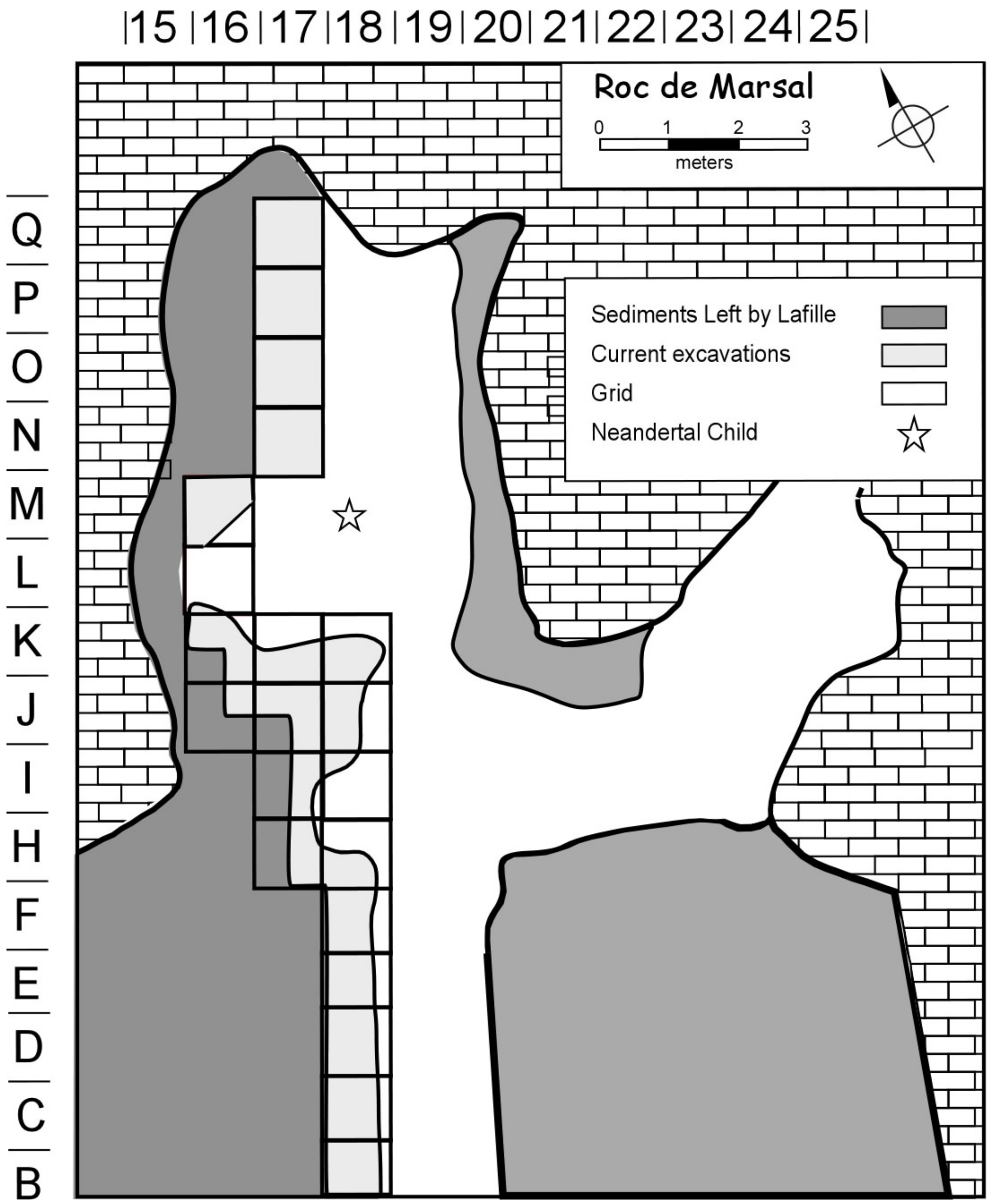


Figure 2.7: Roc de Marsal excavation grid and plan of the main cave

Despite the attention from physical anthropologists for the Neanderthal remains from the site (Madre-Dupouy 1991; Maureille and Bar 1999; Tillier 1983; 1996), the archaeological context and lithic assemblages have received relatively little attention. According to the stratigraphy established by Lafille, there are 17 layers at the site which start at the bottom, with three layers in the back of the cave (A, B, and C) that are not assigned to any particular type of Mousterian industry. The following three layers (I, II, and III) contain a Denticulate Mousterian industry, then four layers (IV, V, VI, and VII) of Typical Mousterian, followed by one of the richest Quina sequences in southwest France in five layers (VIII, IX, X, XI, and XII). The top of the sequence suffered significant disturbance in antiquity, and some evidence suggests they contained Chatelperonian and Aurignacian material. These disturbances are undoubtedly in large part due to the extensive Middle Ages occupation of the cave found at the very top of the sequence (Turq 1985; Sandgathe et al. 2005).

The cave consists of two chambers, the one currently open on the western side and a collapsed chamber on the eastern side. The western chamber is the one where the bulk of the excavations have taken place, both inside and outside of the current entrance to the chamber. It is about nine meters deep and about five and a half meters wide (Bordes and Lafille 1962). Lafille dug in a total of $27m^2$ units by himself. His methods were quite good and, while he only recorded the three-dimensional locations of about one quarter of the larger artifacts, he did not throw any of the smaller artifacts away (Schurmans et al. 2006; Turq 1989).

The new team excavating at the site established their own stratigraphy and, because I examined material from the new collections, I will use this sequence. To date the material has been divided into a total of 13 layers starting with layer 1 at the top, rather than the bottom as done by Lafille. For the purpose of this study one of each of the different industries is sampled at Roc de Marsal. These are layer 04 (Quina Mousterian, Lafille layer IX), layer 05 (Typical Mousterian, Lafille layer VI and VII), and layer 08 (Denticulate Mousterian, Lafille layer III) (Figure 2.8).

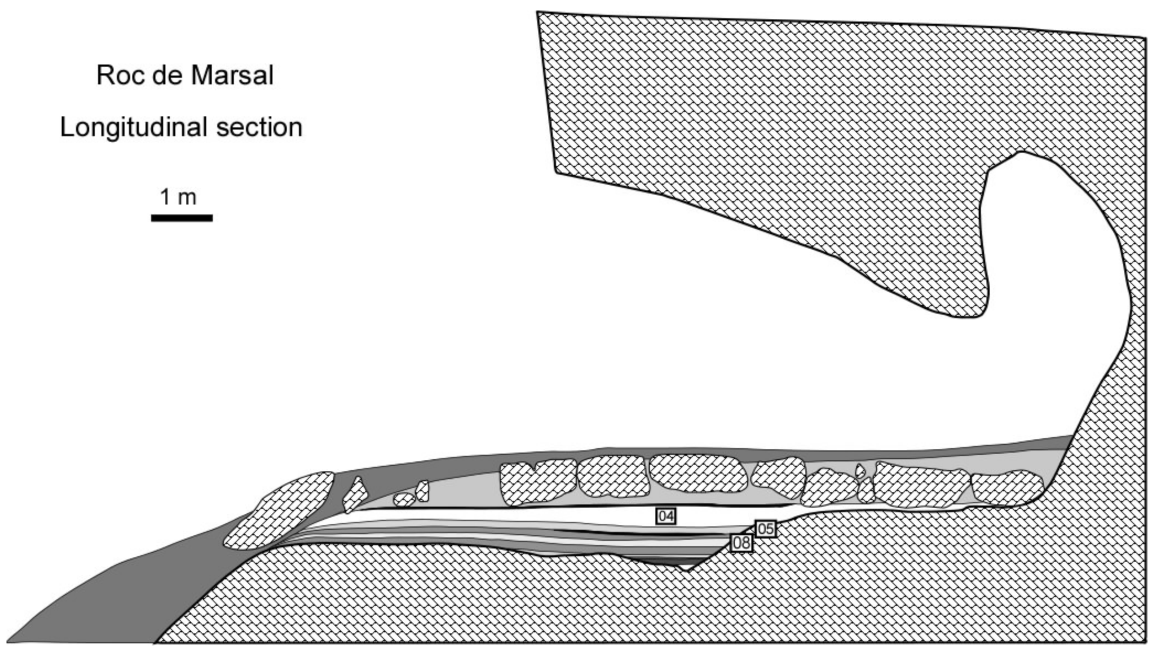


Figure 2.8: Longitudinal section through the cave and stratigraphy of Roc de Marsal

Layer 04 is about 40cm thick, at most, inside the cave and thins to about 10 to 15cm in square F18 outside the cave. The layer is sub-horizontal but inclines upwards towards the back of the cave. The lithic industry is very rich in scrapers and is marked by a relative absence of Levallois technology. In addition to a rich lithic artifact assemblage, layer 04 has abundant faunal remains. Electron Spin Resonance (ESR) dates the layer on average to 76,800 ± 3,200 BP. Layer 05, immediately below layer 04, is some 20cm thick. Levallois technology is present and the assemblage is characterized as a Typical Mousterian. Layer 08 is about 10 to 15cm thick and is rich in organic and archaeological material. The average age for layer 8, obtained by Thermoluminescence (TL), is 81,200 ± 3,900 BP (Sandgathe et al. 2006). The assemblage is characterized by moderate single sidescrapers, a higher presence of Levallois technology, and the presence of more ubiquitous truncated-faceted pieces.

Based on analyses of artifact breakage patterns, edge damage, and the orientation of elongated artifacts (Sandgathe et al 2006; for the methodology see McPherron 2005) it is clear that the assemblages in the cave suffered minimal post depositional disturbances. Artifacts are not preferentially oriented except in the front of the cave where there is an expected alignment with the local slope towards the south. Other damage can be attributed to trampling (see McBrearty et al 1998) rather than large-scale geological processes (Sandgathe et al 2006).

Combe-Capelle Bas

Combe Capelle consists of four named sites located in Saint-Avit-Sénieur on the right bank of the Couze river. The Combe Capelle sites include Plateau de Ruffet, Roc de

Combe-Capelle, Abri Peyrony (also known as Haut de Combe-Capelle), and Combe-Capelle Bas (Figure 2.9). Combe-Capelle Bas was first discovered in the late 19th century by Landesque and excavated shortly thereafter (Landesque 1887). Other excavations at the site include those by Mensignac and Cabannes (1890), Peyrony in 1910, and Ami from 1926 to 1931 (Peyrony 1925, 1934b, 1943a, 1943b). The last excavations at the site were undertaken by Dibble and Lenoir (1995) from 1987 to 1990 (Figure 2.10). The material studied here is from these last excavations.

The archaeological sequence at the site has been re-evaluated considerably throughout these various research efforts. According to the research prior to the Dibble and Lenoir project, there were three types of Mousterian assemblages present. These include the Mousterian of Acheulian Tradition, the Typical Mousterian, and a Quina industry. After excavating the site, Dibble and Lenoir came to the conclusion that there is only one type of industry, a Typical Mousterian rich in notches and denticulates characterized by a Quina technology (Dibble and Lenoir 1995, 1997; Roth et al. 1995). They showed that previous mischaracterizations of the assemblages at the site were due to excavator recovery bias and the mixing of material from Combe-Capelle Bas with that of a nearby location which contained handaxes.

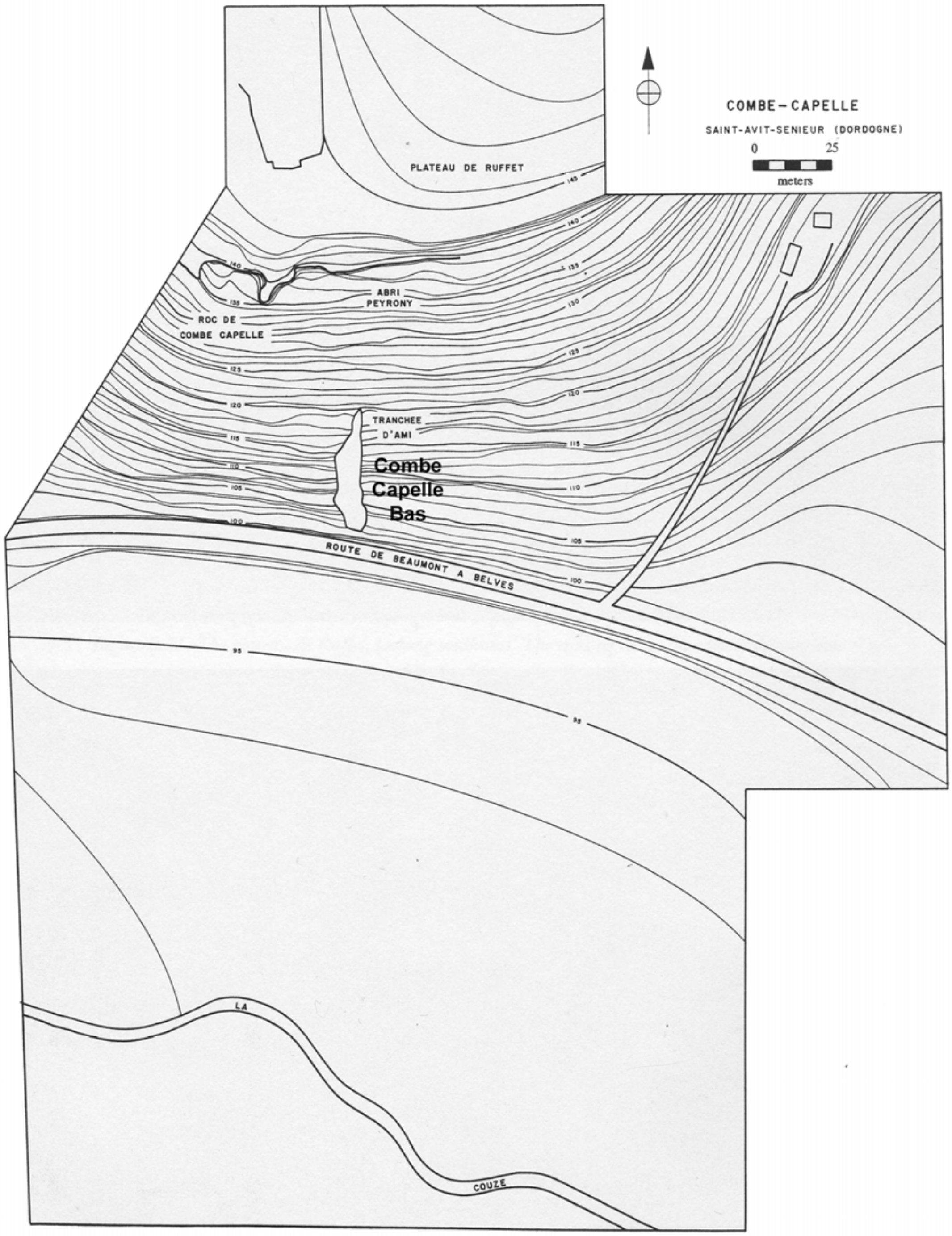


Figure 2.9: Topographic map of the site of Combe Capelle (adapted from Dibble and Lenoir 1995: p. 19)

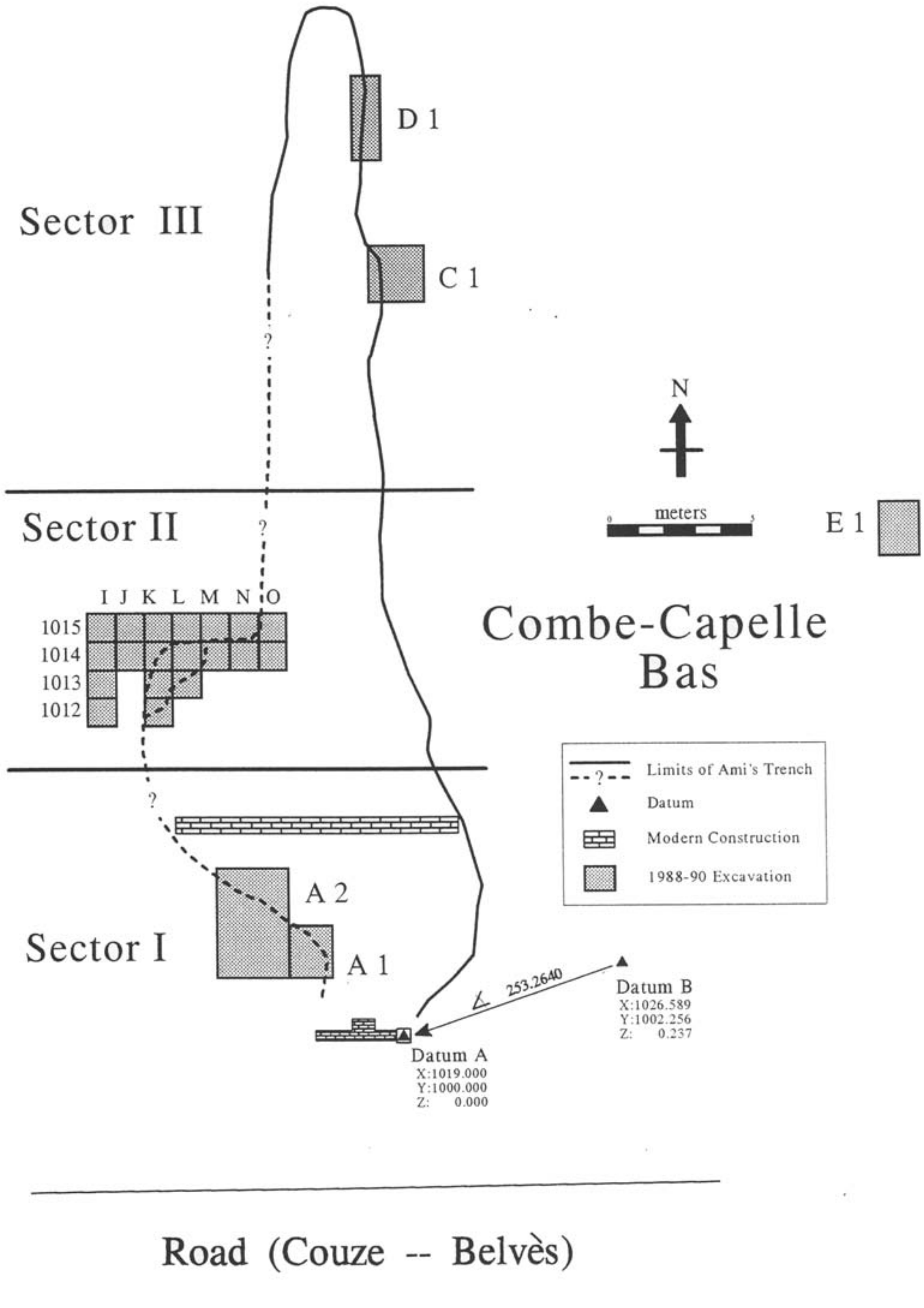


Figure 2.10: Plan and excavation grid of Combe Capelle Bas (adapted from Dibble and Lenoir 1995: p. 30)

Geologists interpreted the site, which is on a slope, as suffering from considerable postdepositional disturbance (Texier and Bertran 1995; Bertran and Texier 1995). The geological study suggests that in the process of moving down the slope, material from different layers would have been mixed. However, both the orientations of the artifacts, as well as the study of the small finds, indicate that disturbance was not nearly as important as suggested by Texier and Bertran (Kluskens 1995; Dibble and Lenoir 1995). The interpretation based on the archaeology that the material suffered limited post depositional disturbance is further supported by resistivity studies conducted at the site (Dibble and Lenoir 1995: 319).

There are also some chronological disagreements between the archaeologists and the geologists. The latter support a date as early as OIS 8 or even OIS 10 based on geological evidence. Archaeological evidence, however, suggests an age more towards OIS 4 or the early part of OIS 3. The archaeological interpretation now seems strengthened by the evidence from TL dating (Valladas et al 2003). In a study of material from layers I-1D, I-1E, and I-2B, Valladas and colleagues (2003) found most dates converging on the 50–60 ka BP age range.

Despite some of these scientific quibbles, the site is well-understood archaeologically and one aspect that was known early in the 20th century is the fact that excellent raw material is present at the site itself (see Peyrony 1943a: 255, 1943b). It is this very fact that is of importance to the study here as it allows us to evaluate the influence of this situation (abundantly available high quality raw material) on the presence or absence of technologies for the manufacture of small flakes. In fact, the study of the site has contributed to current models of the use of stone raw materials by Neanderthal populations (Dibble et al. 1995; Roth and Dibble 1998).

In this study three layers are examined: I-1E, I-2A, and I-2B. Figure 2.11 illustrates the stratigraphic sequence of these layers. Layer I-1E, in between layer I-1 and I-2, contains one of the richest assemblages of the site, both in terms of the number of artifacts and the number of tools. The assemblage is characterized, like the other layers at the site, by a Quina-like technology (Turq 1989), relatively low percentages of Levallois technology, and tools dominated by notches and denticulates and moderate scrapers (Roth et al. 1995). Both layers that comprise the larger unit I-2 (I-2A and I-2B) are incorporated here. Of these layers, I-2A is the richest in terms of artifacts. Both have assemblages that are similar, dominated by large, thick flakes, plain platforms, and a slightly higher frequency of tools relative to unretouched flakes. Cores, which are quite large, do not show the characteristic features of technologies like Levallois or Discoid.

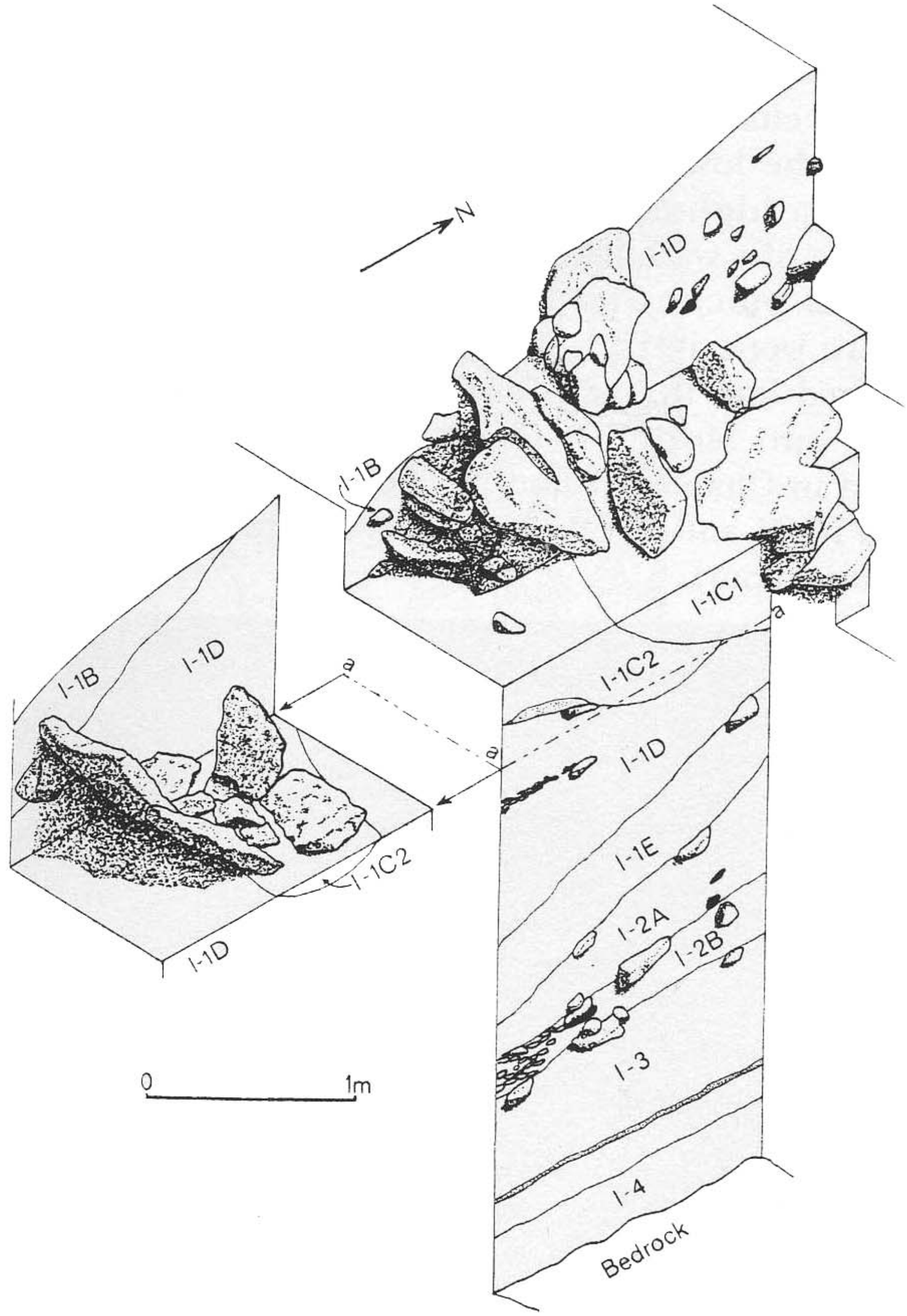


Figure 2.11: Three dimensional view of the stratigraphy in Sector I. Layers examined here are I-1E, I-2A, and I-2B. (Adapted from Dibble and Lenoir 1995: p. 48)

African sites

The two African sites incorporated in this study, Contrebandiers Cave on the Atlantic coast of Morocco and Muguruk near Lake Nyanza in Kenya, are chosen to match the variability in raw material availability in the French sites. That is, one site, Contrebandiers Cave has low raw material availability more closely matching Pech de l'Azé IV and Roc de Marsal, whereas Muguruk, like Combe Capelle Bas, has abundant raw material available at the site itself. Based on the current model of assemblage variability, it is expected that blank to core ratios at Contrebandiers (CB) would be high indicating the intensive utilization of raw material. Furthermore, the flake to tool ratio is expected to be low indicating high tool production. Compared to sites where raw material is readily available, there should be a significant component of small flake production at this site. By contrast Muguruk should exhibit low blank to core ratios and a correspondingly high flake to tool ratio. If raw material size and availability is the determining factor in small flake production, then Muguruk should exhibit very little evidence of truncated-faceted pieces, small Levallois cores, and Kombewa cores.

In addition to the ability to contrast two different raw material contexts for the African sites, the study of these two assemblages also allows a comparison between MSA assemblages with MP assemblages. We know in the case of Contrebandiers Cave and assume in the case of Muguruk that the makers of the assemblages were anatomically modern humans. The Middle Paleolithic assemblages from France, on the other hand, were made by Neanderthals and therefore comparing the two sets of sites provides an opportunity to examine general similarities and differences between them. In particular, the goal is to determine if similar types of factors (such as raw material availability and intensity of reduction) structure the lithic assemblage variability in each.

Contrebandiers Cave

The site of Contrebandiers is located along the coastal road connecting Rabat and Casablanca. The cave site, 17 km from Rabat, is some 270 meters from the Atlantic at 14 masl (Figure 2.12). During the prehistoric occupation of the cave the distance to the Atlantic must have been considerably farther, although, at present, a precise study of the bathymetry of the area has not been undertaken. The site has deposits from the Neolithic, Iberomaurusian, Aterian, and Mousterian periods and is one of the rare sites with a long prehistoric cultural sequence in North Africa. The cave itself is formed in the ancient coastline sandstone rocks. This ancient coastline probably corresponds to the Ouljien period or Oxygen Isotopic Stage (OIS) 5e at about 125 ka BP. The cave was discovered in 1955 by Roche who organized the first excavations from 1955 to 1957 (Roche 1976; 1963, 1973). From 1967 to 1975 Roche and Texier continued excavation in collaboration with the Moroccan authorities (Roche and Texier 1976). In 1994, Bouzouggar opened the site again to increase lithic sample sizes for his dissertation and to re-examine the stratigraphy at the site (Bouzouggar 1997a, 1997b). Recently new excavations were started at the site (Figure 2.13) to assess the stratigraphy, collect dating samples, and sample the sediment to reconstruct the environment.

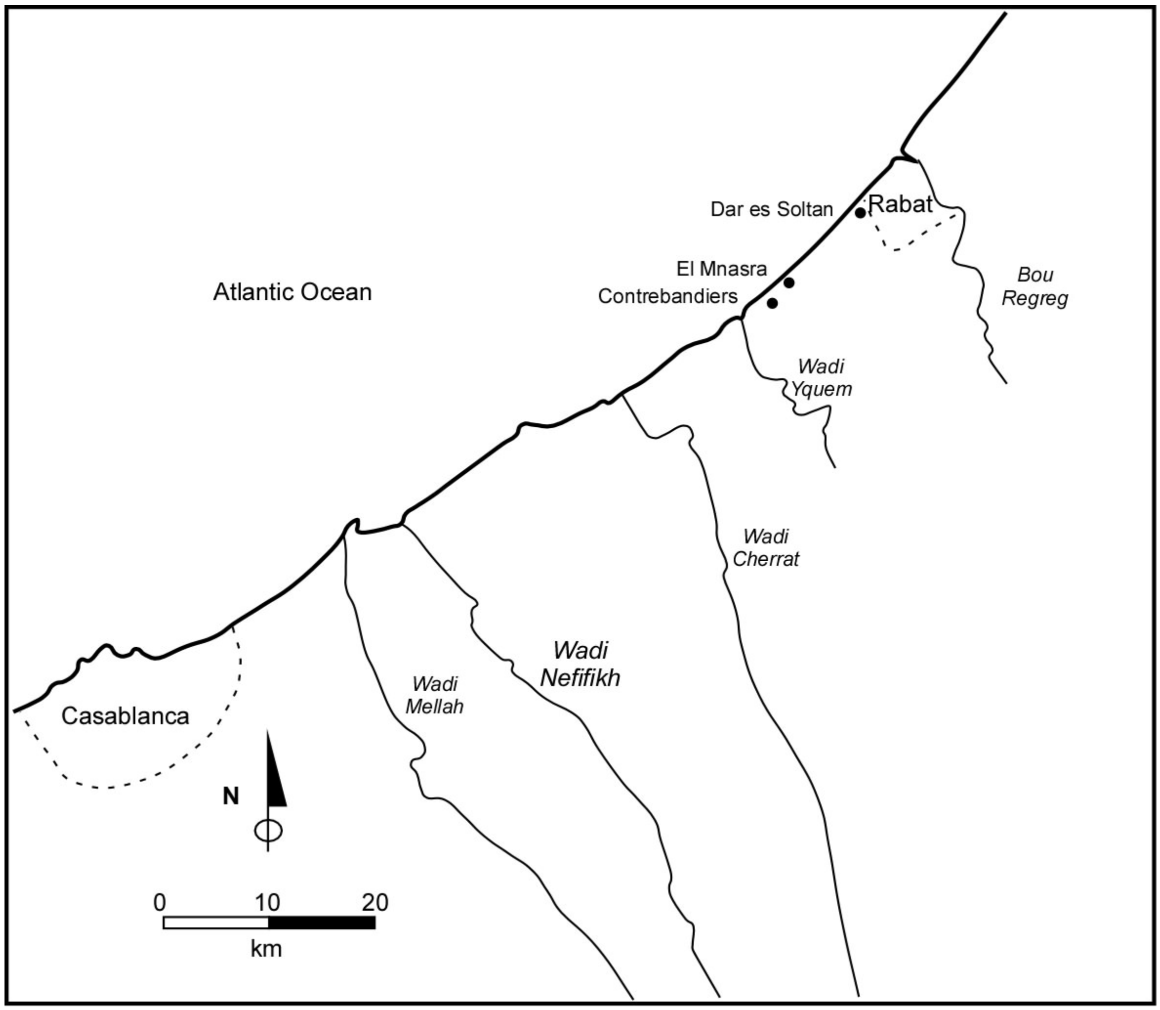


Figure 2.12: Location of Contebandiers Cave on the Atlantic coast of Morocco (redrawn after Roche 1976, p. 171)

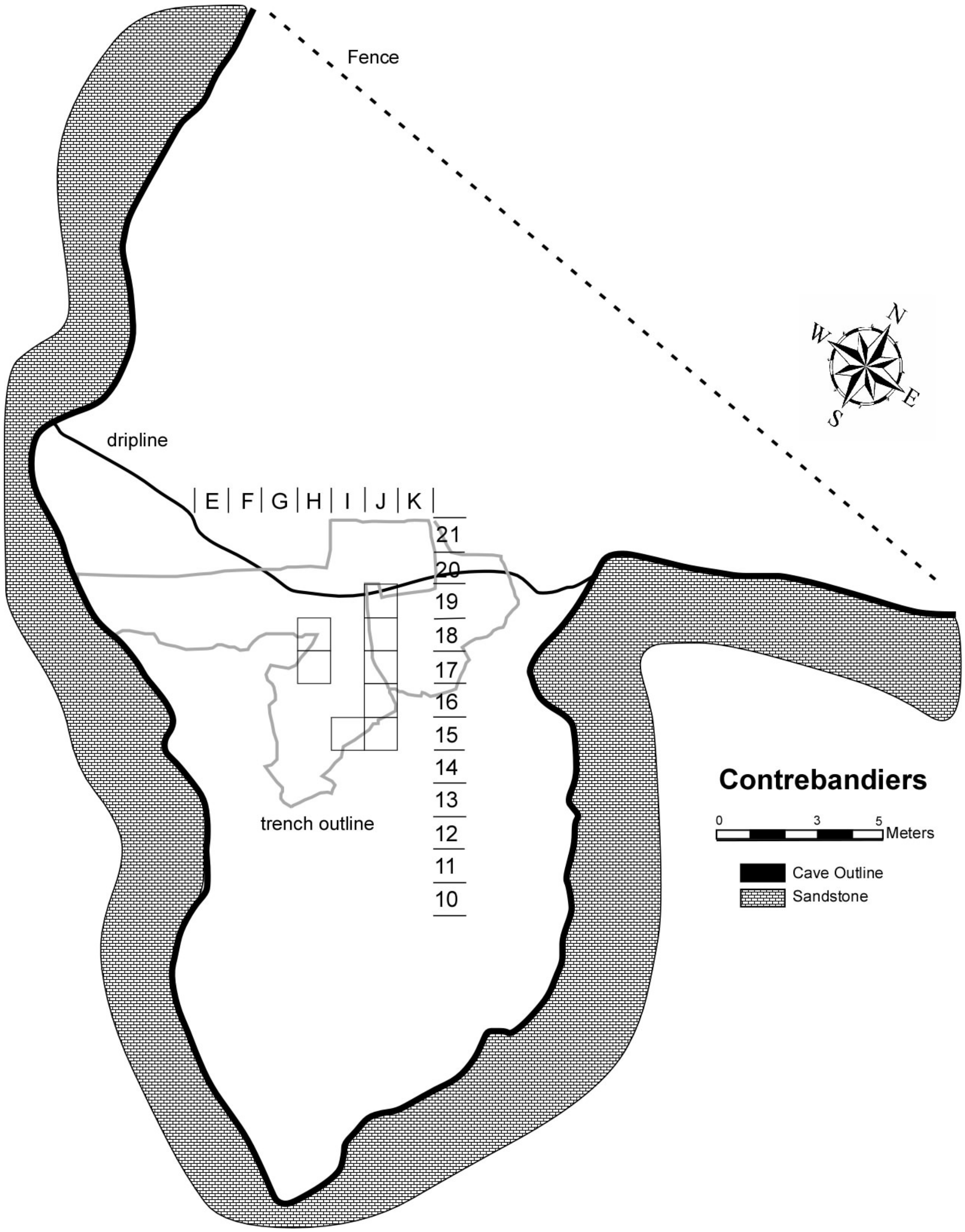


Figure 2.13: Plan of Contrebandiers Cave with the excavation grid and trench outline from previous excavations

The site is best known for its important human remains dating to the Aterian, including a mandible found during the first excavations (Vallois and Roche 1958; Roche 1976; Hublin 1993; Debénath et al 1986; Debénath 2000; Ferembach 1998). During renewed excavations in 1975, a human occipital and frontal fragment were found close to where the mandible was found in 1956. These remains also date to the Aterian period (Roche and Texier 1976; Ferembach 1976; 1998; Ménard 1998; Saban 1998).

The site has a notoriously difficult stratigraphy. As a result, several interpretations of the stratigraphy have been suggested over the years. None of these stratigraphies have been correlated with one another. The original description of the stratigraphy at Contrebandiers (Roche 1958–1959, 1963, 1976) recognized seven layers from top (I) to bottom (VII). The first layer (I) corresponds to the Neolithic, the second (II) to the Epipaleolithic, and from the third (III) down the site yielded Aterian industries (Figure 2.14). At this time Roche did not yet recognize the existence of Mousterian layers. The bottom two layers are sterile with layer VII representing the ancient Ouljien beach. With the new excavations, Roche and Texier established an entirely new stratigraphy for the site (Roche and Texier 1976; Roche 1976; Debénath et al 1986; Bouzouggar 1997a). This new stratigraphy consisted of 16 layers and was not correlated directly with the previously established sequence. Roche made clear that the correlation between layers was far from straightforward due to the significant lateral variation in the layers (Roche 1976). Further, he established that the Iberomaurusians dug pits that extended into the underlaying Aterian layers, further complicating the stratigraphy (Delibrias and Roche 1976).

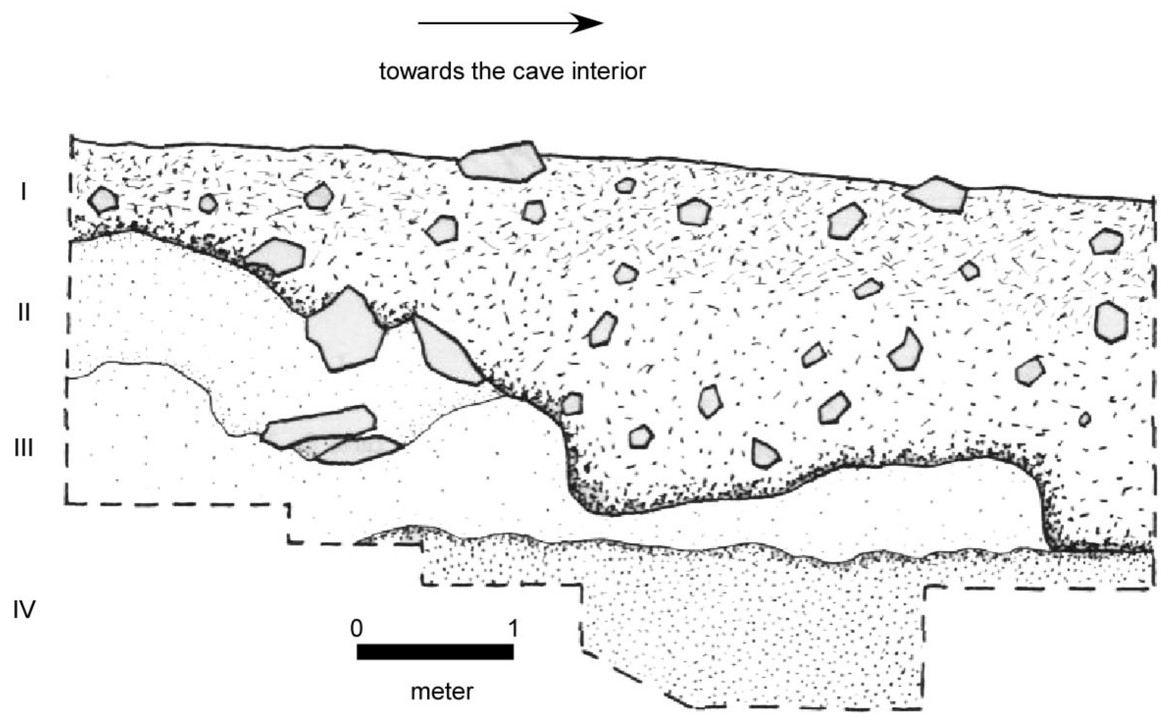


Figure 2.14: Stratigraphy of Contrebandiers Cave drawn by Jean Roche (reworked after Roche 1963, fig. 66)

In this new stratigraphy, from top to bottom, layers 1–5 are associated with the Neolithic, layer 6 is sterile, the Iberomaurusian is found in layer 7, and the Aterian is found from layers 8 to 14. Layers 15 and 16 are again sterile (Roche and Texier 1976; Niftah 2003). In a later clarification, Roche specifies that from layer 11B downwards the assemblages lack stemmed tools and should be classified as Mousterian and not Aterian (Debénath et al 1986).

In 1994 Bouzouggar (1997a) excavated Contrebandiers Cave anew and proposed yet another stratigraphy for the site. As before, this stratigraphy remained uncorrelated with the previous two sequences for the site. The stratigraphy of Bouzouggar consists of 15 layers and, due to where he dug, starts immediately with the Upper Aterian in layer I.

The site has been dated by a series of ^{14}C determinations as well as two U-Th dates. As shown in Table 2.1, the U-Th dates were obtained from the same shells that were submitted to ^{14}C dating. The table shows that these two methods yielded widely different results. The U-Th dates are considered to represent the formation of the cave walls just prior to OIS 5e. However, why the ^{14}C results are so young is unclear (Delibrias et al 1982). Even if we just take the results obtained on bone, the results for Contrebandiers cave are inconsistent. It is clear that the site needs to be re-dated using a number of complementary methods (see Table 2.1).[3]

[3] Some of the very young dates might be the result of the intermixture of faunal remains from overlaying Iberomaurusian layers in the underlaying Aterian ones (Delibrias and Roche 1976). Most bones in the Aterian layers are covered with some sort of carbonate. However, this covering was missing on some of the bones submitted for dating and they are now thought to derive from overlaying layers (Delibrias and Roche 1976).

Table 2.1: Absolute Dates from the Site of Contrebandiers Cave

level	*sample*	*location*	*method*	*Date*	*sd*	*number*	*industry*
?	ceramic	?	TL	6600	600	Cle TL 136	Cardial Neolithic
8	bone	J K 20	C14	12500	170	GIF 2577	Aterian
8	shell	J K 20	C14	22630	500	GIF 2576	Aterian
8	shell	J K 20	U-Th	137000*	17000	-	Aterian
9	bone	J H 20	C14	14460	200	GIF 2579	Aterian
9	shell	J K 20	C14	35200	2100	GIF 2578	Aterian
9	shell	J K 20	U-Th	138000*	17000	-	Aterian
10	bone	J H 20	C14	12320**	400	GIF 2580	Aterian
11	bone	J 20	C14	24500	600	GIF 2582	Aterian
11	shell	J 20	C14	> 40000	-	GIF 2581	Aterian
12	soil	E 18	C14	23700	1000	GIF 2585	Aterian
12	shell	G 20	C14	> 35 000	-	GIF 2584	Aterian
12	bone	G 20	C14	12170	160	GIF 2583	Aterian

* dating the same shells as the above ^{14}C date; ** insufficient sample, probably not a good date

Below the Iberomaurusian layer there are numerous layers that are associated with Aterian and Mousterian industries. The most complete description of portions of these industries can be found in the dissertation of Bouzouggar (1997a). However, most of the industry remains unpublished. In a brief note published in the *Bulletin archéologique marocaine*, Jean Roche mentions that the lithics from layers 14 through 16 were studied. These assemblages were poor in number and manufactured using coarse raw materials such as quartzite and quartz. The Levallois indices are low. The next year, a similar published note indicates numbers of artifacts that belong to some of the archaeological layers. Layer 9 from the original excavations has 260 pieces, layer 11a from the Roche – Texier excavations has 720 artifacts, and finally layer 11c from the original excavations contains 4,900 artifacts. The technology in these layers is crude and often on coarse raw materials. The use of quartz is more common as one proceeds downward in the sequence at the cave. In layer 9, 18% of the assemblage consists of quartz, while there is 42% quartz in layer 11c. In general a wide variety of raw materials was used at the site. Levallois and blade indices are low, and denticulates and notches frequent. In layer 9, 20% of the assemblage consists of stemmed artifacts. This percentage decreases in older assemblages (6% in 11a, 4.75% or none in 11b [depending on the source], and none in layer 11c). This led Roche to conclude that layers 11b and c belong to the Mousterian industry even though the latter does not differ technologically from the Aterian (Debénath et al 1986; Debénath et al 1981-982; Debénath et al 1983–1984).

In his PhD dissertation Bouzouggar (1997a) analyzes a total of 2,814 artifacts from three Aterian layers at Contrebandiers cave (from top to bottom these are his layers III, V, and VII). The material comes from his excavations as well as from the Roche-Texier excavations. The raw materials used at Contrebandiers Cave include quartz, quartzite, chert, and grey limestone. Over time and based on his sample, there is no evidence that the use of raw material changed over time. However, there is some evidence to suggest that each raw material was treated differently. For example, the fine grained chert was utilized more extensively than was the much coarser quartz (Bouzouggar 1997a, 1997b).

In terms of the more standard typo-technological assessment of these three layers, it could be said that stemmed tools decline in frequency in the older layers (Bouzouggar 1997a), an observation also made by Jean Roche. Foliates and large tools made on cobbles are rare throughout. Levallois is abundant in layer III, declines in layer V and is the most abundant in layer VII. Notches and denticulates are common in all three layers and seem to increase with age. Scrapers are abundant in all layers, but in layer VII notches and denticulates are more important as a class. Raw material utilization, particularly of chert, is high (Bouzouggar 1997a, 1997b).

The exact relationship between the Mousterian and the Aterian in North Africa is still to be determined (see Wendorf and Schild 1992; Debénath et al 1986; Bouzouggar and Barton 2007), but for now it seems clear that at Contrebandiers Cave the only real difference between the Mousterian and the Aterian lies in the presence of stemmed artifacts, whereas the overall technology remains the same (Debénath et al 1986). Therefore, if there is any mixture of Mousterian and Aterian material in Roche's layer III, the layer from which all artifacts are studied here, it is expected to be slight and the effects on the overall characterization of the material minimal. In addition to the complete assemblage from layer III, the tools and cores from the Aterian layers of the Roche and Texier excavations are incorporated in this study. Given the complex statigraphy at the site it is doubtful that the distinction of layer III and IV matches the one later drawn between the Aterian (layers 8 through 11a) and the Mousterian at the site (layers 11b through 14). From the excavations by Roche and Texier all tools and cores from layers 9 through 11a were included in this study, attempting to match as best as possible the division between layers III and IV from the 1950s excavation.[4]

Muguruk

The prehistoric site of Muguruk is located 3 km from the shore of Lake Victoria in Kenya's Nyanza province and some 16.5 km northeast from the town of Kisumu (Figure 2.15). The site lies on the left bank of the Muguruk river in a place called Ojolla. This important prehistoric site was discovered in 1936 by Archdeacon Owen and first published by Louis Leakey and Walter Owen at the end of World War II (Leakey and Owen 1945). Since then a number of prehistorians have undertaken excavations at the site, including Alex Opira-Odongo in 1978, and McBrearty from 1979 to 1980 (Figure 2.16). Only the excavations carried out by McBrearty (1988) were published, as well as described in her PhD dissertation (1986). The material from Muguruk is well-curated at the National Museums of Kenya and a copy of McBrearty's fieldnotes and artifact

[4] Because the numbering of specimens was non-existent for some and not consistent for other portions of the collection, individual numbers had to be given to the artifacts. Each of the boxes received a 'BOX ID' and the pieces in that box numbered starting with 1. For example, 176-34 would refer to the 34th artifact from box number 176. Numbering the pieces allows an effective integration of the physical artifacts and the data collected for it, including photographs, and any other information that might be collected in the future. The context information written on each of the boxes was entered into the database to link context information with the contents of each box.

catalogue are available to researchers. The notes McBrearty wrote provide the necessary context to the excavations missing from the artifacts themselves and the catalogue.

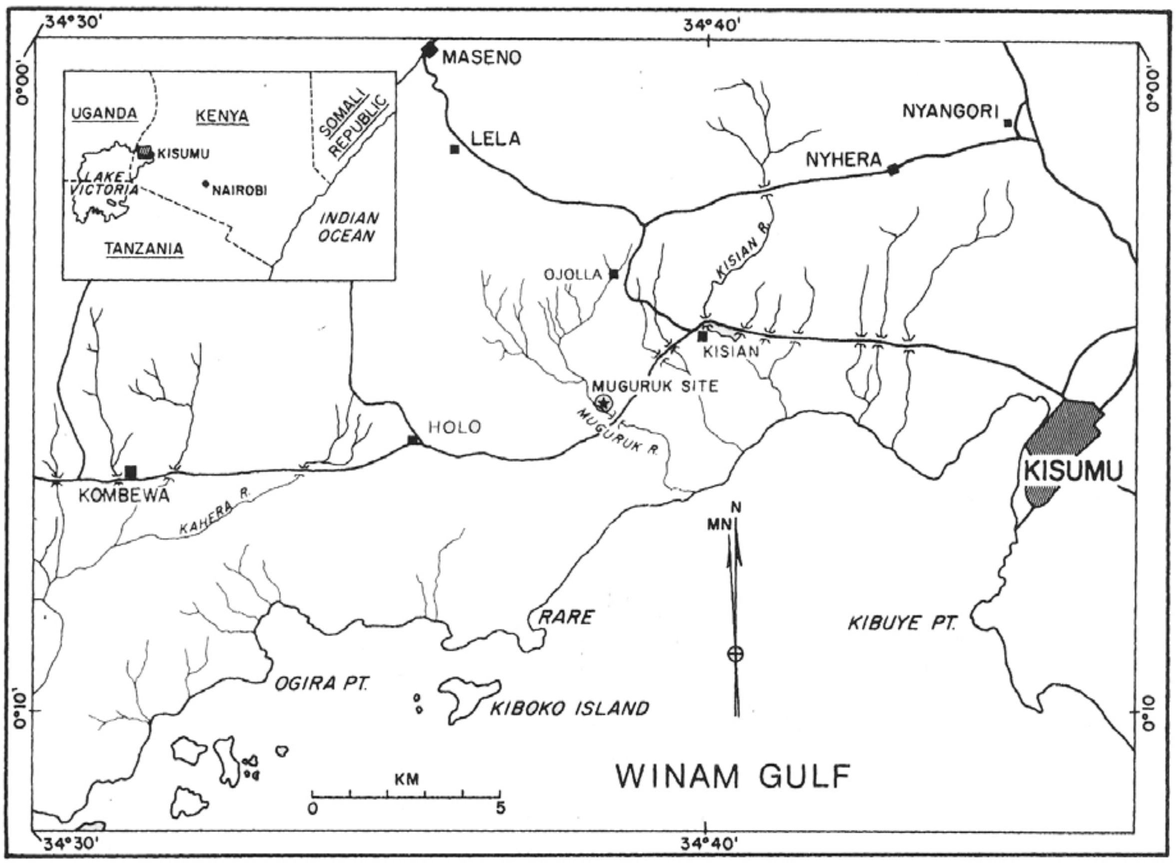


Figure 2.15: Location of Muguruk in southwestern Kenya (adapted from McBrearty 1988, p. 392)

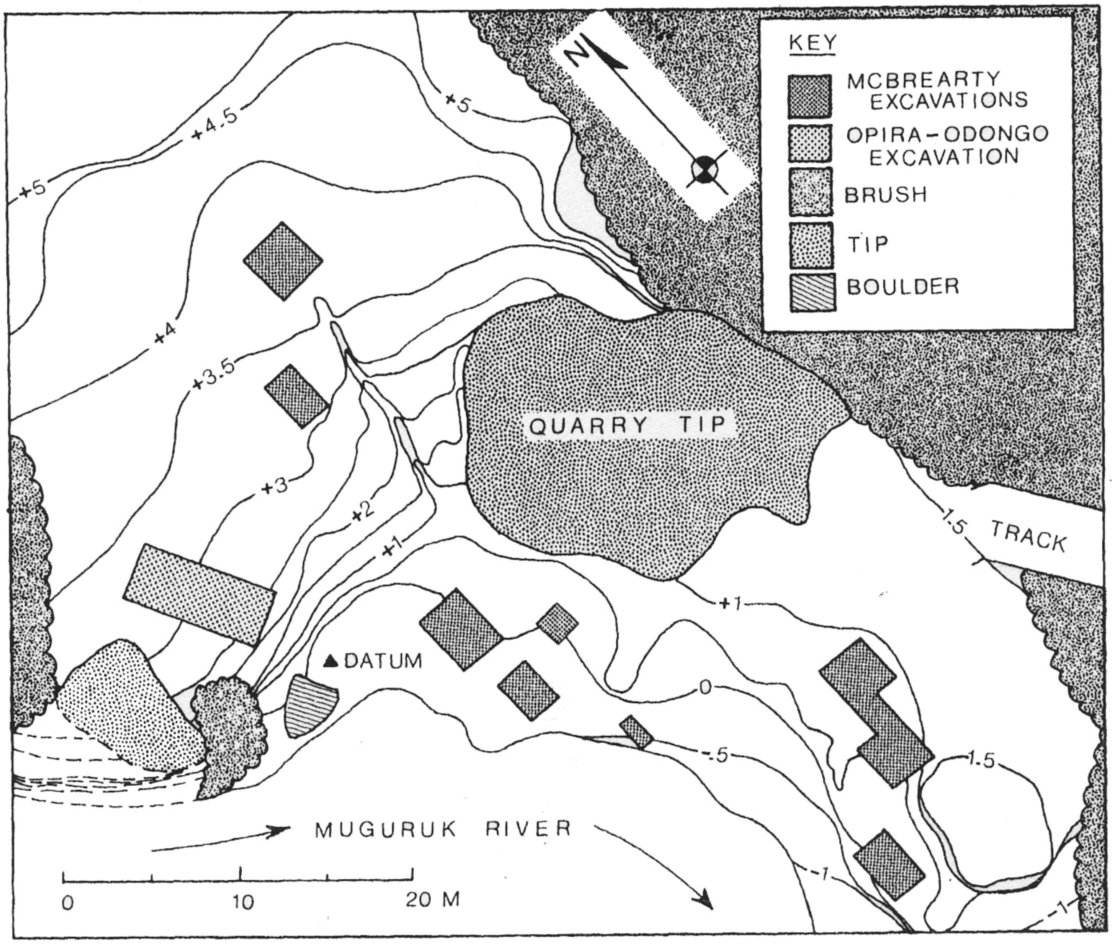


Figure 2.16: Topographic map of the Muguruk site with the location of the excavation trenches from both the Opira Odongo and the McBrearty excavations (adapted from McBrearty 1988, p. 396).

The site contains an important sequence of archaeological assemblages with stone tool artifacts that belong to the broad of the Middle Stone Age. The assemblages belong to the Sangoan-Lupemban tradition (McBrearty named them the Ojolla industry) and the East African Middle Stone Age (McBrearty named them the Pundo Makwar industry). An exact age for the artifacts from the site is unknown, but similar stone tools at other sites suggest that the different layers at Muguruk should belong somewhere in the admittedly broad window between 250 and 35,000 years ago. Currently, the site of Muguruk is protected as an archaeological monument by Kenyan law. Unfortunately the site has been damaged extensively by a nearby quarry (see Figure 2.16) from which local phonolite is extracted to make gravel. Further erosion from rain, the Muguruk River, and blasting at the quarry threaten the few remaining portions of this important site.

The vast majority of the stone tools at the site are made using a volcanic rock type called Ombo Phonolite which is locally available. Stratigraphically the site is divided into six units (see Figure 2.17), but only three of these contain archaeological assemblages. These include layer 2[5] near the base of the sequence with the Ojolla or Lupemban-Sangoan industry and layers 4 and 6 each containing assemblages of the Pundo Makwar industry (part of the Middle Stone Age proper). The difference between the Pundo Makwar and the Ojolla industries from the site is marked. The former industry is dominated by single surface core reduction and falls into the Levallois tradition of so-called prepared core technologies. The Ojolla industry, on the other hand, is dominated by bifacial technology and flakes with evidence of deriving from bifacial types of cores, i.e., highly curved flakes with a low external platform angle (EPA) and broad or

[5] Conforming to standard practice in Kenya, McBrearty labels the various stratigraphic units at the site with the word “member.” To maintain consistency with the rest of the text, I will use “layer” to refer to these stratigraphic units.

expanding form. The characteristic Lupemban tools also belong to this industry, and most of the flakes (debitage) can be attributed to their manufacture or resharpening.

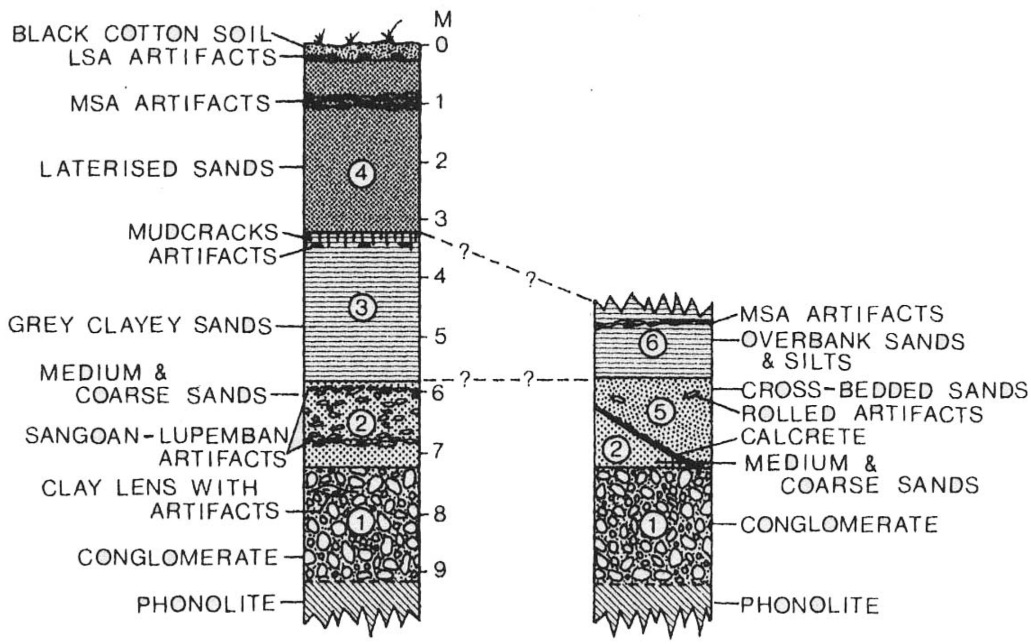


Figure 2.17: Stratigraphic column and proposed correlation between the stratigraphies from two opposite areas of the site. Note that the bedrock consists of phonolite which is the main source of raw material used at the site (adapted from McBrearty 1988, p. 394).

The archaeology contained in layer 2 occurs in two distinct horizons. One of these horizons occurs near the contact with layer 1 and the second occurs at the contact between layer 2 and layer 3 (McBrearty 1986; 1988). The industry from these layers taken together is characterized by the presence of slender lanceolate points (Figure 2.18), other bifacial implements, and 'heavy duty' tools such as choppers, and picks

(McBrearty 1988). The use of the “Lupemban-Sangoan” label here derives from arguments made by Isaac (1982) that the Lupemban and the Sangoan cannot be distinguished stratigraphically.[6] The Sangoan seems to date to a period between and/or overlapping with the Acheulian and the Middle Stone Age (McBrearty and Tyron 2006; Van Peer et al. 2003).

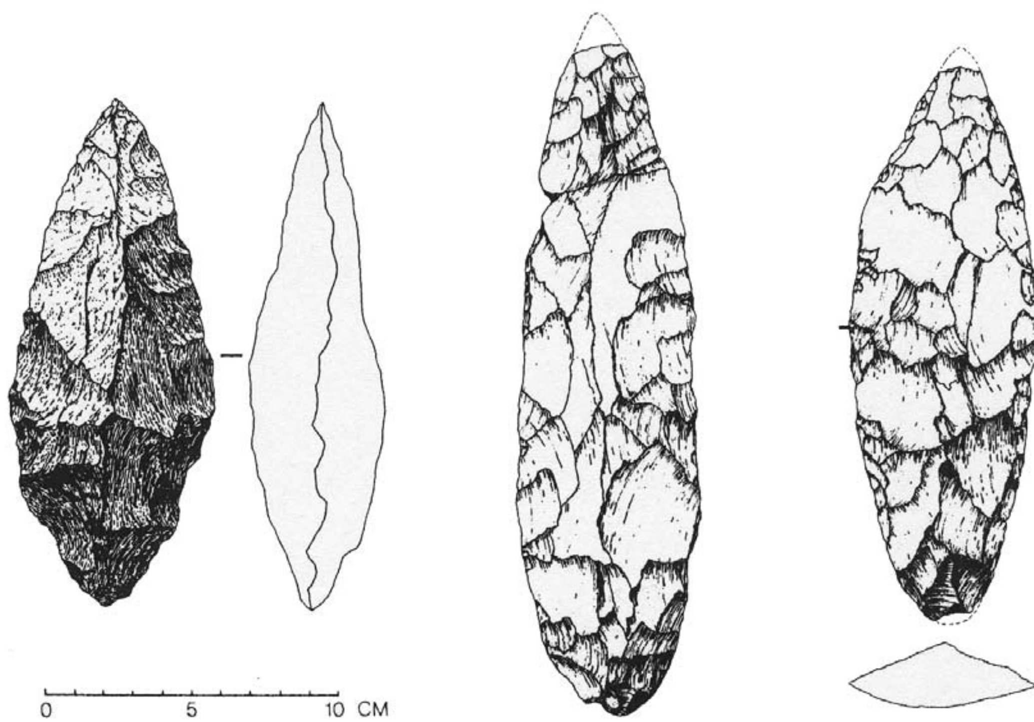


Figure 2.18: Examples of lanceolate points from the Ojolla industry at Muguruk (adapted from McBrearty 1988, p. 401).

[6] However, it has become standard practice to divide the two again (see Clark 2001; Van Peer et al. 2003; McBrearty et al. 1996; McBrearty 1991).

The second industry found at Muguruk, Pundo-Makwar, occurs in both layer 4 and layer 6, and is one of the Middle Stone Age flake-based assemblages. This Pundo Makwar industry is a prepared core industry with few formal tools. Levallois technology is quite common — about 20% in layer 6 and 38% in layer 4. The industry from layer 4 was chosen for analysis as it seems to be the youngest of the layers at Muguruk and as such might fit better with the general chronology of the other sites examined. Also the presence of Levallois technology forms a good point for comparison with the other assemblages examined.

One of the important bits of information contained in the notes is a concern related to post depositional processes that might have affected the site. What is interesting is that McBrearty decides early on in her notes that she thinks the site is relatively undisturbed. She says this should be the case based on the abundance of small artifacts, the freshness of the edges, and the restricted vertical distribution of the material. These observations are repeated in her publication, where she compares the distribution of flake sizes to experimentally-derived distributions and concludes they match quite well. Further, the fineness of the sediment at the site and the lack of preferred orientation of the material strengthen her argument that the artifacts are relatively undisturbed (McBrearty 1988). The overriding problem with this assessment is the damaged appearance of the material itself. In fact, McBrearty must have altered her opinion subsequent to her publication as she warned me of the damaged nature of the collection (McBrearty personal communication, April 2006, Puerto Rico, Society for American Archaeology Meetings). The artifacts are not fresh. That this observation is not biased by a chert-centric perspective is strengthened by discussions with Sonia Harmand who works on much older material. She also thought the material looked worn. Casually looking at Harmand's material from East Turkana as well as the material from Songhor, another site excavated by McBrearty, strengthened this view.

The worn nature of the collections forced me to be quite conservative in my recognition of formal retouched tools. Furthermore, it is necessary to consider carefully if this situation makes the examination of small flake production possible at the site. I do think it is because (a) small flakes are present and, more importantly, (b) the focus of the research is really on the flake scars of small flakes found on cores and tools rather than the small flakes themselves. That small flakes are present suggests that no bias is expected in the retrieval of larger pieces on which the negatives for the production of small flakes are to be found.

Analytical Methods

As mentioned, cores and tools from which small flakes were detached are the primary focus of this research. This particular approach is chosen because we currently lack an appropriate methodology to identify desired small flakes in an assemblage. While micro-wear might provide a methodology to recognize used versus unused small flakes, there are two problems with using micro-wear. First, it is doubtful that all used flakes are used sufficiently to develop identifiable micro-wear traces. Second, comprehensive analyses of entire assemblages using micro-wear would be very costly. Furthermore, given the small size of some of the flakes taken from Asinipodian cores (see Dibble and McPherron 2006, 2007) as well as other such cores (Hovers 2007; Goren-Inbar 1988) it is clear that many of the flakes do not meet the standard cutoff for the analysis of individual stone tools in most Middle Paleolithic projects (e.g., Dibble and Lenoir 1995). Focusing on the flake scars allows a tight control on the techniques used in their removal. Such ability to identify the specific techniques of removal and any removal preparation cannot be expected to be effectively recognized from the flakes themselves as has been shown through refitting studies in the Near East (Volkman 1983; Marks and Volkman 1987).

In addition, to the cores and tools, samples of the unretouched blanks are examined following the methodology of Nishiaki (1985). This allows comparison of attribute states of blanks to those of tools and cores in general, and with cores for small flake production in particular (following the methodology of Dibble and McPherron 2006, 2007; McPherron and Dibble 1999). By comparing the size distribution of unretouched flakes with flake scars on cores and tools it is possible to establish if small flakes represent a distinct class of artifacts or rather if they are simply an extension of larger flake production.

Data was gathered with a computer, scale, digital calipers, and the aid of a data entry program called E4. Figure 2.19 shows a screen shot from the program listing the variables on the left, part of the accumulated data on the bottom, and the currently active variable in the top right. This program, developed by McPherron and Holdaway, stores the data in an Access database and allows the user to define variables and specify particular kinds of data for input. For example, the state of the variable 'platform surface' can be entered with the aid of a menu listing the potential values for this variable (plain, dihedral, etc.). The user simply selects the desired value and moves to the next variable. Values for length and several other continuous variables are entered with the aid of digital calipers. Measurements are directly transferred from the calipers to the data entry program and the Access database.

What follows is a description of each of the variables recorded for this study. These variables record individual attributes on flakes, tools, and cores. There is also a set of variables designed specifically for the study of flake scars on cores and tools. While some of the landmarks on cores are different from those on flakes, every attempt was made to make the sets of attributes as much comparable as possible. Any artifacts with "n/a" (not applicable or not identifiable) as the attribute state for a particular variable are excluded from the analysis of that variable.

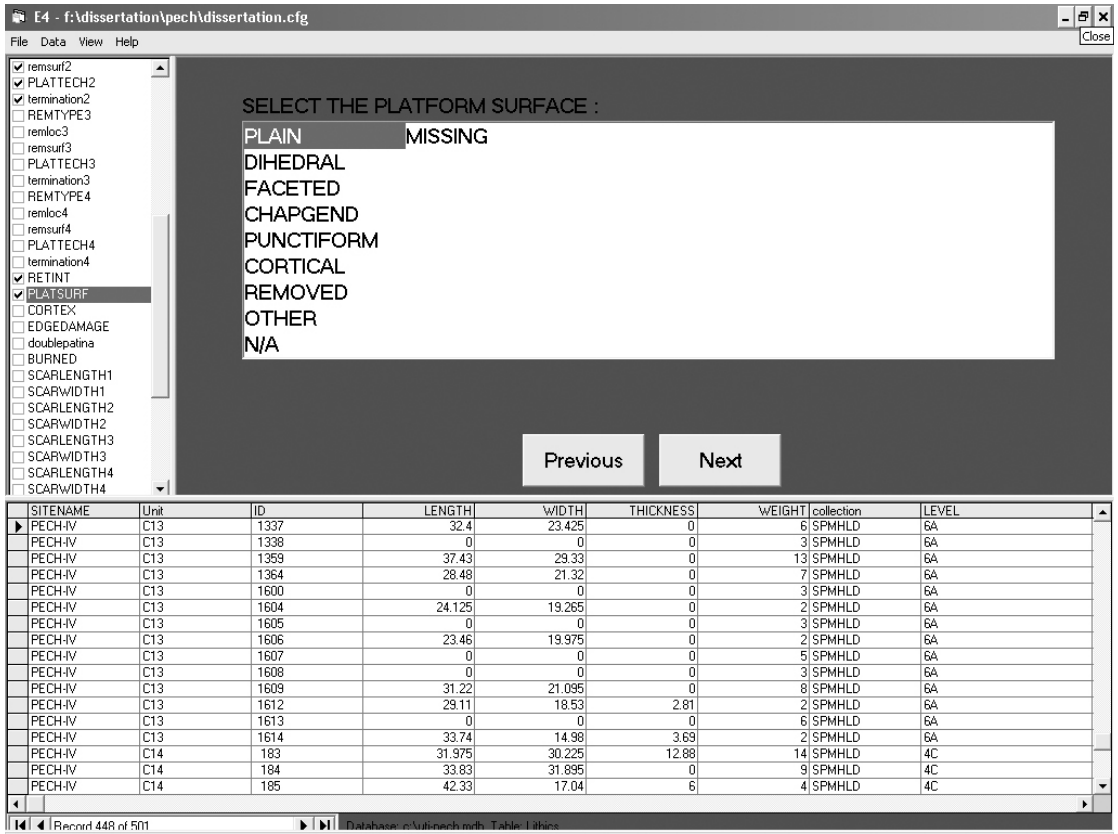


Figure 2.19: Screen shot from E4 showing the menu choices for platform surface. The sequence on the left top corner lists the variables highlighting the currently active one. The bottom half shows the data table.

The key <u>context information</u> for each artifact is either recorded directly or extracted from already existing digital data sources. This information includes the name of the site, the archaeological layer from which an artifact came and the unique identifying number of the artifact itself. Methods for recording unique artifact identifiers tend to differ from site to site. The sites excavated by Dibble and colleagues use UNIT–ID (in most cases the units are excavation squares and the ID a sequential number from 1 to n for the Unit in question). The vast majority of data collected for this study are recorded for individual artifacts, not for artifacts from bulk samples. This was done to ensure maximum flexibility in the analysis.

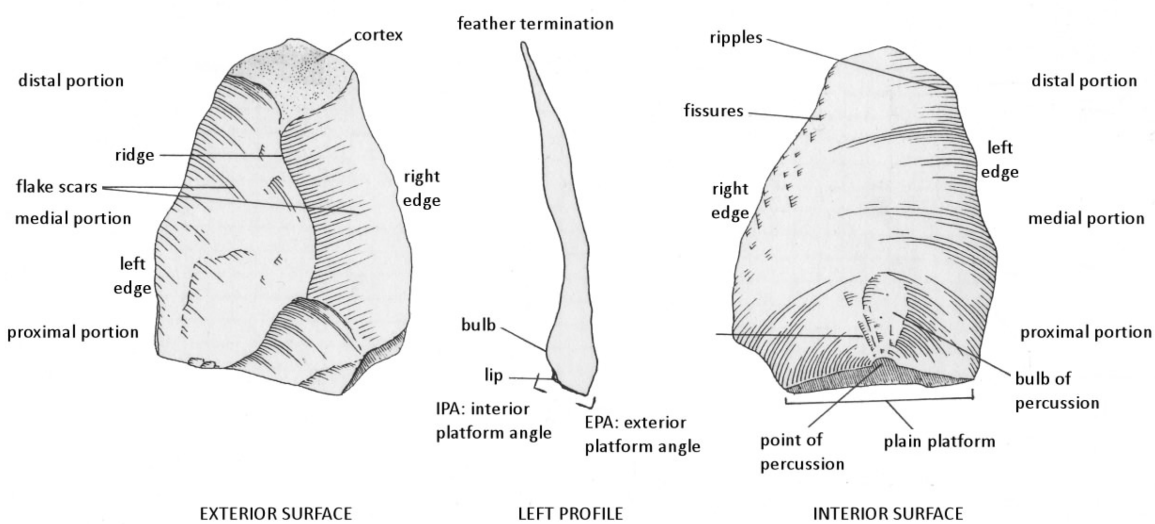


Figure 2.20: Flake attributes (reworked from Débenath and Dibble 1995, p. 13)

The next step in the analysis is the determination of the artifact '<u>dataclass</u>.' This variable represents the basic categories lithic analysts use in the analysis of stone artifacts. Based on the type of artifact specified in the dataclass a number of other variables are either recorded or not recorded. The attribute states for the variable 'dataclass' are presented in Table 2.2. Many of the attributes for flakes are shown in Figure 2.20 and some for cores in Figure 2.21. For example, for medial flakes, it would be impossible to record a type of platform.

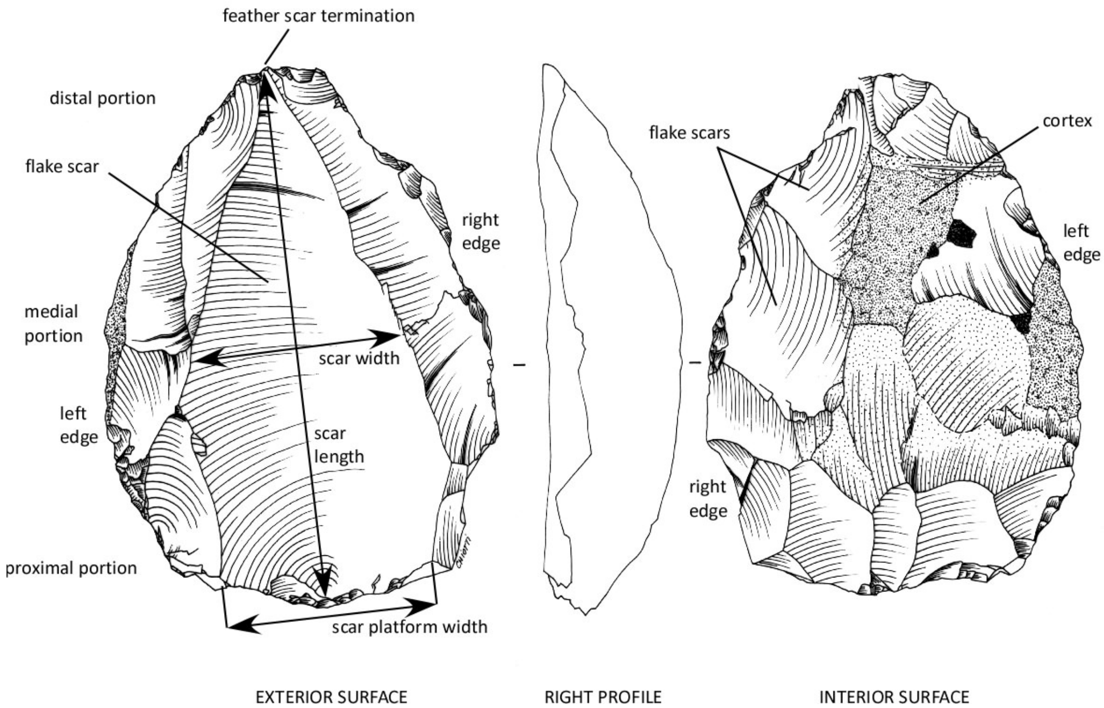


Figure 2.21: Core attributes and scar measurements

*Table 2.2: Attribute States for the Variable D*ataclass

flakes	tools	cores	other
Complete flake	Complete tool	Core	Shatter
Proximal flake	Proximal tool	Core Fragment	n/a
Distal flake	Distal tool	Coretool	
Medial flake	Medial tool		
Lateral flake	Lateral tool		
	Biface		
	Uniface		
	Uniface fragment		

Raw material type was recorded for all artifacts. The categories of raw material are site dependent, and each site examined for this dissertation is quite distinct. The use of stone in the Middle Paleolithic and Middle Stone Age tends to be strongly dependent on the locally available materials. At the site of Muguruk in Kenya, for example, the vast majority of artifacts are made on the locally abundant phonolite. This raw material is entirely absent in all the other sites examined. Because of the variability in the use of stone, the comparison of raw materials across sites is not straightforward, and this has implications for the analysis. For example, Muguruk has considerably more shatter than is typical at other sites and this might be due to the use of the local phonolite. Raw materials are recorded by the type of rock of which they consist (such as chert, basalt, phonolite, or quartzite) and/or further divisions within types of stone. An example of the finer distinction of raw material is found at Roc de Marsal where two types of chert are quite abundant, a dark and light variety of locally available chert. These are recorded respectively as “dark-localflint” and “light-localflint.” When broad comparisons between the use of raw materials of different sites are examined, the distinction between dark and light local flint becomes meaningless and is replaced by the more generic ‘chert’ designation. For some sites, such as Contrebandiers Cave, a detailed subdivision of raw materials as at Roc de Marsal currently is not possible due to limited knowledge of the local geology and the rich abundance of different raw materials found at the site. Therefore a distinction is made between coarse- and fine-grained raw materials. In essence, the coarse-grained raw material category represents quartzites whereas the fine-grained categories encompass different varieties of chert.

The basic flaking technology was recorded at each site and distinguishes between, among others, Levallois, Kombewa, blade, burin, biface thinning, and retouch flake technology. The majority of the artifacts in this category are classified as belonging to a simple, ‘undiagnostic’ flaking technology. This category is used for any artifact that is lacking features specific to a more specialized technological class. When the type of technology is uncertain, ‘n/a’ is the default attribute state.

Artifact form is recorded to indicate the general shape of an artifact. These include certain technology-specific categories such as “lame à crête” and “burinspall,” but the majority of these categories are exclusively shape related with attribute states such as “broad,” “triangular,” and flakes with a cortical side. In studies of African assemblages, shape tends to play a more important role than it does in Europe. This has to do with, on the one hand, historical differences in the emphasis of particular categories, such as tools, in each region and, on the other hand, real differences in the relative presence of formally retouched stone tools. Generally, in Europe sites tend to have higher percentages of retouched stone tools than in Africa. Whether this is a pattern due to real differences in the use of stone, or simply the result of biases in terms of the types of sites we find in each region (caves versus open air), is not immediately clear (see, e.g., Barton and Clark 1993).

Artifact support refers to the lithic category on which an artifact is made. For example, is a tool made using a flake blank, a piece of shatter, a gelifact, etc. Archaeologists often record this information for tools exclusively. In this study artifact support is recorded for all artifacts to allow the identification of cores made on flakes —one particular method for the production of small flakes identified at sites in the Near East (see e.g. Goren-Inbar 1988).

For each artifact a tooltype identification is made. The typology for tools that is the most widely accepted throughout Eurasia and large parts of Africa (particularly North Africa) is the one by François Bordes (1961), despite the fact that this typology was constructed based on material in Northern France and then vigorously applied to collections from Southwest France. This typology was adopted elsewhere and continues to be used today, although numerous authors have taken issue with it (Djindjian 1987, Sackett 1991, Bisson 2000, Mellars 1996). Some have critiqued it for confounding various factors that might be at play in tool typology (i.e., style and function) and as such argued that the typology loses its interpretive potential. Others have taken issue with the fact that the method derives from the 19th century.

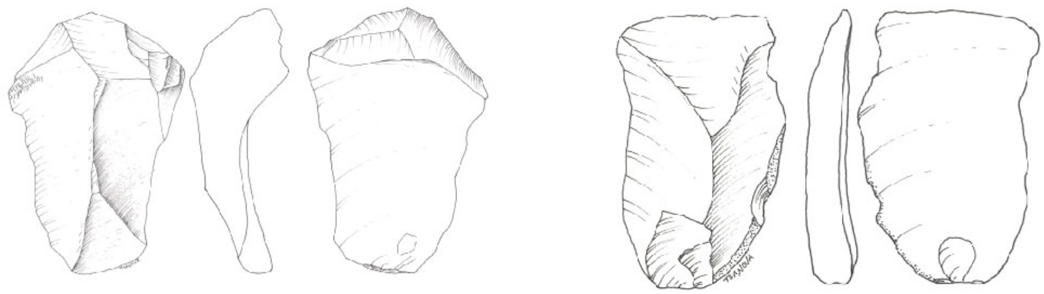
The use of the Bordian typology as a communicative devise should not be underestimated. Right now it is the only method we have in stone tool research — except the basic division into flakes, cores, and tools — that allows us to compare material from different sites. For this reason and because there is no viable alternative to the Bordian typology, it is used here. Specifically, I used a slightly modified version of the typology as described in Debénath and Dibble 1994.

It is widely known that certain artifacts can have edges that could be described as more than one type of tool. In these cases it is possible to record a second tooltype. However, when more than one type is present on a single artifact, strict rules are necessary to determine which type is recorded as the primary tooltype. The rules followed here hold that scrapers take precedence over simple types like notches and denticulates, but not over more complex ones like stemmed tools. Within the scrapers the higher numbered types take precedence over the lower numbered scraper types. For example, a scraper with thinned back (FB type 27) takes precedence over a single convex sidscraper (FB type 10).

For all flakes that preserve the distal end, the termination was recorded. There are three attribute states: feather termination, hinge termination, and an overshot termination (see

Figure 2.22). If, for some reason, the termination type is ambiguous or otherwise cannot be determined the attribute state “n/a” was selected.

For all truncated-facetted artifacts the character of the opposite surface is recorded. This was done because it has been suggested that this modification is a form of hafting preparation. If so, then it would be assumed that whatever is opposite the haft is likely to be the active part of the tool, and hence might show specific patterning.



overshot termination feather termination

Figure 2.22: Two common types of terminations. Drawings by Tsenka Tsenova.

The core type of all cores, core fragments and core tools is recorded. These include Levallois cores, single surface cores, Kombewa cores, limited removal cores, pyramidal cores, etc. There is much variability in the types of cores at each site, and individual core types tend not to be very rigorously defined. Nonetheless, in conjunction with some of the specific attributes recorded for core sizes and flake removals from these cores, it is possible to examine if there are patterns specific to particular types or not. One fairly common type that requires a more detailed description here is the single surface core. This type of core is identified by the fact that there is only one major flaking surface. That surface is also the largest or second largest surface (top or bottom) of the core. In many respects a single surface core is very similar to a Levallois core, but the former lacks the clear pattern of preparation and last central flake removal that is typical for a Levallois core. Research in Egypt has shown that Levallois cores and single surface cores there represent categories that are part of the same general reduction strategy (analogous to that shown in Olszewski et al nd). It seems likely that this is also the case elsewhere as single surface cores tend to be present whenever Levallois cores are.

The attribute of retouch intensity for all scraper and closely related types, such as Mousterian points, reflects one of three different character states: light retouch, normal or medium retouch, and heavy retouch. In cases where the attribution was unclear or not applicable “n/a” is recorded.

The platform surface for all flakes and tools that preserve the proximal portion of the artifact is recorded. Major types of platforms include: plain, dihedral, faceted, chapeau gendarme, cortical, punctiform, removed, and missing. Again “n/a” could be selected if the correct choice was unclear. These platform types are standard in lithic studies and textbooks can be consulted for examples of each (Debénath and Dibble 1994; Andrefsky 1998). However, two variable states are perhaps less clear and need some explanation: missing and removed platforms. Missing platforms denotes when a platform is not present — that is, the platform was not removed through retouch. Removed platforms are platforms that have been removed by retouch or otherwise clear flake removals. In either case, the artifact is complete enough to consider it part of the complete rather than fragmentary flakes or tools (i.e., medial or distal).

The percentage of cortex for each artifact is recorded in major intervals (see Dibble et al 2005). The categories consist of broad intervals that are easily estimated by observers.

The two extremes include no cortex at all and fully cortical pieces. Other intervals are: 1-10%, 10-40%, 40-60%, 60-90%, and 90-99% cortex.

Damage to the edges of artifacts is recorded in five major categories. These include no edge damage, edge damage on one side, edge damage on two sides, rolled, and sandblasted. Rolled and sandblasted artifacts are the most damaged, but differ in the manner in which the artifact has been damaged. Rolled artifacts received damage from physically rolling and the impact with other hard items. Sandblasted artifacts do not necessarily move much, however, their surface is smoothed by the impact of sand particles suspended in the wind.

Patina is not recorded for the artifacts, but whether an artifact is double patinated or not is recorded. Nishiaki (1985) suggested that small flake removals might be the result of the reuse of raw materials. Hence it would be expected that a disproportionate number of truncated-faceted pieces show a double patina. Similarly, whether or not an artifact is burned also is recorded.

Length of artifacts is measured from the point of percussion to the most distal end of the flake (Jelinek 1977; Dibble et al. 1995: 39). For cores the length is determined by the longest axis. Similarly for broken pieces lacking the point of percussion, the length is simply determined by the longest axis. Width, conforming to the methodology originally employed by Jelinek (1977), is measured at the midpoint of length and perpendicular to it. For flakes the width is measured in the same plane as length when the artifact is laying flat, bulb of percussion down. For cores, width is determined by the second largest dimension perpendicular to and at the midpoint of length. Core thickness logically is the third measure perpendicular to both length and width at the midpoint of both length and width. For flakes the thickness is the measure of the distance from the surface of the interior to the exterior of the flake at the intersection of the length and width measurements.

Platform width and platform thickness were measured for all complete flakes and tools. These measurements follow the system as established by Dibble et al. (1995) for the study of the Combe Capelle Bas material in Southwest France. Platform width is measured from the leftmost portion of the platform to the rightmost portion of the platform. When we are dealing with core-edge flakes which remove a portion of the core beyond the platform and there is no obvious break between the platform proper and the core-edge, then no measurement was taken. Platform thickness is measured perpendicular to platform width starting at the point of percussion.

Interior Platform Angle (IPA) and Exterior Platform Angle (EPA) were measured as well. Both of these measurements are among the more difficult to replicate effectively. However, that should not discourage us from attempting to define these measurements in such a way that we can effectively measure them. Both of these, and EPA in particular, have real value in the analysis of stone artifacts (Dibble 1997). In this study, IPA was measured as the angle between the plane determined by the flake platform and the interior surface of the flake. The interior surface, much more so than the platform, is not a simple flat surface, so some further specification is needed. I decided to consider the interior flake area as determined by the line connecting the point of percussion and the distal-most interior portion of the flake. EPA on the other hand is measured as the angle between the platform surface and the exterior surface of the flake (Dibble and Whittaker 1981). Both of these measurements have been criticized (Shott et al. 2000) for their subjectivity, but as yet no good inter-observer study has been performed to determine the extent of the problems with these respective measurements. Finally, <u>weight</u> was recorded for all artifacts to the nearest gram using a digital scale.

The next eight variables are designed to record specific information about flake scars on an artifact (see Table 2.3). There are several methodological questions that must be answered when recording flake scars. First, which scars are taken into consideration and which are not? Second, how can the variables be constructed so that resulting data is directly comparable with data collected on individual artifacts such as cores and flakes? This is necessary if, as is the case here, one wants to demonstrate or refute the similarity between removals from flakes and those from cores. Third, what is the procedure when certain attribute states are simply not visible or available for a particular scar? Each of these questions will be treated in turn.

Table 2.3: Variables Recorded for Flake Scars

Flake scar variables
removal type
removal location
removal surface
platform technology
termination
scar length
scar width
scar edge angle

Almost all stone artifacts exhibit flake scars. The majority of these are remnant scars (flake scars) on the exterior of flakes and they tend to be incomplete. For example, the left edge of flake '1' in Figure 2.23 was removed when flake '2' was removed from the core. In other words, flake scar 1 stems from a flake removal prior to the removal of flake 2 in the figure. Scars like the remnant flake scar 1 and 2 are not considered in this study. Conversely, scars like flake scar 3 (which is the negative resulting from the removal of flake '3') is. Flake scars resulting from removals that were initiated prior to the manufacture of the flake itself also are not considered. For example, the flake scars identified in Figure 2.20 both were initiated prior to the manufacture of the flake illustrated in the figure. Thus, only scars from flakes removed after the artifact itself was detached from its core are taken into consideration. On cores, flake scars that are complete are included in my analysis. An example of one of those is the flake scar visible on the exterior surface of the core in Figure 2.21. There are some classes of artifacts where determining the sequence of removals is not always easy. For example, when the edge of a core is removed, it is quite possible that entire flake scars are still present on the resulting flake. Scars on these classes of artifacts, such as core rejuvenation flakes, were not recorded here. Note that the sequence of removals can be difficult to determine. For example, the order of the two flake scars identified on the interior surface of the core in Figure 2.21 is unclear. Unless it was absolutely clear upon inspection of the artifact itself which of the two flake scars identified was the last one removed, neither is included in this study.

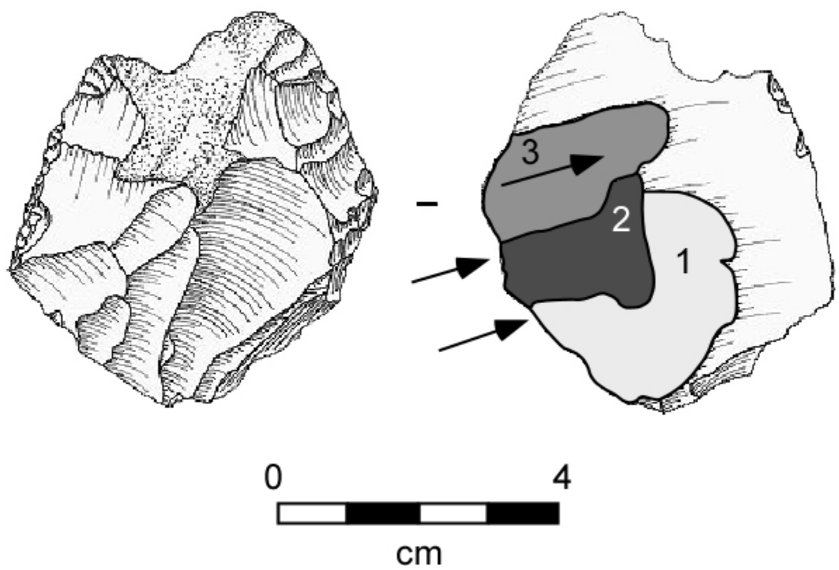


Figure 2.23: Kombewa core with three removals from the interior of the flake. The sequence of these removals can be reconstructed as indicated by the numbers on their negatives. Flake '1' was removed first, than flake '2', than flake '3'. While both length and width can be measured for flake '3', the width measurements for flakes '2' and '1' are no longer available as the last flake ('3') removed a portion of the second flake. Similarly a portion of the first flake removed from the kombewa core is missing.

A maximum of four flake scars per individual artifact were recorded, with one from each major area of flaking. For example, from a continuous scraper edge, only one flake scar would be recorded. However, if on an opposite edge a notch was removed, the negative of that notch could also be recorded. Flake scars were chosen based on their position relative to the flaking sequence. That is, the last scar on a flake was the primary target for recording. A second criterion was how well preserved an individual scar is. For example, in our hypothetical scraper edge, we might find that there are several scars which could have been the last flake scar. From among those scars the scar which is undamaged and for which the various attributes are easily recognized was selected for recording. Size only mattered as a third criterion. That is, if there were several equally suitable scars on a single flaking surface then the largest of those was favored over the others. A total of eight variables were measured for each scar.

The first element recorded for scars is their <u>typological appearance</u>. If the scar in question is part of what we consider a scraper edge, then the typological appearance for that scar is ‘scraper’ and so on. Other options are Clactonian notch, complex notch, T-F, burin, truncation, bifacial, denticulate, facetted, backing, and core-like.

The second item considered is the <u>location</u> of the flake scar. Identifying this location for flakes is relatively straightforward as there is a widely agreed upon framework for orienting flakes. The location on a flake is determined relative to the position of the bulb of percussion which forms the proximal portion of the artifact. The side opposite to the proximal end is the distal end. Left and right sides are determined when the flake is placed with the bulb closest to the observer. That is, when the exterior surface is visible, the left side is left lateral and the opposite side right lateral. For cores, however, there is no such agreed upon orientation. I decided to orient the core relative to the longest axis, the second longest axis, and the primary area of flaking. The longest axis in conjunction with the primary or main area of flaking determines the proximal and the distal portions of the core. In other words, the Levallois flake scar on a typical Levallois core would be visible and the negative bulb of the Levallois flake is down (the proximal portion of the core). The side opposite to it is distal and right and left lateral sides are on either side (see Figure 2.21). For certain types of cores this characterization is much less straightforward. For example, a true pyramidal core has its primary areas of flaking all around the core, rather than on one particular face of that core. In these cases the core had to be oriented as best as possible according to the criteria just described.

A second variable 'removal surface' to further describe the location of the flake scar is used. The question here is, what best describes the main surface on which the scar is found? The different attribute states include interior, exterior, side, and combinations of these two. As would be expected, the majority of removals are found on the exterior surface. Keep in mind, however, that this is a result built into the typological system as cores are oriented such that the main flaking surface is by definition on the exterior surface. The rationale behind this orientation is that it gives the best possible match between the orientation of a flake and the core from which this flake came. Consider for example the Levallois core and its Levallois flake in Figure 2.24. When both are oriented according to the rules described here, then the flake would fit onto the core without needing rotation of any sort.

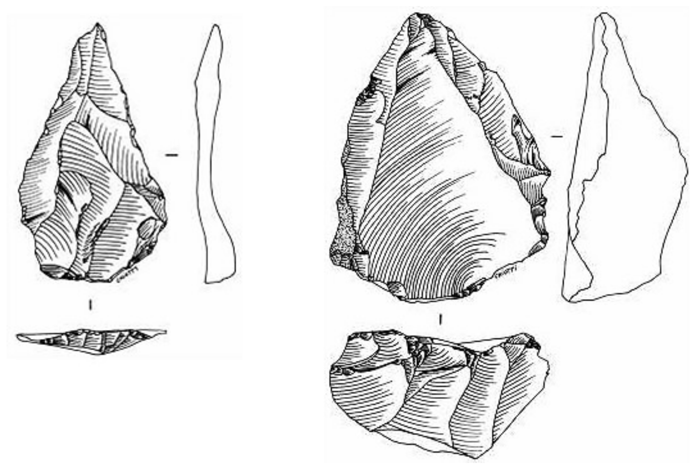


Figure 2.24: A Levallois core and flake which refit. Both are oriented correctly. The proximal sides are down and the exterior surfaces up.Drawings by Laurent Chiotti.

Several of the variables for flake scars on cores are designed so they would be directly comparable to corresponding variables recorded for the flakes themselves. These variables include <u>platform character</u>, <u>termination</u>, <u>scarlength</u>, <u>scarwidth</u>, and <u>edge-angle</u>. The platform type is determined by the area immediately below the platform scar. From this area it is determined if the platform was plain, dihedral, faceted, cortical, etc. The termination records the type of termination that is exhibited by the flake scar.

Attribute states include feather, hinge, and overshot. Scarlength and scarwidth are measured as they are for artifacts. That is, length is determined by the distance from the point of percussion to the point furthest removed, whereas width is measured perpendicular to length at its midpoint. Finally, edge-angle is the angle between the continuation of the platform negative from the negative point of percussion on the one hand and that same point and the distal end of the flake negative on the other hand. This measurement is expected to match IPA after the edge-angle is subtracted from 180 degrees.

Measures of Assemblage Characteristics

Below some of the specific terms, indices, and ratios used in the analysis are defined.

Real count: sum of all tools incorporated into the Bordian typology.

Essential count: sum of all *retouched* tools incorporated into the Bordian typology with the exception of artifacts with retouch on the interior (type 45), artifacts with abrupt and alternating retouch (types 46-49), and artifacts with bifacial retouch (type 50).

IL: The Levallois Index is defined as the sum of all Levallois products divided by the total assemblage with the exception of cores, core fragments, coretools, and shatter.

ILty: The typological Levallois Index is computed as the sum of all Levallois products divided by Bordes' real count.

Scraper Reduction Index: Defined as the sum of all convergent and transverse scrapers with the addition of limaces, Mousterian points, and elongated Mousterian points divided by all single and double scraper types.

Notch Reduction Index: Defined as the sum of denticulates and tayac points divided by the sum of notches and endnotches.

Blank: All complete and proximal flakes and tools are considered blanks.

Flake scar: the scar pattern found on the exterior of a flake or possibly any side of a core which demarcates a complete or incomplete previous removal. Note, only 'complete' flake scars were included in this study.

Flake: only complete and proximal flakes were included in flake counts not distal or medial fragments.

Blank to core ratio: Defined as the blank count of an assemblage divided by the sum of cores and core fragments.

Flake to tool ratio: Defined as the sum of all complete and proximal flakes divided by the sum of all complete and proximal retouched tools.

Toolcore: Toolcores are defined as all retouched tools which are not scrapers.

Chapter 3 Results

In this chapter the assemblages of each of the sites are examined in turn. I first discuss the sites in France and then turn to the African sites. In the description of each layer some comparison with other layers are drawn, but more explicit comparisons and larger implications of these comparisons between the sites will be considered in the discussion chapter that follows. The lithic assemblage of each layer is considered first in terms of its basic typo-technological characteristics. Next flake scars on tools (excluding flake scars on scrapers) and flake scars on cores are examined in more detail to determine the relationship between these two classes of removals. Comparisons are drawn with flake scars on scrapers and with the complete flake population where appropriate. The analyses were done using Statistica, Excel, and Access. Note that not all results are discussed, only those relevant for the study. For example, results of the analyses considering EPA and IPA are not included as it quickly became clear that the data were not reliable enough to be meaningful here.

Pech de l'Azé IV

Layer 4C

Assemblage composition

A total of 624 lithic artifacts from this layer were examined. With an average of 43 artifacts per seven liter sample of sediment, or one bucket (see Table 3.1), this layer has the highest artifact density of the layers at Pech examined here. However, in terms of lithic artifacts, this layer is the least dense of the layers examined. Only about 6 of the artifacts per bucket are lithics; the remaining material consists of often heavily broken bone. That there are about six times as many bones as there are lithic artifacts is significantly different than in layers 6A and 8 at Pech IV and might point to a functional difference in site use.

Table 3.1: Richness of the Layer in Terms of Faunal and Lithic Artifacts

layer	fauna/lithic	lithic/bucket	artifacts/bucket
4C	5.9	6.2	42.6
6A	2.0	8.1	24.1
8	0.7	9.7	16.3

A similar picture emerges from an examination of the basic categories of the lithic assemblage itself (Figure 3.1). Layer 4C is characterized by a relatively high number of tools (Table 3.2), few cores and core fragments (Table 3.3), and fewer flake fragments and shatter than in layers 6A and 8. Based on this evidence alone it seems the emphasis in layer 4C is on activities other than core reduction, perhaps the processing of animal carcasses. Blanks seem to be brought into the site rather than made at the cave itself. Tools also seem to be brought into the cave and further reduced at the site. The Scraper Reduction Index is the highest of the three levels of Pech examined: 0.41.

Table 3.2: Breakdown of the Bordian Types in Layer 4C at Pech IV

Type #	Bordian tooltype		count	percent
1	Typical Levallois flake		15	11.5
2	Atypical Levallois flake		10	7.6
3	Levallois point		2	1.5
5	Pseudo-Levallois point		6	4.6
6	Mousterian point		1	0.8
9	Straight single scraper		8	6.1
10	Convex single scraper		26	19.8
11	Concave single scraper		2	1.5
13	Double straight-convex scraper		2	1.5
15	Double Convex scraper		4	3.1
19	Convex convergent scraper		6	4.6
21	Dejete scraper		5	3.8
22	Straight transverse scraper		2	1.5
23	Convex transverse scraper		3	2.3
25	Scraper on interior		2	1.5
27	Scraper w/ thinned back		1	0.8
28	Scraper w/ bifacial retouch		1	0.8
32	Typical burin		2	1.5
38	Naturally-backed knife		11	8.4
42	Notch		2	1.5
43	Denticulate		5	3.8
44	Bec burinante alterne		1	0.8
48	Abrupt/alternating retouch		6	4.6
51	Tayac point		1	0.8
54	End-notched flake		3	2.3
61	Chopping-tool		1	0.8
64	Truncated-Faceted piece		3	2.3
		Total	**131**	**100**

Table 3.3: Breakdown of the Core Types in Layer 4C at Pech IV

core type	**count**	**percent**
Kombewa core	2	10.0
Levallois core	1	5.0
Single surface core	3	15.0
Double surface core	1	5.0
Chopper	1	5.0
Globular core	2	10.0
Other	1	5.0
Informal core	2	10.0
N/A	7	35.0
Total	**20**	**100**

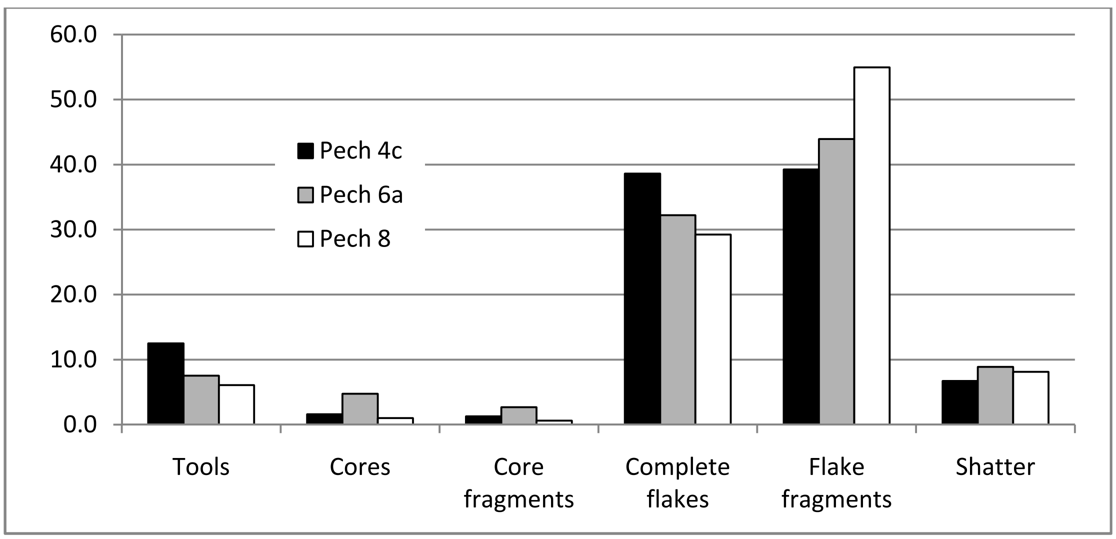


Figure 3.1: Breakdown of the lithic assemblages at Pech IV into basic categories. The vertical axis represents the percentage of each artifact category for the layer in question. In other words, the sum of the percentages from all artifact categories for each layer equals 100 (Pech 4C: n=624; Pech 6A: n=2,418; Pech 8: n=2,486).

If we look at the assemblage from a slightly different perspective, one that focuses more on tools and downplays the importance of blanks and cores, the patterning looks different (see Figure 3.2). Layer 4C, like many Middle Paleolithic assemblages in Europe

(Bordes 1981), is dominated by scrapers (Table 3.3). The other types including four types of notched pieces (notches, denticulates, Tayac points, and end-notched pieces), the Upper Paleolithic types of tools (endscrapers, burins, borers, and backed knives), and other tools (all essential tool types not including scrapers, notched pieces, and UP types) are of minimal importance in comparison to the scrapers. It is interesting to note the similarity of 4C from this perspective with layer 8 and the marked difference with layer 6A. With exception of the incidence of Levallois pieces (Table 3.4), these are the main elements that help determine the industrial affinity of the assemblage — in this case both layers 4C and 8 (I2 and XYZ of Bordes) belong to the Typical Mousterian.

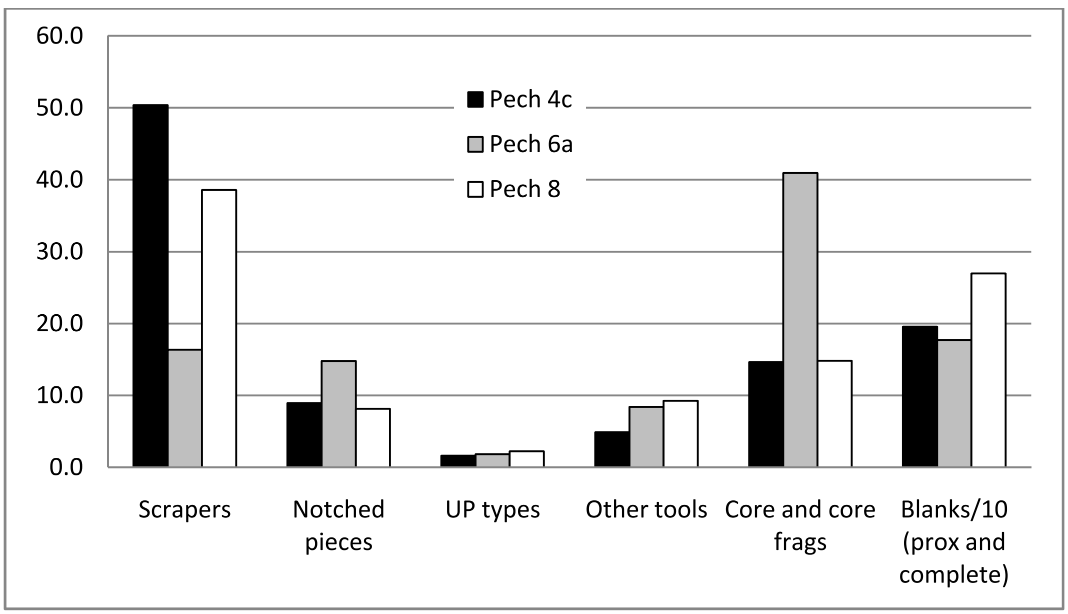


Figure 3.2: Breakdown of lithic assemblages at Pech IV into 4 major types of tools, cores, and unretouched blanks. The vertical axis represents the percentage for each artifact category per layer. In other words, the sum of all artifact categories for each layer equals 100%. To prevent blanks from dominating the graph, their totals were divided by 10 such that comparisons between the various categories can be done more effectively (Pech 4C: n=123; Pech 6A: n=440; Pech 8: n=270).

The Levallois indices (Table 3.4) show that layer 4C is not very rich in Levallois blanks (IL and ILty). The IL index is a measure of all Levallois blanks divided by the total number of blanks including blank fragments. The ILty is similar for the numerator, but the denominator consists of the total count of tools in the Bordian typology (retouched and unretouched). There are also two other measures of the incidence of Levallois cores and single surface cores in the assemblage. Single surface cores, broadly defined, include Mousterian discs, Levallois cores, and cores which exploit the same surface as a typical Levallois core, but often lack the final and defining removal. Research in Egypt has shown that single surface cores are part of a general Levallois reduction strategy and typically are more intensively reduced than Levallois cores themselves (Olszewski et al nd). In either case, all measures shown in Table 3.4 are consistent and indicate that Levallois and single surface types of reductions are relatively rare in layer 4C when compared to the other two Pech layers.

Table 3.4: *Four Different Indices for the Ubiquity of Levallois and Levallois-like Technology at Pech IV.*

	Pech IV - 4C	Pech IV - 6A	Pech IV - 8
IL	4.8	11.9	7.3
ILty	20.6	40.5	36.1
IL core	5.6	6.7	5.0
Single surface cores	22.2	63.9	55.0

There are numerous potential measures of the intensity of utilization of an industry. Two of the more common ones are shown in Figure 3.3. The first is the blank to core ratio. When there are many blanks per core the traditional interpretation is that each core was reduced extensively. A high blank to core ratio, in other words, indicates a high intensity of raw material utilization. Keep in mind, however, that this measure assumes that no products of the knapping process were removed from the site. If either cores or blanks are preferentially removed, a not altogether unlikely scenario, then this measure might not be very effective. A second measure, the flake to tool ratio, divides the number of unretouched flakes (complete and proximal) by the number of retouched ones (also complete and proximal pieces). In this case an industry is considered intensively used when the flake to tool ratio is low. Again the measure is not assumption free; import and/or export of either flakes or tools can affect it. Regardless of these problems, the measures can still provide a good initial indication which can be further strengthened with additional data, such as measures of artifact size. In Layer 4C both measures of the intensity of raw material utilization suggest that the industry is intensively reduced. That is, the blank to core ratio is high, and there are many tools relative to unretouched flakes.

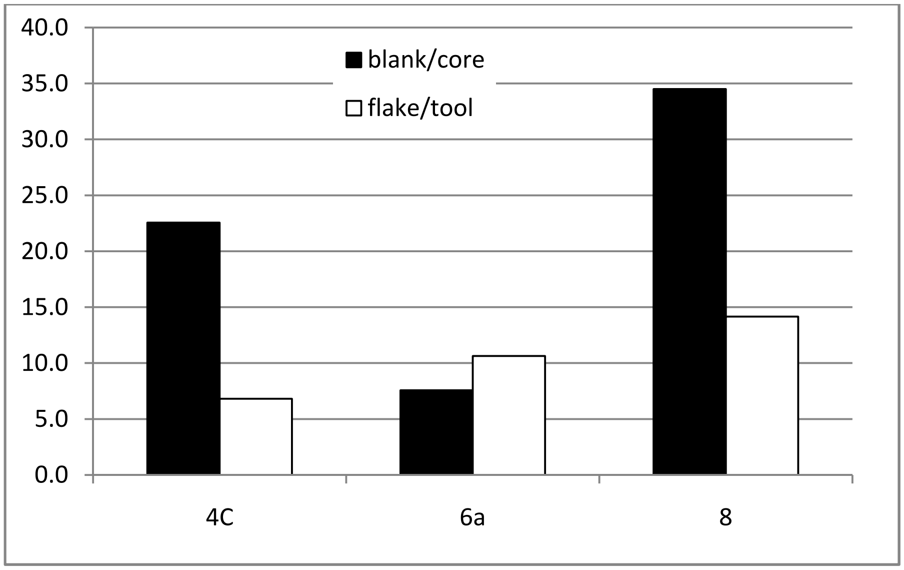


Figure 3.3: Two measures of reduction intensity (blank to core and flake to tool ratios) for layers 4C, 6A, and 8 at Pech IV.

In terms of the sizes of complete flakes, complete tools, and cores it is clear that there is, as expected, quite a bit of overlap (Figure 3.4). Typically unretouched flakes are smaller on average than are cores and tools and that pattern is consistent with layer 4C at Pech IV. However, the sizes of cores are slightly smaller in terms of length than they are for complete tools. Keep in mind however, that this pattern is slightly deceiving because if we take width, weight (Figure 3.5), or thickness (Figure 3.6) as our size measurement then it quickly becomes clear that cores are larger on average than complete tools, except in their longest dimension (length). Further, cores are as large as complete tools when considering length*width (Figure 3.7).

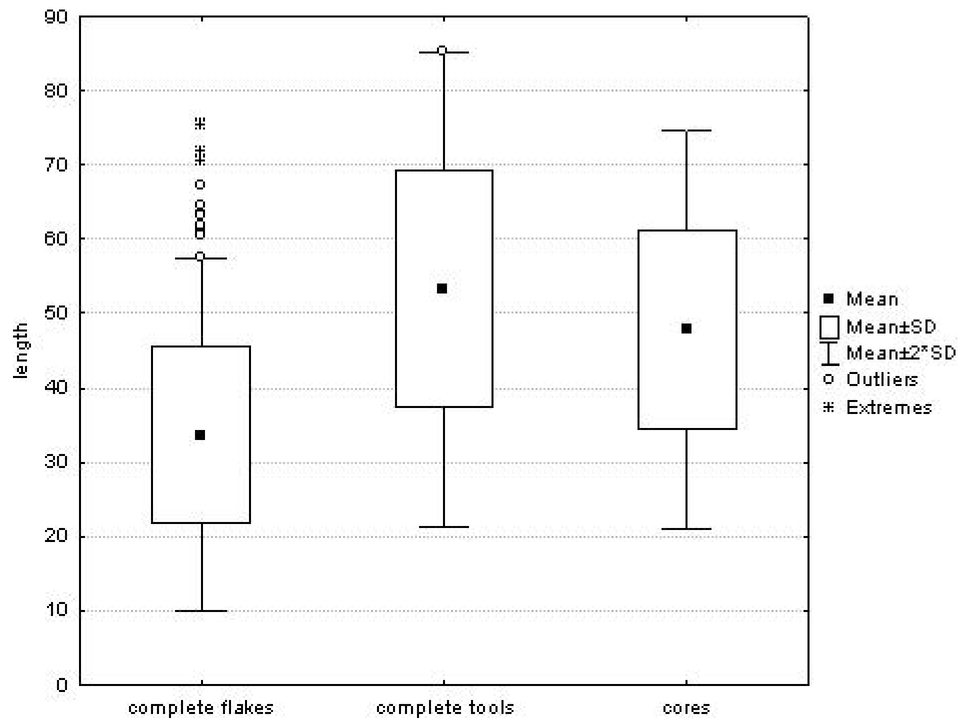


Figure 3.4: Box-and-whisker plot of the length of complete unretouched flakes, complete formally retouched tools, and complete cores in layer 4C at Pech (complete flakes: n=241; complete tools: n=39; cores: n=10).

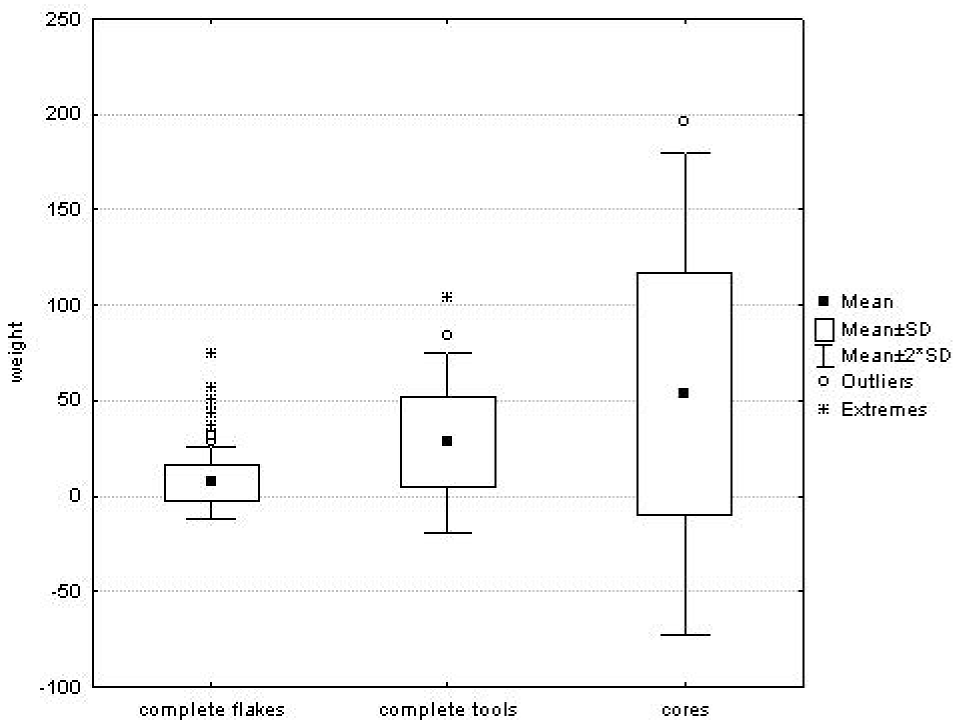


Figure 3.5: Boxplot of the weight of complete unretouched flakes, complete formally retouched tools, and complete cores from layer 4C (complete flakes: n=240; complete tools: n=39; cores: n=10).

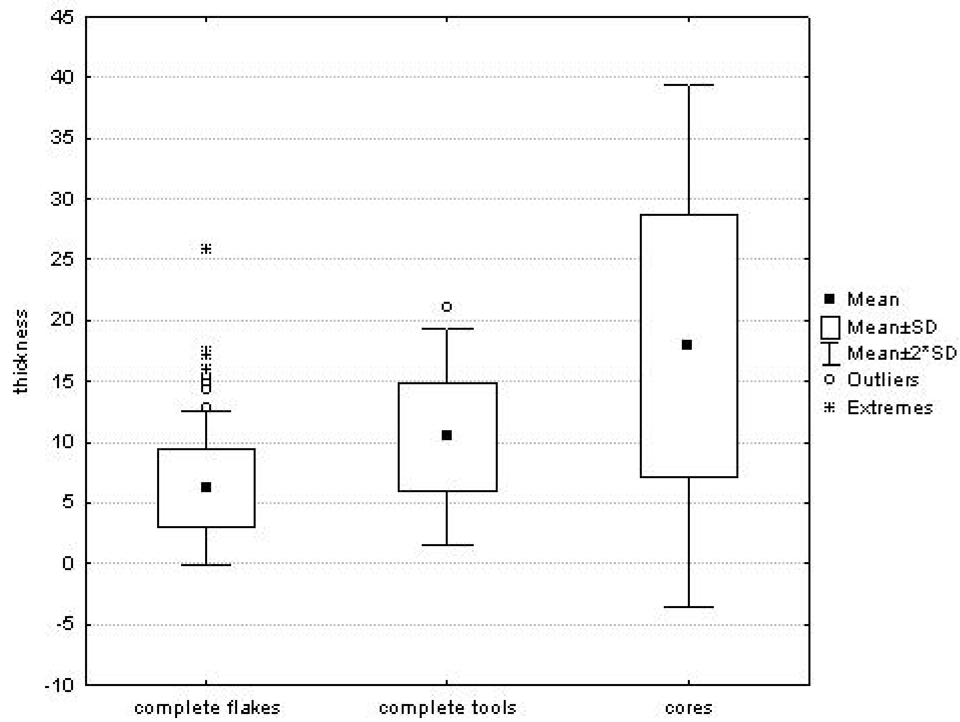


Figure 3.6: Boxplot of the thickness of complete unretouched flakes, complete formally retouched tools, and complete cores from layer 4C (complete flakes: n=241; complete tools: n=39; cores: n=10).

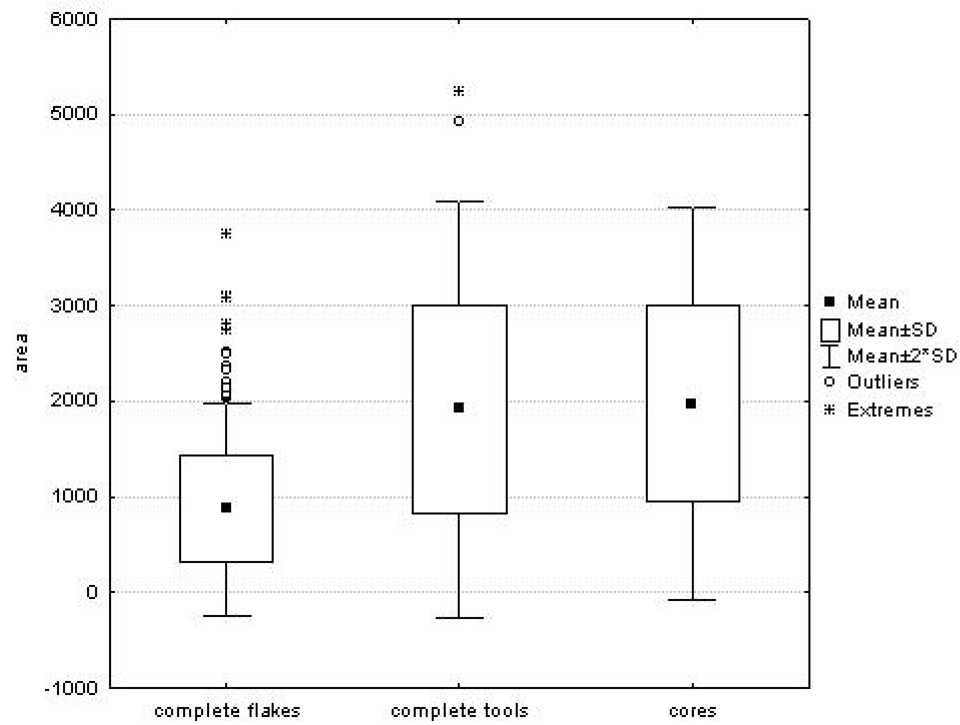


*Figure 3.7: Boxplot of the length*width of complete unretouched flakes, complete formally retouched tools, and complete cores from layer 4C (complete flakes: n=240; complete tools: n=39; cores: n=10).*

It has been shown that industries which are characterized by a high blank to core ratio can be expected to exhibit corresponding small average flake and core sizes (Roth and Dibble 1998). Furthermore, it might be expected that the production of small flakes also would be relatively higher in such assemblages. In other words, if raw material is intensively reduced, then more and more techniques that allow the manufacture of increasing quantities of small flakes might be employed. Layer 4C seems to provide an ideal test in this regard as the blank to core and flake to tool ratio both point to intensive utilization of raw material. However, the expected corresponding increase in small flake producing technologies such as truncated-faceted, Kombewa, and other techniques producing cores-on-flakes is not found in this layer. In general, cores are infrequent in the assemblage, as are cores-on-flakes. T-Fs are present, but again, they are not common and only make up 0.5 % of the entire assemblage. In the Asinipodian layer at Pech (6A), by contrast, T-Fs are present four times as frequently, making up a full 2% of the entire assemblage.

A closer look at the small flakes from layer 4C is particularly instructive to better understand the peculiar nature of the assemblage in the layer. Just fewer than 50% of the small flakes in the fraction of 10mm and smaller represent retouch flakes. In other words, the majority of the stone tool reduction in layer 4C has to do with scraper resharpening rather than with the manufacture of flake blanks. This, as we saw, fits well with the richness of the assemblage in terms of scrapers as well as the paucity of the evidence for primary flake reduction. Furthermore, this pattern also seems to fit well with the relatively large size of the tools relative to the cores, suggesting that tools are not derived from the cores found in the layer itself, but rather imported into the site from elsewhere. The intensity of the scraper rejuvenation taking place is not only attested to by the ubiquity of small retouch flakes, but also by the high Scraper Reduction Index.

The pie charts in Figure 3.8 represent the platform preparation for two classes of artifacts. These are flakes, on the one hand, and flake scars on cores and tools, on the other hand. In the chart, scrapers have been excluded from the totals as they can be shown to be a special case. In fact, of the 664 scrapers examined in this study, only 8 showed a platform preparation other than plain. Therefore I excluded scrapers from this and many of the other comparisons between flakes and flake scars or between scars on tools and scars on cores. Platform preparation is relatively rare in layer 4C (Figure 3.8). Of the flakes only 1 in every 4 shows signs of platform preparation whereas only 1 in every 5 flake scars shows similar platform preparation. Roughly equal amounts of prepared platforms for both tools and flakes are dihedral, the others faceted. Cortical platforms are more common in flakes than they are in flake scars.

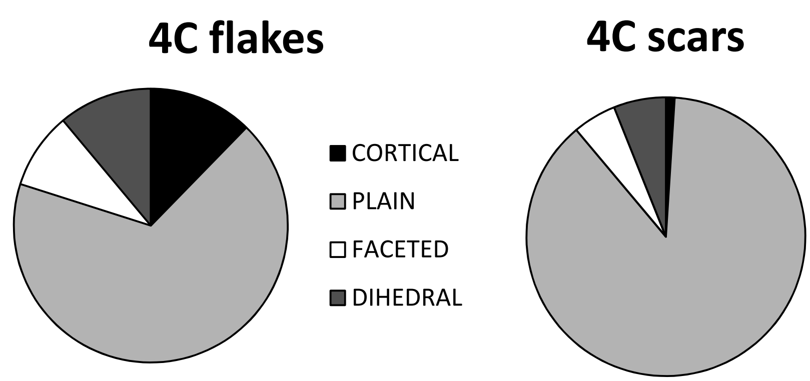


Figure 3.8: Platform preparation in layer 4C at Pech (flakes: n=244; flake scars: n=99).

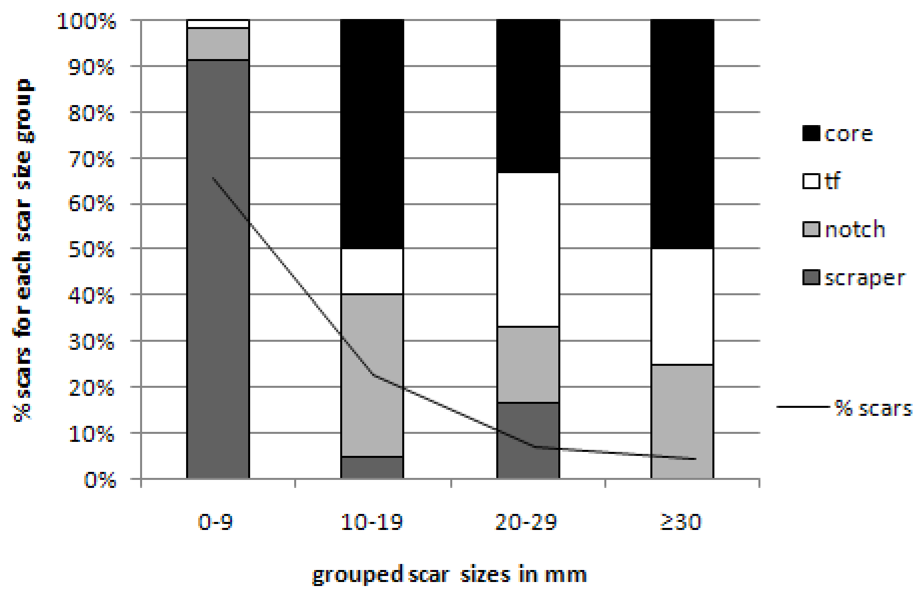


Figure 3.9: Sizes of removals for different classes of artifacts from layer 4C at Pech.

When we look at the sizes of removals from different classes of artifacts it is clear that the smaller removals are concentrated among the scrapers as might be expected (Figure 3.9). However, as the sizes of the removals become bigger they are divided among different classes of artifacts fairly evenly. This suggests that in this layer we cannot easily differentiate removals in terms of size as belonging to certain artifact classes exclusively such as cores. Indeed, while cores feature some of the larger removals, we can see that T-F pieces also exhibit relatively large removals. The same can be said for notch removals. It is also clear from the graph that small removals, those under 10 mm in length, make up the majority of flake scars in the assemblage from layer 4C. This finding fits well with an assemblage dominated by scrapers and scraper resharpening. In fact, half of the removals measured for this layer are flake scars on scrapers, a pattern that matches the strong presence of retouch flakes in the screen residue.

Comparison of flake scars on cores and tools

In the comparison of flake scars on cores and those on flakes, I will not include scraper rejuvenation scars as they are the only category that seems to constitute a special case. Indeed, almost all scraper rejuvenation scars are distinctive in their very small size (less than 10 mm). Three categories are compared in Figure 3.10. These are the flake scars on tools (other than scrapers), flake scars on cores, and finally the actual sizes of complete unretouched flakes themselves.

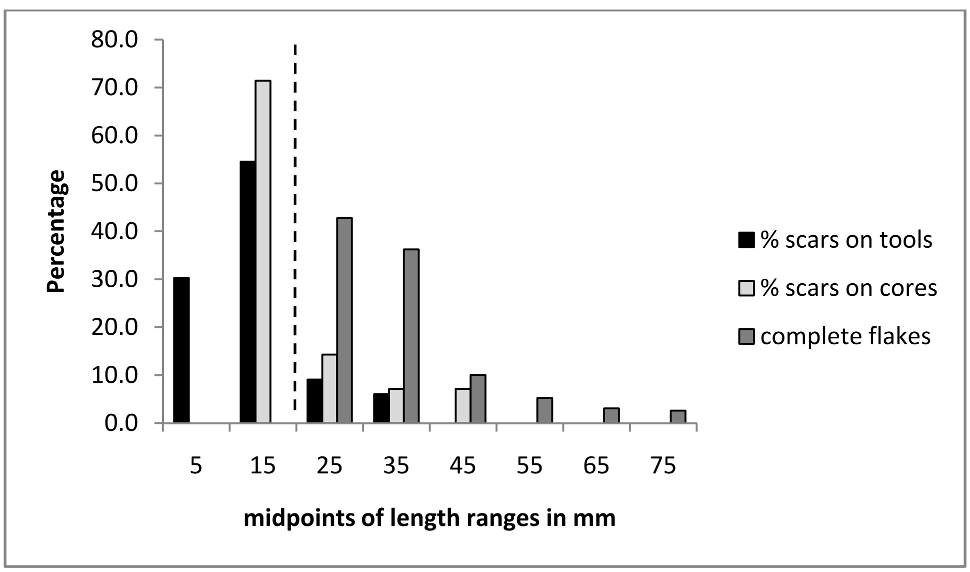


Figure 3.10: Tool and core removal negatives compared to each other and to the complete flake size distribution. Scraper scars are excluded from the graph.

The types of removals on tools are more diverse than they are on cores. In fact, all of the removals from cores were typed as “core-like,” whereas those on flakes are often “core-like” but also include notch removals and T-F removals (Figure 3.11). This figure suggests, as we saw for the flake scar sizes on tools, that a sizeable proportion of the removals on tools are not distinguishable from flake scars on cores.

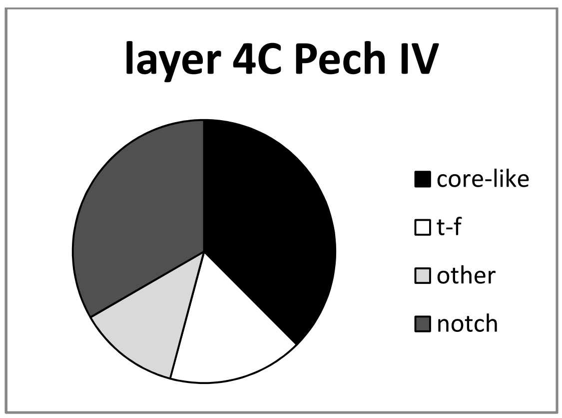


Figure 3.11: Breakdown of the type of flake scars on tools (n=24).

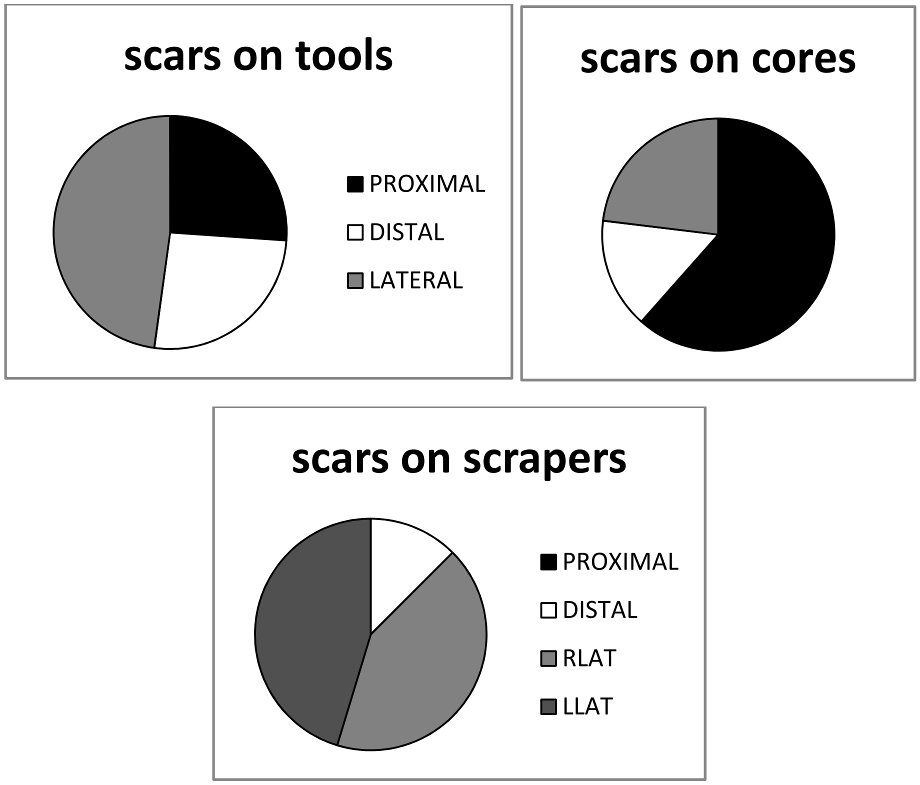


Figure 3.12: Breakdown of the location of removals on tools (n=23), cores (n=13), and scrapers (n=64).

There is no obvious preference in the location of flake scars on tools (Figure 3.12). Roughly equal amounts of removals are on either of the lateral sides, with the remainder divided equally between the proximal (or bulbar area) and the distal portion of the tool. Cores, on the other hand, do show a marked preference for flaking on the proximal portion of the core, but this can be easily understood as a result of the orientation criteria for the cores. As discussed in the chapter 2, part of the orientation is determined by the area with major flaking. That area, by definition, is the proximal portion, and therefore a large proportion of proximal flake scars is expected. However, what the data do show is that most removals are found alongside the longest axis of the block of raw material (either the proximal or the distal side) and not so often along the two lateral sides. This can be contrasted with removals from flakes which are more evenly distributed.

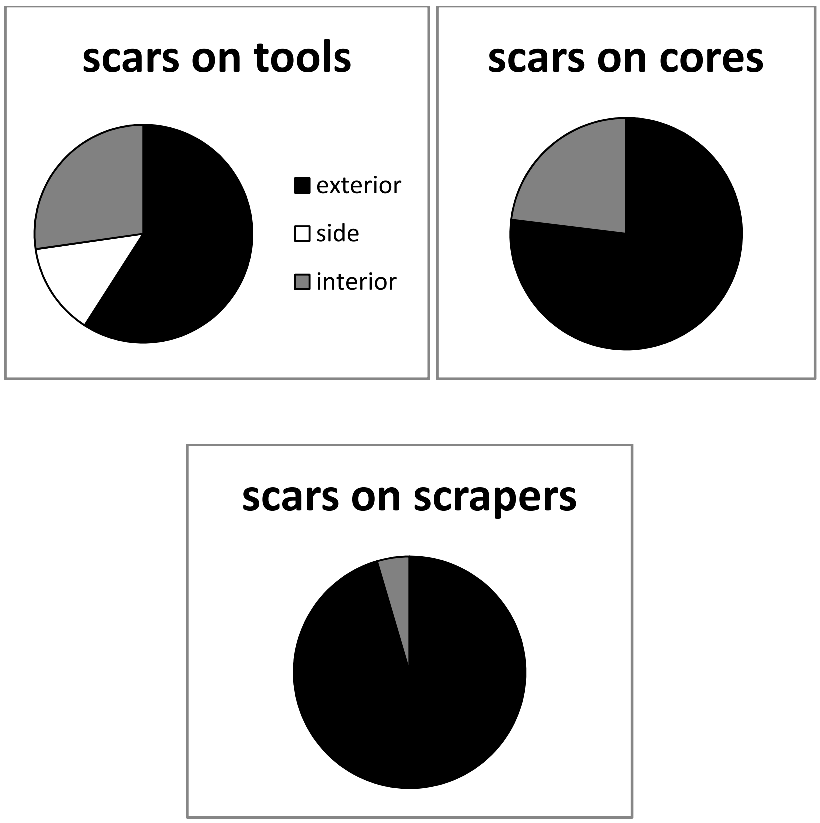


Figure 3.13: Breakdown of the location of removals for tools (n=22), cores (n=13), and scrapers (n=66) from layer 4C at Pech.

The breakdown of the surfaces from which flakes are removed perpendicular to the one determining proximal and distal portions of artifacts (Figure 3.13) shows that there is a strong preference to use the interior surfaces of flakes as the striking platform and thus remove stone from the opposite side, the exterior of the flake. The removal surface on cores again is influenced by the definition of these surfaces, and therefore it would be expected that most removals are found on the exterior surface.

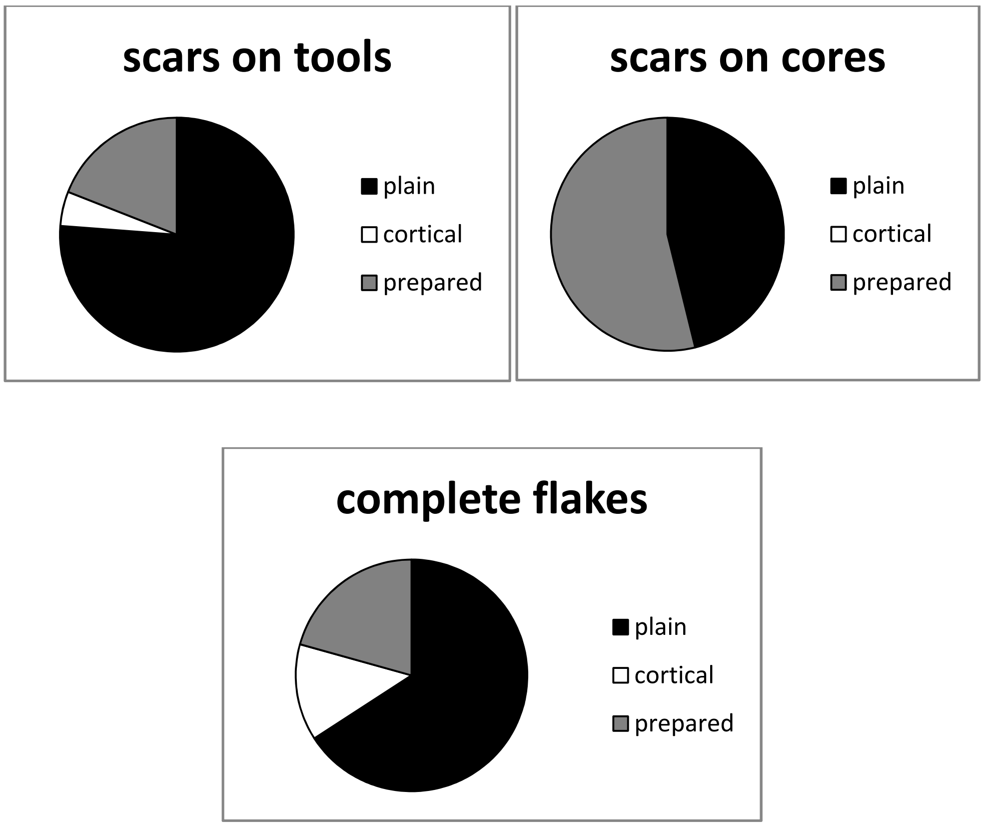


Figure 3.14: Breakdown of the platform preparation for flake scars on tools (n=21), flake scars on cores (n=13), and on complete flakes (n=208) from Layer 4C at Pech IV.

As was already clear from an examination of blanks in Layer 4C, the majority of platforms are unprepared (either plain or cortical). This same pattern is evident when we examine the platform negatives on tools (Figure 3.14). However, more of the removals on cores are prepared. To see if there is a size pattern with regard to platform preparation, the percentage of prepared versus unprepared platforms on complete flakes is represented for different size categories in Figure 3.15. The figure shows that there is no increased platform preparation as cores become smaller. If anything the pattern is the reverse, because platforms tend to be slightly more often prepared for larger flakes than they are for smaller ones.

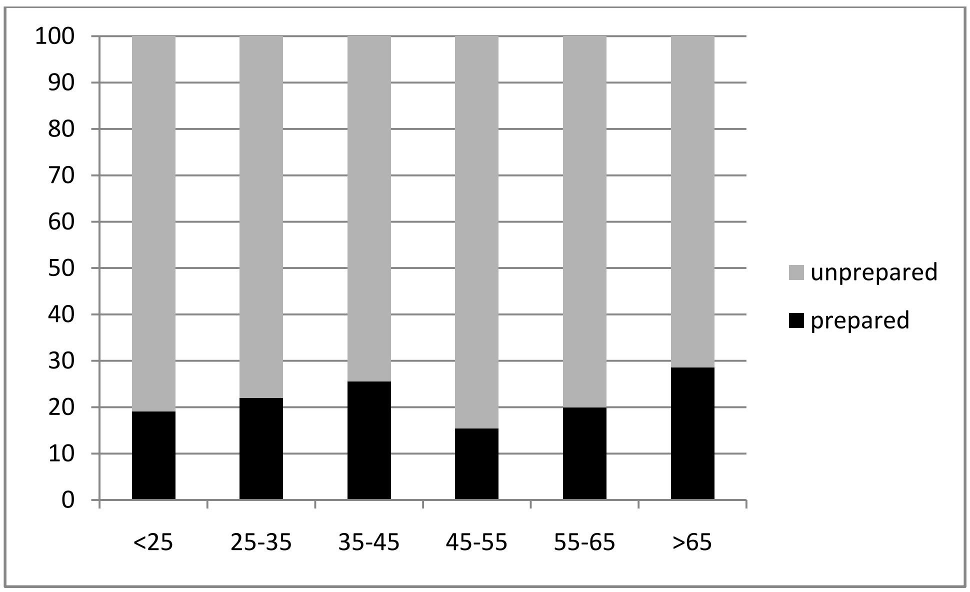


Figure 3.15: Prepared versus unprepared platforms for a number of different blank size categories in mm (n=211) in layer 4C at Pech IV.

Layer 6A

Assemblage composition

A total of 2,419 stone artifacts and 201 scar negatives were examined from layer 6A. This layer is chronologically older than layer 4C and markedly less dense in archaeological material (see Figure 3.1). In fact, there are only about half as many artifacts in this layer for every seven liters of excavated sediment as there are in layer 4C. This considerable difference, however, is due to the number of faunal remains and not to the prevalence of lithic artifacts. The number of lithic artifacts per bucket is greater (8.1 vs. 6.2) than in layer 4C. Based on macroscopic examination of the fauna, the paucity of faunal remains from layer 6A does not seem to be attributable to poor preservation in this layer, but rather to functional changes in the use of the site. As mentioned previously, the occupation in Layer 4C might represent the remains of specialized butchering activities. Based on the diversity of stone tools represented (Table 3.5) and the clear presence of primary blank production in the layer, layer 6A perhaps is better characterized as a habitation occupation.

Table 3.5: Breakdown of Bordian Types in Layer 6A at Pech IV

Type #	Bordian tooltype	count	percent
1	Typical Levallois flake	170	28.7
2	Atypical Levallois flake	70	11.8
5	Pseudo-Levallois point	12	2.0
9	Straight single scraper	17	2.9
10	Convex single scraper	38	6.4
12	Double straight scraper	1	0.2
15	Double Convex scraper	1	0.2
16	Double Concave scraper	1	0.2
19	Convex convergent scraper	2	0.3
20	Concave convergent scraper	1	0.2
21	Dejete scraper	1	0.2
23	Convex transverse scraper	1	0.2
24	Concave transvers scraper	1	0.2
25	Scraper on interior	5	0.8
26	Abrupt scraper	1	0.2
27	Scraper w/ thinned back	2	0.3
30	Typical endscraper	2	0.3
31	Atypical endscraper	2	0.3
32	Atypical burin	1	0.2
35	Atypical percoir	1	0.2
37	Atypical backed knife	2	0.3
38	Naturally-backed knife	53	8.9
42	Notch	36	6.1
43	Denticulate	24	4.0
45	Retouch on interior	4	0.7
48	Abrupt/alternating retouch	102	17.2
54	End-notched flake	5	0.8
62	Divers	1	0.2
64	Truncated-Faceted piece	36	6.1
	Total	**593**	**100**

For several of the stone tool categories, such as tools, complete flakes, and flake fragments, layer 6A seems to lie between the pattern observed in layer 4C and the pattern in layer 8 at the base of the stratigraphy in Pech IV. However, there are two categories for which this is not the case: cores (including core fragments) and shatter (see Figure 3.1). The relatively pronounced presence of cores (Table 3.6) and the high percentage of shatter suggests that basic core reduction is an important component of the activities structuring the stone tool assemblage during this occupation. However, the items produced at the site might have been taken elsewhere, which would explain why there are both fewer complete flakes and more flake fragments and shatter than in layer 4C.

Table 3.6: Breakdown of Core Types from Layer 6A at Pech IV

core type	**count**	**percent**
Kombewa core	28	14.3
Disc core	1	0.5
Levallois core	12	6.1
Single surface core	102	52.0
Double surface core	1	0.5
Tested block	3	1.5
Globular core	4	2.0
Pyramidal core	2	1.0
Other	7	3.6
Informal core	15	7.7
N/A	21	10.7
Total	**196**	**100**

Figure 3.2 divides the retouched tools from the three layers at Pech IV into four main classes. The figure shows that both notched tools and other tools (which include T-F pieces) are more abundant than in layer 4C. In other words, there is a higher diversity in

the kinds of tools present in layer 6A. Furthermore, the bar chart shows clearly that core and core fragments are much more ubiquitous compared to layers 4C and 8. Based on two types of cores in this layer, small Levallois and Kombewa cores, Bordes suggested that this layer represents a new type of Mousterian facies which he called the Asinipodian — the Latin derived name of the site itself.

As the reference to small Levallois cores already suggests, it is not surprising to find that all Levallois indices for this layer are higher than those from layer 4C. Particularly noteworthy is the very high percentage of single surface cores in this layer (64%). This number contrasts rather sharply with the relatively low percentage of Levallois cores, which are only marginally higher than in layer 4C. One way to understand this pattern better might be to examine the indices of reduction to see if high core reduction might account for this pattern.

Indeed, if single surface cores and Levallois cores are part of the same family of core reduction strategies (Olszewski et al. nd), then it seems plausible that in circumstances of high reduction the number of true Levallois cores might decline vis-à-vis single surface cores. However, the data do not support this view. One of the measures of reduction intensity, the blank to core ratio, is lowest in layer 6A (see Figure 3.3). The other possible measure of reduction intensity introduced earlier, the flake to tool ratio, lies between the values observed in layers 4C and 8. This means that either these ratios are not good measures of reduction or that layer 6A does not reflect an intensely reduced assemblage.

The sizes of complete flakes, cores, and complete tools (Figure 3.16) show a pattern that is similar to the one observed in layer 4C. That is, complete flakes are the smallest on average, complete tools the largest, and cores fall somewhere in between. In comparison with layer 4C it seems that complete flakes are bigger in 6A, cores are smaller, and so are complete tools. These differences are particularly clear for the cores when we compare the maximum area represented for each by multiplying the maximum length and the maximum width (see Figure 3.17). Abandoned cores in layer 6A on average have a maximum exploitable core surface area of $1357mm^2$ ±825, whereas those in layer 4C are $1973mm^2$ ±1027. Weight shows the same pattern (Figure 3.18) with, average cores in layer 6A weighing 30 grams versus 53 grams on average for the layer 4C ones. Based on these size indices, it is fair to say that cores are more intensively reduced in layer 6A than they are in 4C assuming that original nodule size was constant between the two layers. In fact, we saw earlier that there is indeed little evidence for core reduction as opposed to tool reduction in layer 4C, a pattern entirely consistent with the interpretation of layer 4C as a site with a specialized function, whereas layer 6A shows a broader range of activities including tool- and marked core reduction. The implication is that the blank to core ratio might not be a very good indicator of core reduction in layer 6A.

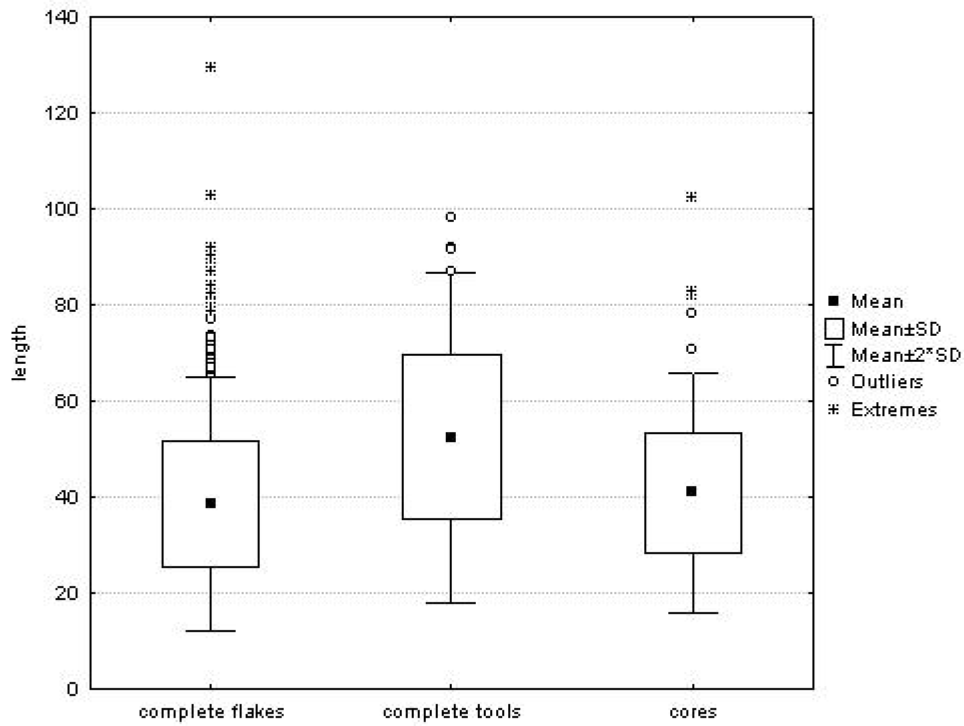


Figure 3.16: Box plots of the distribution of length for complete flakes (n=776), complete tools (n=86), and cores (n=115) in layer 6A at Pech IV.

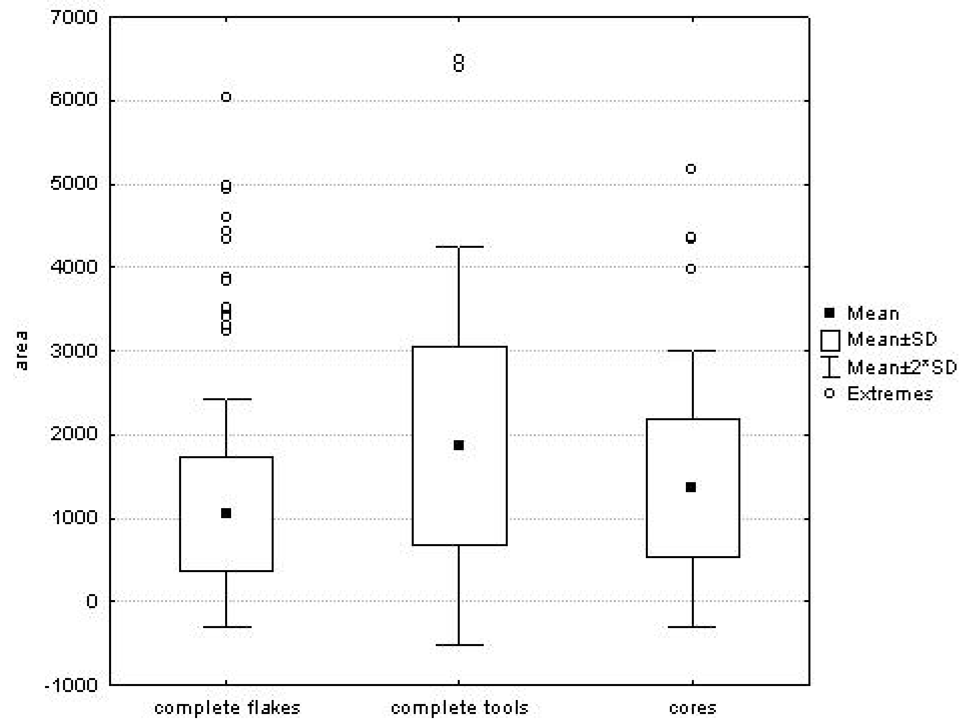


*Figure 3.17: Box plots of the length*width (surface area) of complete flakes, complete tools, and cores in layer 6A at Pech IV*

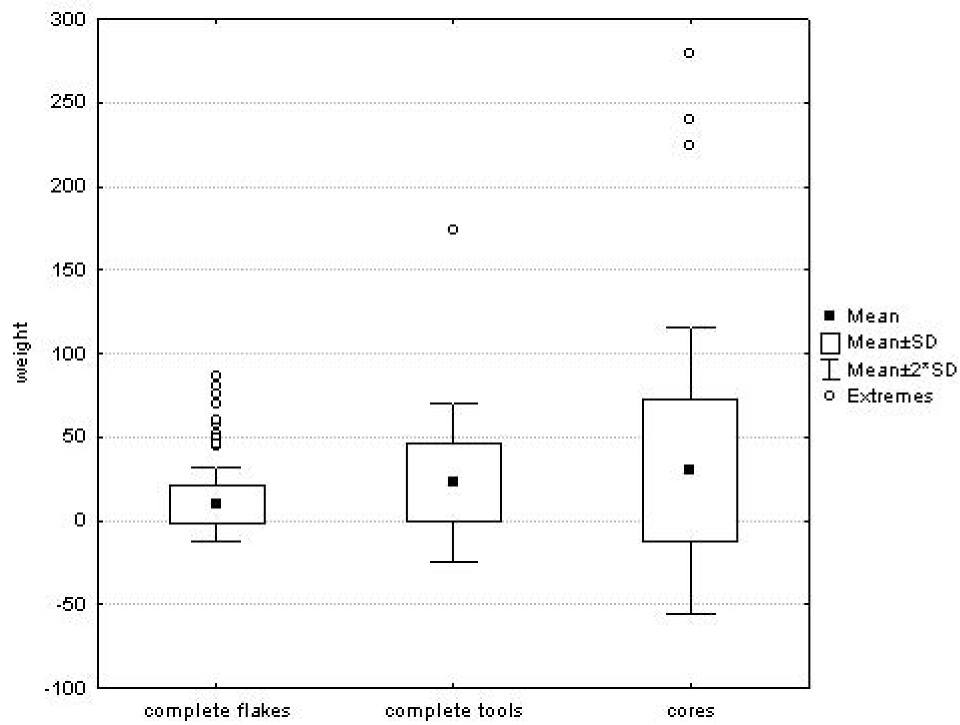


Figure 3.18: Box plots of the distribution of weight for complete flakes (n=778), complete tools (n=86), and cores (n=113) in layer 6A at Pech IV.

The small flakes in layer 6A are markedly different from those in layer 4C. Very few of the flakes are retouch flakes. After analyzing several bags of small flakes with over 200 flakes in them, I only found two retouch flakes. This pattern is consistent with the observation that scrapers are relatively rare in this level and that resharpening them at the site is perhaps even rarer.

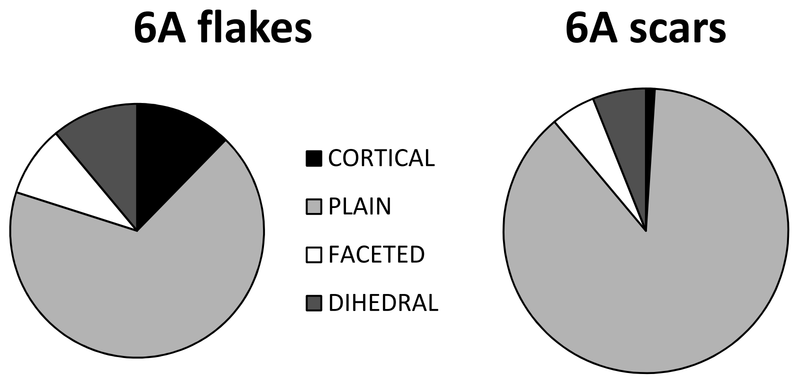


Figure 3.19: Platform preparation on complete flakes and on all negative scar removals from tools and cores. Flakes n=1,153 and scars n=158. For this graph the scrapers have been excluded from the tools.

The breakdown of platform preparation between flakes and flake scars are compared in Figure 3.19. Overall the patterns are rather similar to each other. The biggest difference can be observed for cortical platforms. More flakes have a cortical platform than do flake scars. This is not surprising because, as cores and tools are further reduced, there will be less and less cortex on the tools and cores, and therefore the potential to obtain a cortical platform will be diminished overall. Furthermore, as the reduction proceeds, it might be less desirable to strike a cortical surface as it might be more difficult to control the flake resulting from such a platform compared to plain or prepared platforms. The majority of platform types seen in both groups are plain.

Comparison of flake scars on cores and tools

Having outlined the assemblage from layer 6A, I now consider the contribution of small flakes to the assemblage. This can be done by considering how possible small flake producers (cores and tools) can be compared to the overall assemblage of flakes. Furthermore, part of the question at hand is to determine if in fact possible small flake producers like T-F can be shown to represent a particularly core-like or tool-like pattern.

Based on Table 3.5 and 3.6 it is clear that layer 6A has numerous items that could be considered part of the intentional production of flakes. More than 20 % of the formal tools are T-Fs. Furthermore, notches and denticulates are rather numerous in layer 6A compared to layers 4C and 8. Scrapers are also frequent, but less so than in the other two layers considered here. In terms of cores there are about 20% Kombewa cores and a total of 37% of the cores (which include the Kombewa cores) are made on flakes.

In Figure 3.20 the sizes of flake scars on cores, T-Fs, notches, and scrapers are compared with each other. The smallest size class which was dominated by scraper removals in layer 4C is more equally divided between different types of removals. The majority are notches, followed by T-Fs and scrapers. As flake scars become bigger, there is a dramatic increase in T-F and core scars and decrease in notch scars. This pattern continues for cores, whereas the contribution of T-F to each increasing size category diminishes. There are two patterns that seem to emerge from the graph. First, flake scars on cores and T-Fs seem to be part of the same pattern, with the added nuance that cores have slightly larger scars than do T-Fs. Second, in layer 6A, notch scars appear to be different from scars on cores and T-Fs.

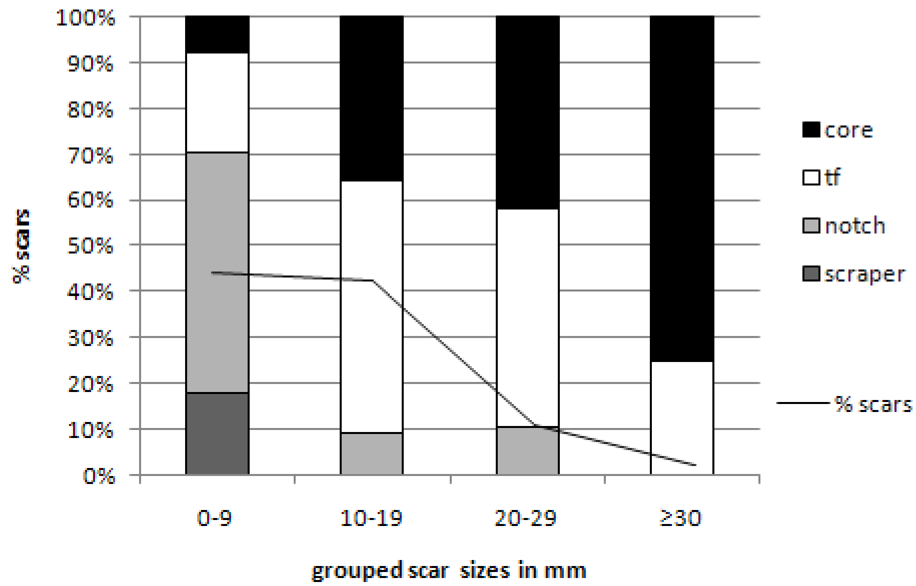


Figure 3.20: Distribution of flake scars on 4 categories of lithic artifacts by size in layer 6A at Pech.

Another way to look at this data is to graph the size distribution of scars on tools, scars on cores, and complete flakes (Figure 3.21). Based on this figure it seems that the distribution of flakes sizes is markedly bigger than the sizes of the flake negatives. This is not unexpected because the flake population is the result of a continuous reduction process. Early on in that process the flakes would be expected to be larger than the flakes removed later in the sequence. While the flake population represents the discarded totality of flakes from the manufacturing process, the flake scars only represent the tail end of the reduction process. In other words, the flake scars represent the very last points at which the stone tool knappers still considered the core or tool worthy of further reduction.

There is also a difference between the sizes of the scars on cores and those on tools. This is the case despite the fact that scraper scars were excluded from this graph as they represent a special case — scrapers always cluster on the small end of the size ranges, their platforms are almost exclusively plain, and the scars are predominantly found on the lateral sides of the flake blanks. The remainder of the tools shows significant overlap with core negatives but also can be distinguished from cores by their smaller overall size. The reason for this, as suggested by Figure 3.20, are the notches, particularly the notches that are manufactured by retouching the notch rather than the Clactonian notches (which are manufactured by a single blow).

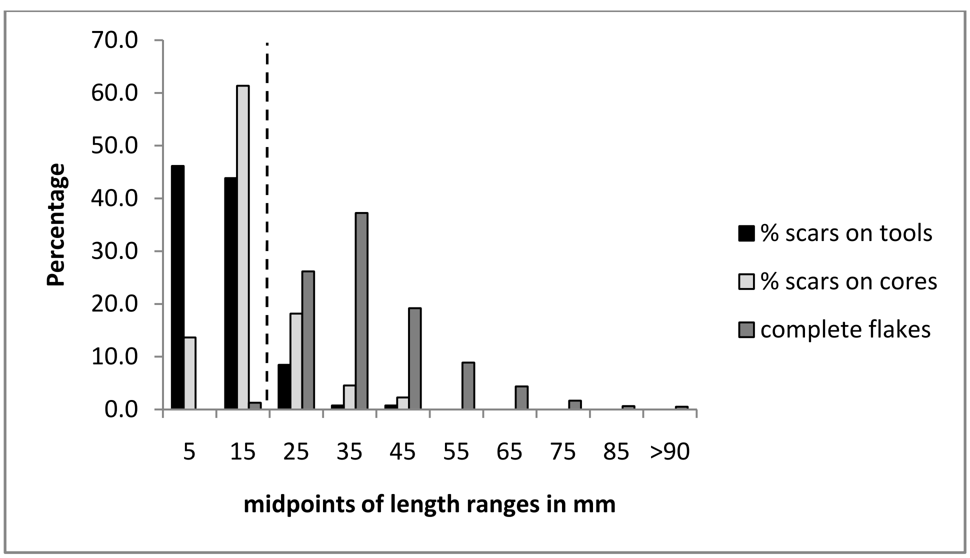


Figure 3.21: Tool and core removal negatives compared to each other and to the complete flake size distribution. Scraper scars are excluded from the graph.

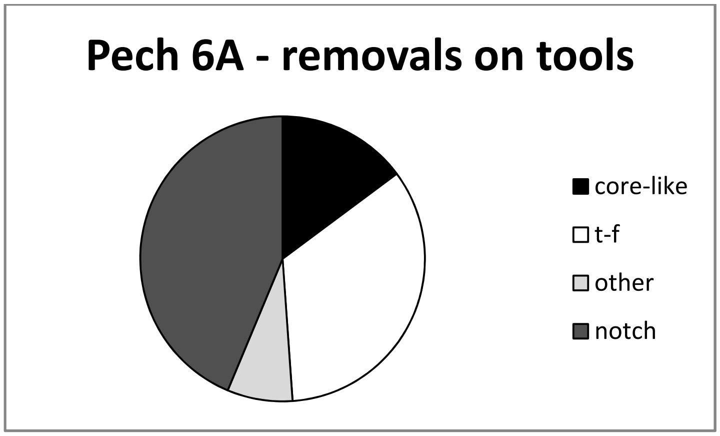


Figure 3.22: Removals from tools (n=135) in layer 6A at Pech IV

The type of removals on tools can be characterized in a number of ways. Some are core-like, others display features that include platform preparation followed by a larger removal from the opposite side of the edge (T-F), and yet others are notch-like in that the removal leaves a “notch” in the edge from which it was taken. While these distinctions are to some extent subjective, they give an idea of the kinds of removals that are observed. Core-like and T-F removals make up half of the removals found on tools, whereas most of the remainder are notch-like removals (Figure 3.22).

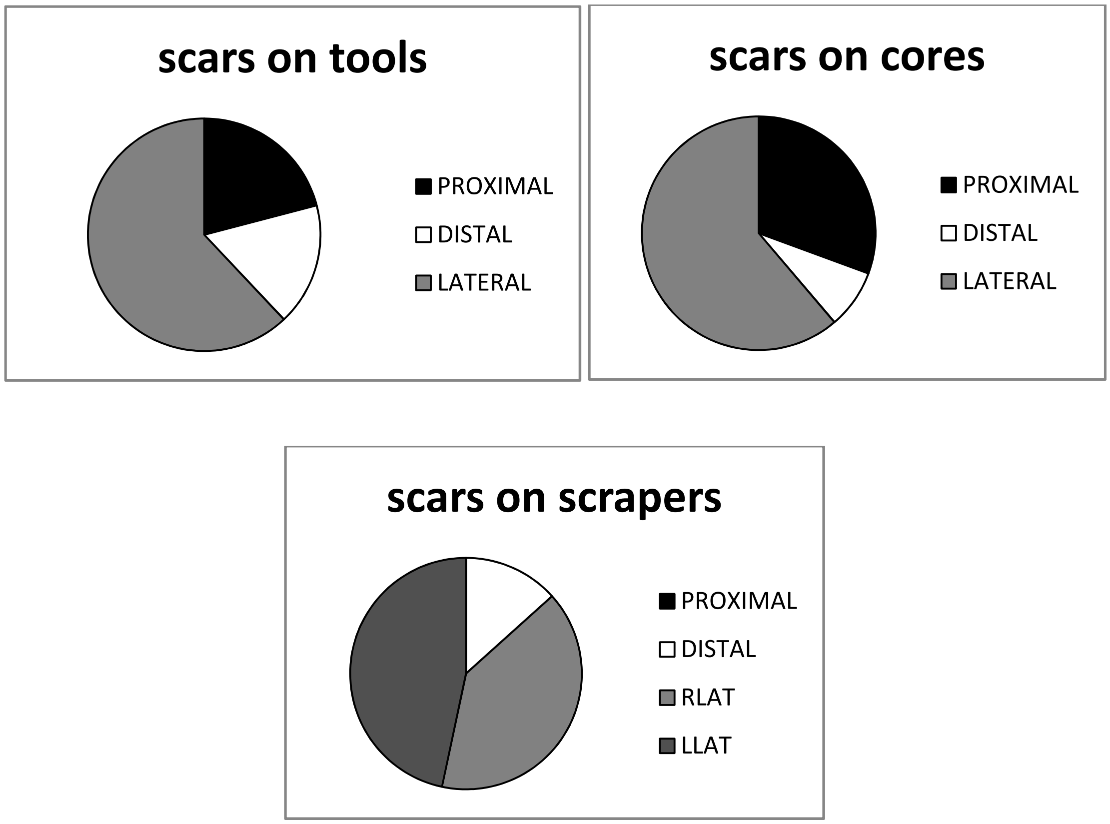


Figure 3.23: Breakdown of the location of flake scars on tools (n=129), cores (n=49) and scrapers (n=15) relative to the proximal and distal portions of artifacts in layer 6A at Pech.

The breakdown of the locations of flake scars in terms of the proximal, distal, and lateral sides is shown in Figure 3.23. The figure illustrates the clear difference between cores and tools on the one hand and scrapers on the other. Flake scars on scrapers are equally divided among the right and left sides of the flake and have relatively few removals from the distal end. Tools (excluding scrapers) and cores, however, show a pattern in which the majority of flake scars are found laterally, but with more sizeable contributions of proximal and distal flake scars compared to scrapers.

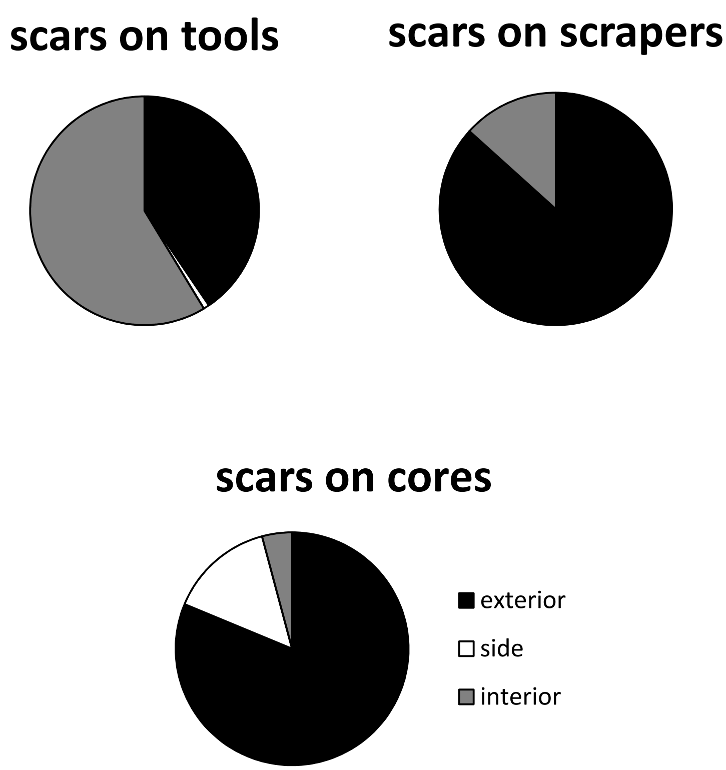


Figure 3.24: Breakdown of the removal surface of flake scrars on cores (n=48), tools (121), and scrapers (n=15) in layer 6A at Pech.

The removal surface of flake scars on tools and cores are different from one another (Figure 3.24). Given that the majority of the cores are single surface cores, making the location of major flake scars automatically the exterior, the core pattern might be in part attributable to this. In other words, there are very few cores on which multiple surfaces have been exploited. Tools show a lot of work on the interior, which is not a pattern typically expected. In layer 6A this is due to the large presence of flakes that have been reduced by the Kombewa technique (interior removal of the bulb of percussion). Scraper rejuvenation flakes are removed predominantly from the exterior surface, which is typical. In layer 6A there is also a clear presence of scraper removals from the interior of flakes, which tends to be rarer in Middle Paleolithic assemblages.

Platform preparations on tools and cores are fairly similar to each other, with the exception that prepared platforms are rarer on tools than they are on cores (Figure 3.25). In either case the majority of the flake scars show plain platforms; cortical platforms are seldom encountered. The latter pattern is distinct from the platform types seen in complete flakes which more frequently show cortical platforms. This pattern is perhaps best related to both a change in the relative frequency of cortex on the core and the possible avoidance of cortical striking platforms as reduction proceeds.

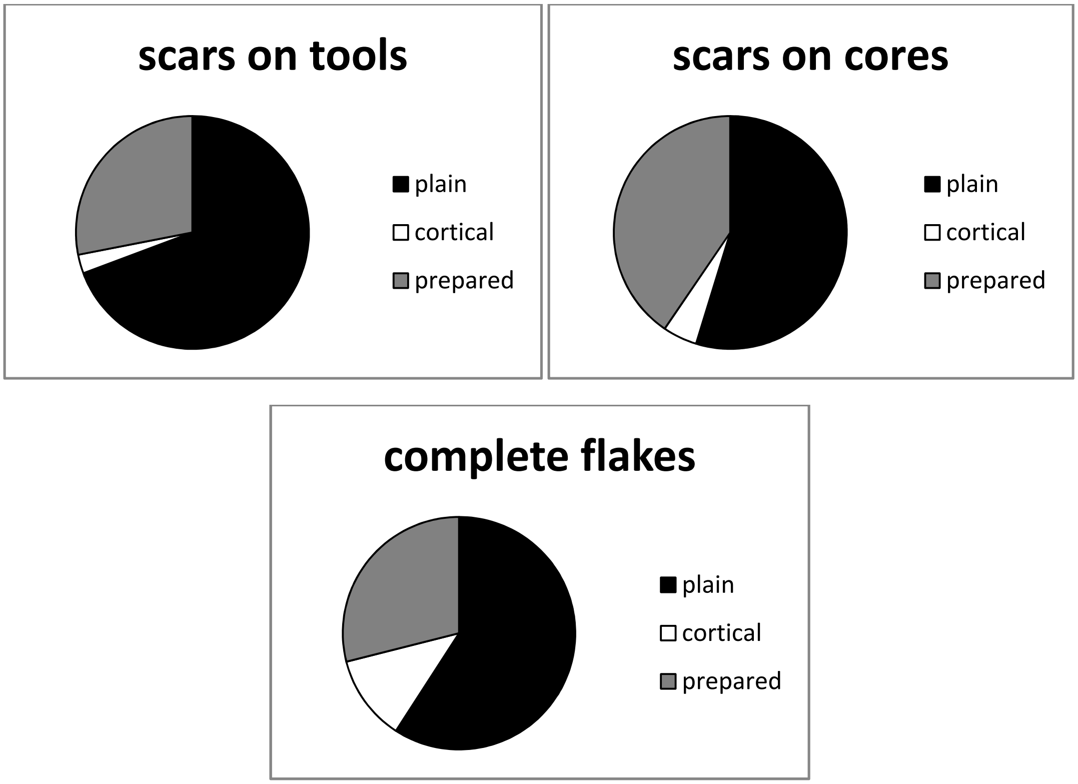


Figure 3.25: Platform preparation on cores (n=42), tools (n=114), and flakes (n=646) in layer 6A at Pech.

Layer 8

Assemblage composition

Layer 8 at the bottom of the sequence in Pech IV has a rich assemblage of lithic artifacts. A total of 2,486 artifacts from this layer were examined. While this layer is not the densest in terms of the numbers of artifacts per bucket (Table 3.1), it is so in terms of lithics — almost 10 artifacts per bucket greater than 2.5cm on average. There are fewer fauna greater than 2.5cm in each seven liter sediment sample than in the two overlying layers examined. This pattern is argued to be due to the extensive use of bone as fuel in the numerous hearths in layer 8 (Dibble et al nd).

In terms of the basic lithic categories, layer 8 stands out (for a breakdown of Bordian types and cores, see Table 3.7 and Table 3.8). Layer 8 has either the lowest or highest value compared to the other two layers for each of the categories except shatter (Figure 3.1). Layer 8 has the fewest tools, cores, core fragments, and complete flakes, while it has a very high number of flake fragments. Together with the prevalence of shatter, the local nature of the raw material, and the appropriate amount of cortex for full onsite reduction (Dibble et al nd), this evidence suggests that full reduction took place at the site. This then implies that complete nodules were probably brought into the site. This kind of pattern is expected for habitation sites — an interpretation which seems to match well with the presence of hearths in this layer. However, Dibble and colleagues point out that the precise function of these and Neanderthal hearths at other sites remains unknown (Dibble et al nd).

Table 3.7: Breakdown of the Bordian Types in Layer 8 at Pech IV

Type #	Bordian tooltype		count	percent
1	Typical Levallois flake		120	26.4
2	Atypical Levallois flake		40	8.8
3	Levallois point		3	0.7
4	Retouched Levallois point		1	0.2
5	Pseudo-Levallois point		12	2.6
6	Mousterian point		5	1.1
9	Straight single scraper		21	4.6
10	Convex single scraper		45	9.9
11	Concave single scraper		5	1.1
13	Double straight-convex scraper		3	0.7
14	Double straight-concave scraper		1	0.2
15	Double Convex scraper		7	1.5
17	Double Concave-convex scraper		2	0.4
18	Straight convergent scraper		3	0.7
19	Convex convergent scraper		11	2.4
23	Convex transverse scraper		3	0.7
24	Concave transvers scraper		2	0.4
25	Scraper on interior		1	0.2
31	Atypical endscraper		1	0.2
32	Typical burin		3	0.7
33	Atypical burin		1	0.2
36	Typical backed knife		1	0.2
38	Naturally-backed knife		46	10.1
40	Truncation		3	0.7
42	Notch		14	3.1
43	Denticulate		6	1.3
48	Abrupt/alternating retouch		76	16.7
54	End-notched flake		2	0.4
64	Truncated-Faceted piece		16	3.5
		Total	**454**	**100**

Table 3.8: Breakdown of the Core Types in Layer 8 at Pech IV

core type	count	percent
Kombewa core	6	12.5
Disc core	3	6.3
Levallois core	2	4.2
Single surface core	17	35.4
Tested block	1	2.1
Other	4	8.3
Informal core	7	14.6
N/A	8	16.7
Total	**48**	**100**

When tools are examined more closely, it is clear that, by and large, layer 4C and layer 8 are similar to each other (Table 3.2, 3.5, and 3.7). Scrapers in both cases are far more numerous than other types of tools (even though based on the assemblage view in Figure 3.2 there are over 10% less scrapers in layer 8 than there are in layer 4C). While the typology of layers 8 and 4C is very similar, the technology is not. Layer 8 has a much clearer presence of Levallois technology and in some ways is closer to Layer 6A in this respect than to Layer 4C. This is the case particularly for the single surface type cores and ILty (Levallois flakes/total tool count).

The blank to core and flake to tool ratios seem to present opposite patterns (Figure 3.3). On the one hand the blank to core ratio is high, the highest by a considerable margin of the three layers examined here. This pattern might suggest intense reduction in layer 8. The flake to tool ratio, on the other hand, is also high. Again the value is the highest for the three layers and suggests that tool reduction is in fact relatively low in layer 8, much lower than in layers 4C and 6A.

The length of complete flakes, complete tools, and complete cores show a pattern typical for Pech IV. The tools are the longest, the cores slightly shorter, and the complete flakes the shortest (Figure 3.26). The width, also typical, shows that cores are larger on average than complete tools (Figure 3.27) a pattern repeated when we look at weight and surface area (Figure 3.28 and 3.29).

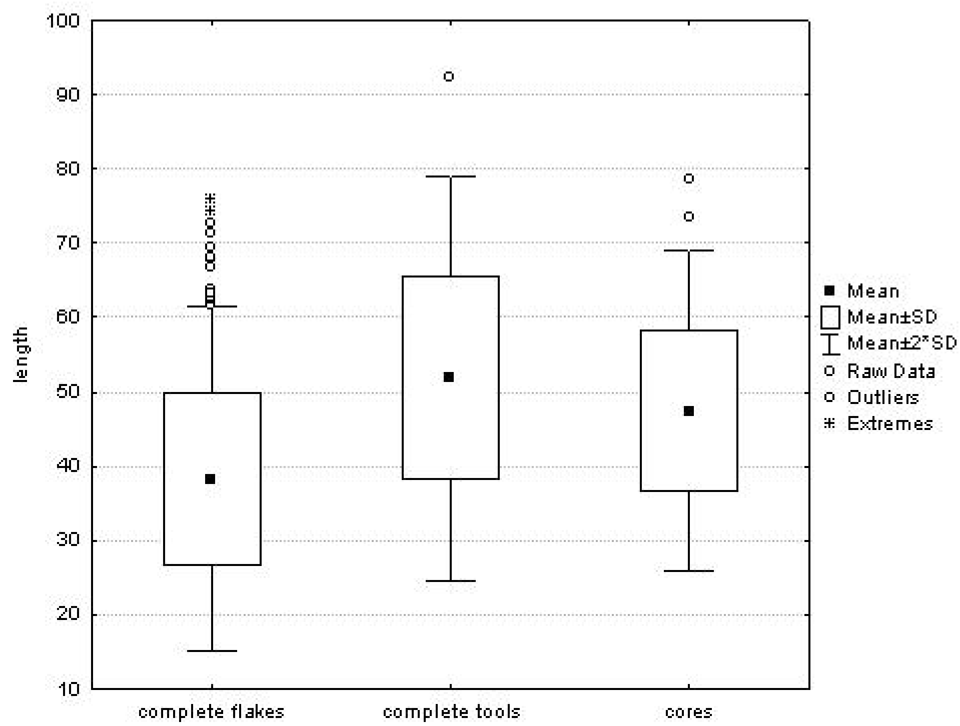


Figure 3.26: Box-and-whisker plots of the length of complete flakes (n=721), complete tools (n=75), and cores (n=24) from layer 8 at Pech.

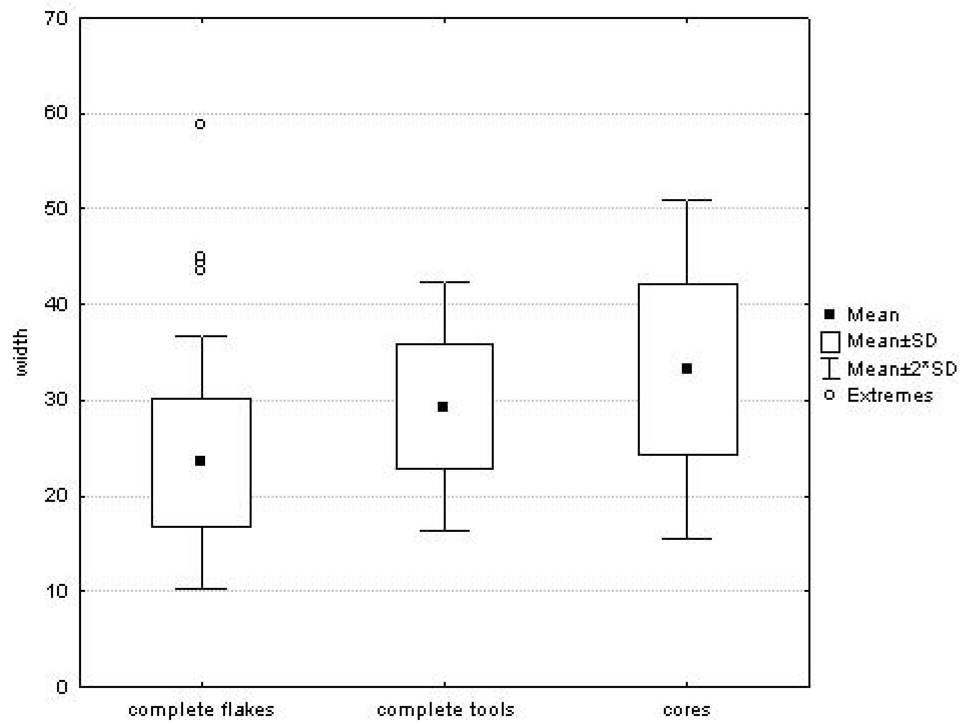


Figure 3.27: Boxplots of the width of complete unretouched flakes (n=722), complete formally retouched tools (n=75), and complete cores (n=24) from layer 8 at Pech.

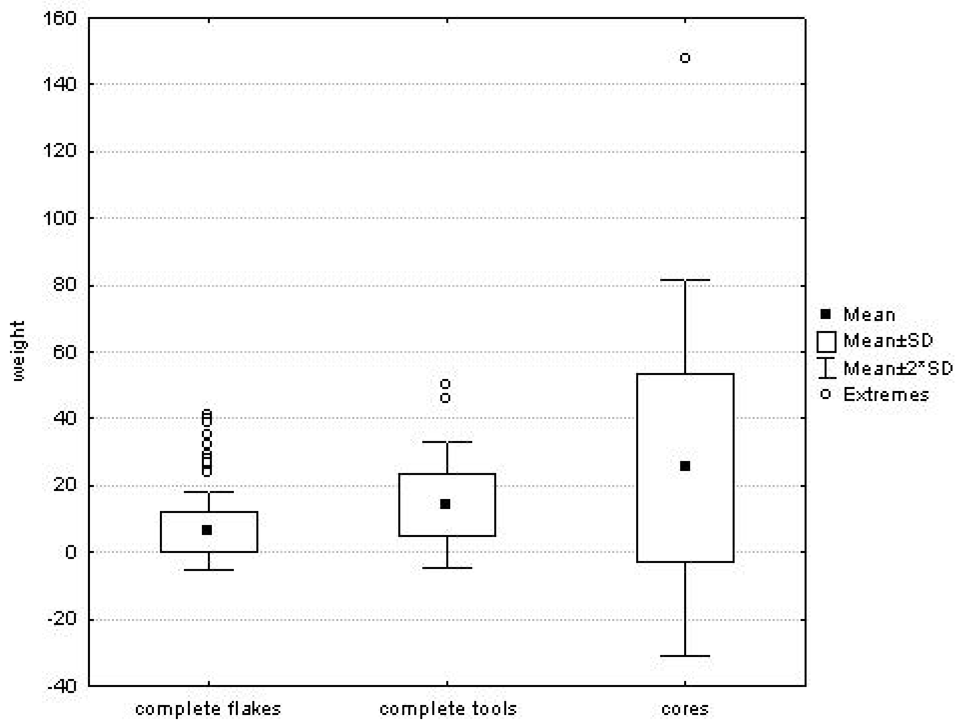


Figure 3.28: Boxplots of the weight of complete unretouched flakes (n=722), complete formally retouched tools (n=75), and complete cores (n=24) from layer 8 at Pech.

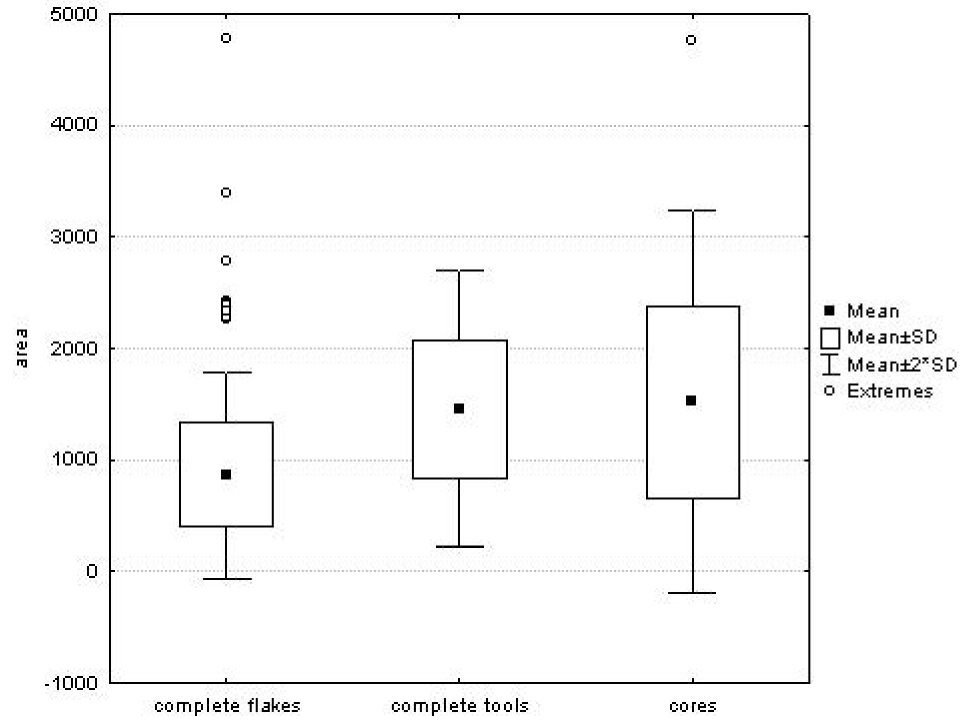


Figure 3.29: Boxplots of the surface area of complete unretouched flakes (n=720), complete formally retouched tools (n=75), and complete cores (n=24) from layer 8 at Pech

As mentioned earlier, industries with high blank to core ratios can be expected to show corresponding small average flake and core sizes (Roth and Dibble 1998). Compared to layer 6A, where the blank to core ratio is low, however, the differences seem minor. Average flake sizes are slightly lower in layer 8, but average core sizes are higher. By and large, the pattern seems similar between the layers, despite the sizeable difference in blank to core ratio. Furthermore, there are markedly fewer indicators of small flake production such as truncated-faceted pieces, Kombewa cores, and cores on flakes in layer 8 than there are in layer 6A. Much like in layer 4C, T-Fs only make up 0.6% of the entire assemblage. In other words, the blank to core ratio alone does not seem a good indicator of the extent of core and tool reduction. Rather the blank to core ratio might have to be understood in relation to transport of material across the landscape in addition to intensity of reduction. In this regard each of the three layers at Pech IV might represent a different kind of case. In layer 4C blanks are brought in, but cores are not. In layer 6A blanks are produced and transported from the site, and, in layer 8, blanks are produced and used at the site.

Most of the platforms (Figure 3.30) in layer 8 are plain, but prepared platforms make up over 25% of the assemblage. This pattern is apparent in both the complete flakes and the flake scars. Flake scars, as expected, show fewer cortical platforms and also fewer dihedral platforms than complete flakes. In general, platform preparation and flake scar preparation show a very similar pattern and suggest that lithic reduction took place at the site and essentially did not change over the course of reduction.

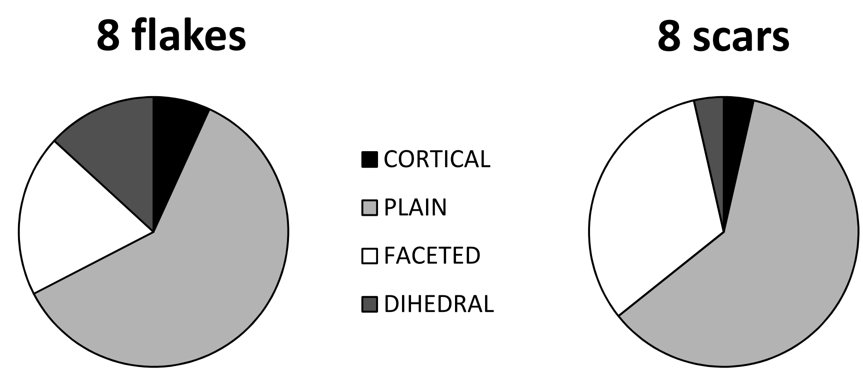


Figure 3.30: Platform preparation for complete flakes (n=1,145) and flake scars (n=56) in layer 8 at Pech.

Figure 3.31 illustrates the distribution of flake scars for different size categories. From the graph we can surmise that removals from cores and those from T-Fs overlap extensively in terms of size. The same can be said, to some extent, for notches, although they are smaller than removals from cores and T-Fs. Flake scars on scrapers, matching the pattern in both layers 6A and 4C, are found in the smallest size category exclusively.

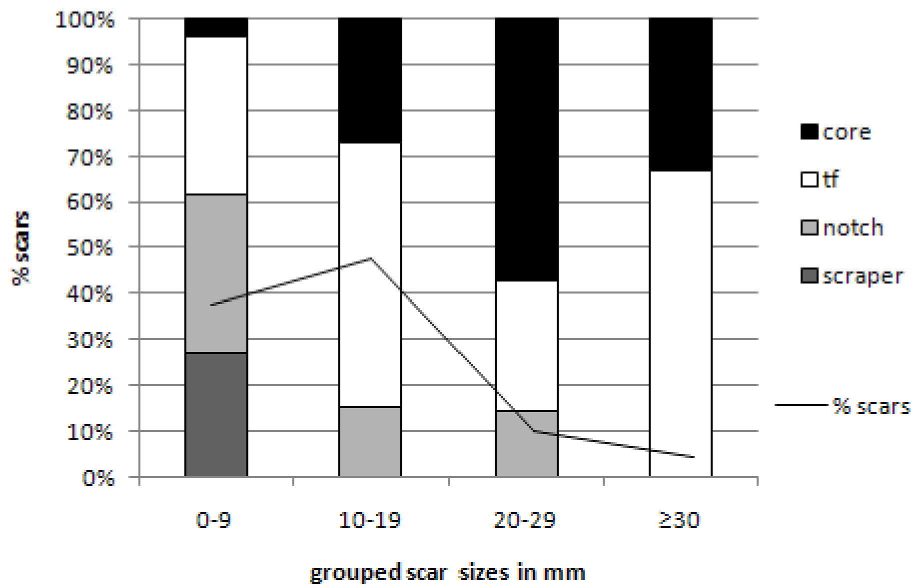


Figure 3.31: Sizes of removals for different classes of artifacts in layer 8 at Pech.

Comparison of flake scars on cores and on flakes

In a comparison of the flake scars on tools and cores against complete flakes, a pattern very similar to that observed in the other layers at Pech IV emerges (Figure 3.32). Note that for this comparison the contribution of scrapers to tool removals has been omitted. Complete flakes are larger as a population than the scars on both tools and cores. As mentioned previously, this makes sense given that the flake population is composed of flakes made early in the reduction sequence and those made later (and presumably are smaller). Furthermore, the scars on cores are on average larger than the scars on tools. Given that tools tend to be smaller than cores in most dimensions (width, thickness, and weight, but not length), it is not surprising that the flakes made from them would on average be somewhat smaller than those from cores. At the same time, the extensive overlap between flake scars on tools and cores does suggest that in terms of their length the two are by and large indistinguishable.

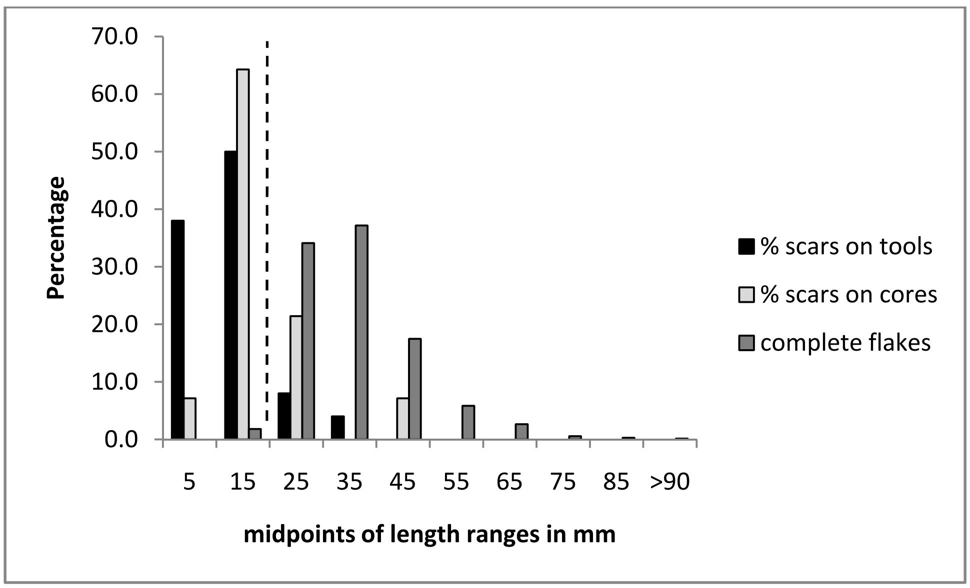


Figure 3.32: Tool and core flake scars compared to each other and to the complete flake size distribution in layer 8.

Removals from tools fall into different categories (Figure 3.33). These include core-like removals, which make up about 25% of the flake scars, T-F removals, accounting for another 25%, and notch removals which make up the majority of flake scars on tools. Again some overlap with cores is evident.

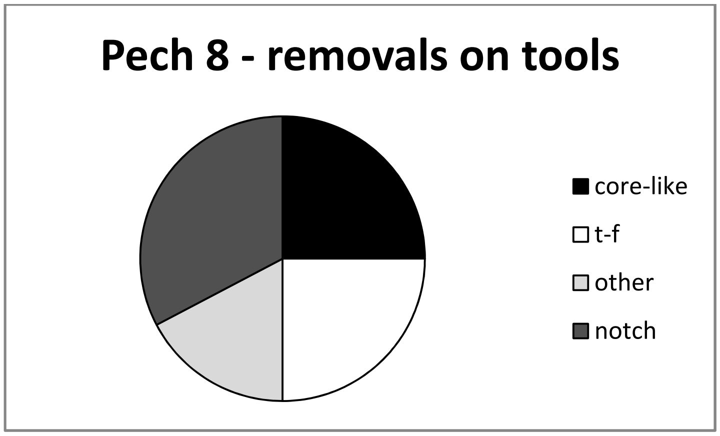


Figure 3.33: Breakdown of removals from tools (n=52) in layer 8 at Pech.

The location of removals (proximal, distal, or lateral) is similar for tools and cores (Figure 3.34). The main difference is that flake scars on cores are more frequent on the proximal side as opposed to those on tools. This last pattern should be attributed in part to the way in which cores are oriented, because the main scar on a core helps determine that side as the proximal portion of the core (see chapter 2). Scrapers, on the other hand, are flaked exclusively on their lateral sides. There are nearly equal removals from the right lateral and from the left lateral side. This pattern of flake scars on scrapers stands in sharp distinction with those on tools or cores.

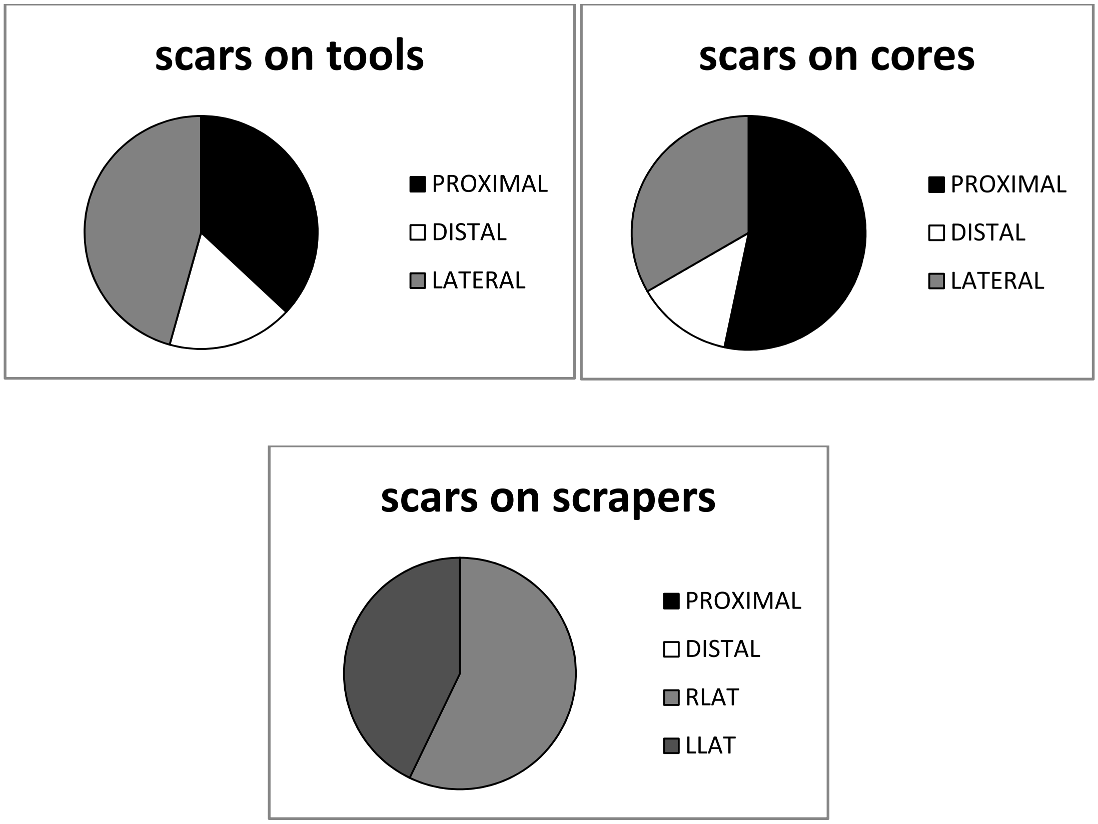


Figure 3.34: Location of removals on tools (n=46), cores (n=15), and scrapers (n=7) from layer 8 at Pech.

The removal surfaces of scars on cores and tools can also be compared. When we examine these removal surfaces (Figure 3.35), it becomes clear that flake scars are found preferentially on the exterior surface of cores, while those on tools are equally divided between the exterior and the interior surface. Scrapers are distinct and exclusively show a pattern of exterior flake scars.

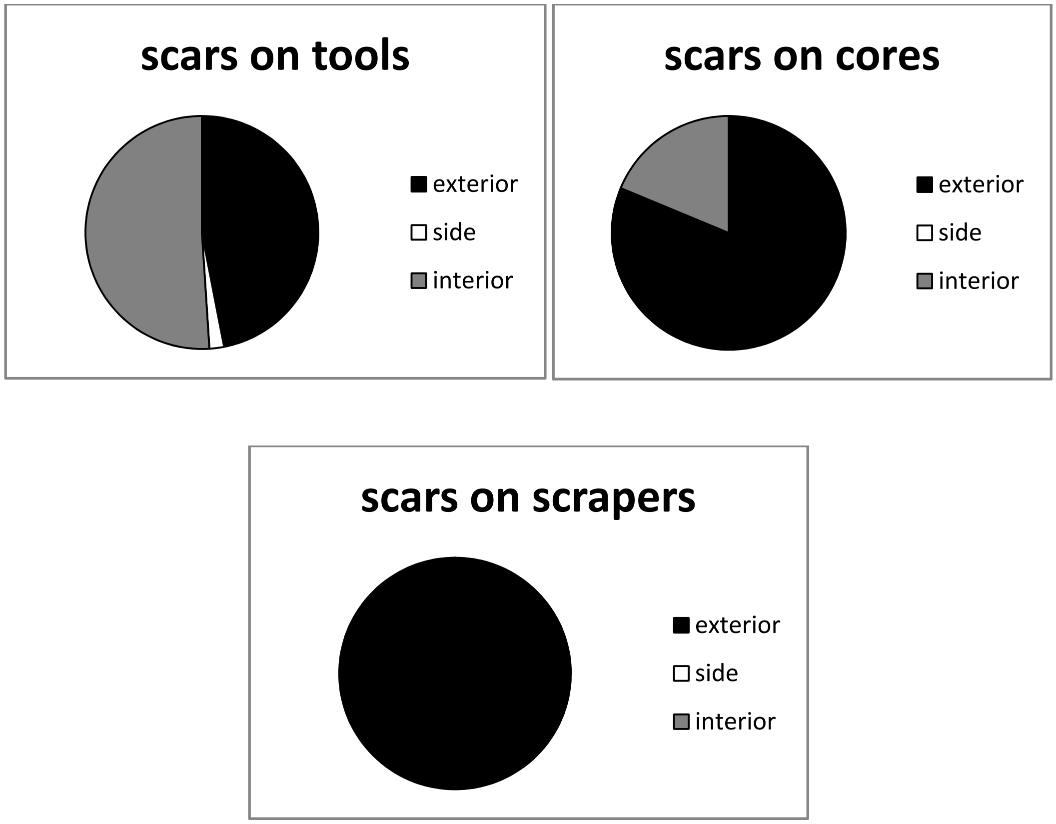


Figure 3.35: Breakdown of the location of removals from tools (n=49), cores (n=16), and scrapers (n=7) from layer 8 at Pech.

Comparing platforms from scars on tools and those on cores (Figure 3.36) shows that equal amounts of platforms in both are prepared. However, there are more cortical platforms visible on cores than there are for tools, which show no cortical platforms. Compared to complete flakes, cores have slightly more cortical platforms. Perhaps this suggests that cores in layer 8 are not yet entirely exhausted. Also, more cores show prepared platforms than do either complete flakes or tools. For the most part the proportion of prepared platforms on flakes and flake scars on tools and cores are very similar to each other. In this respect, again, cores and tools (excluding scrapers) can be linked to one another.

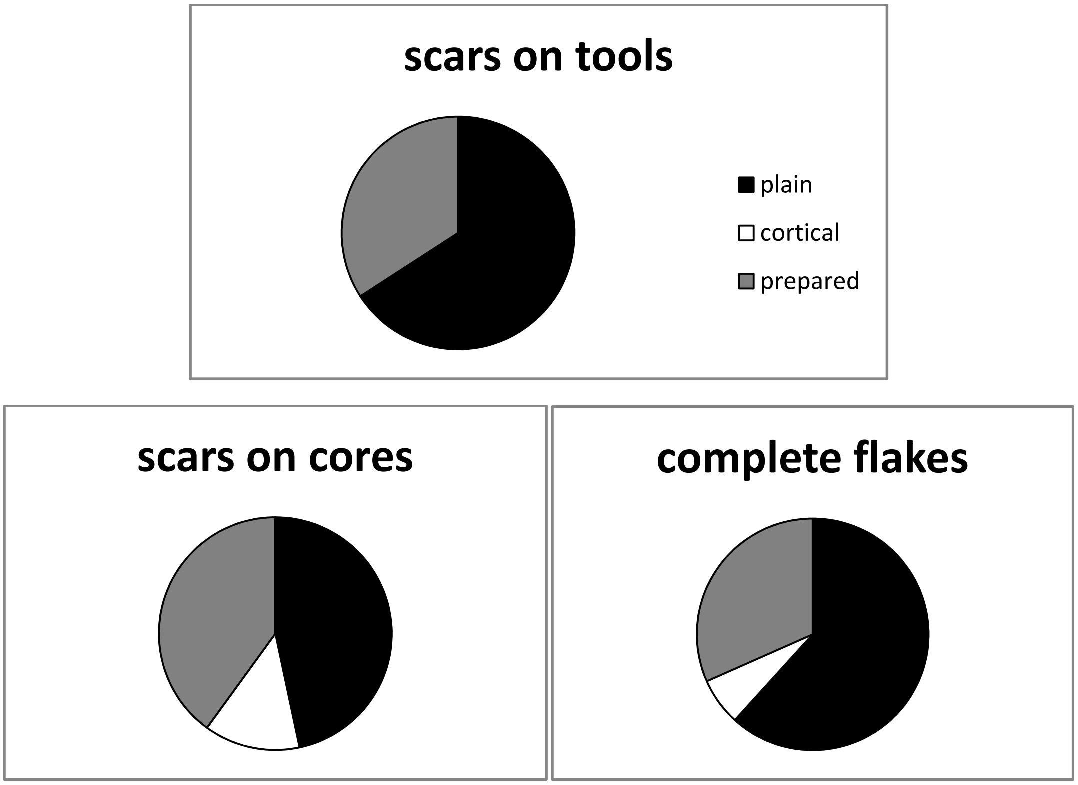


Figure 3.36: Breakdown of the platform preparation on tools (n=41), cores (n=15) and complete flakes (n=588) from layer 8 at Pech.

Roc de Marsal

All tools and cores that were excavated at the site of Roc de Marsal prior to 2007 were analyzed for this study. However, not all the unretouched flakes and shatter from the excavated material was studied. This means that the analysis that makes use of the unretouched blanks in relation to the number of cores and/or tools from the three layers at Roc de Marsal was adjusted to account for this discrepancy. In comparison with tools and cores, the counts of the unretouched flakes and shatter were adjusted to reflect their accurate sample sizes. These samples consists of 99% of the unretouched component of material from level 04, 80% of the material from level 05, and 69% of the material from level 08.

Layer 04

Assemblage composition

From layer 04 a total of 2,558 lithic artifacts were examined, of which 506 are formally retouched stone tools. Table 3.9 shows the average number of artifacts per seven liter sediment sample. Roc de Marsal is clearly a very rich archaeological site, dense in both faunal and lithic artifacts. Layer 04 has almost 11 lithic artifacts per bucket and eight times as many faunal objects greater than 2.5cm.

Table 3.9: Number of Fauna and Lithic Artifacts per Seven Liter Sediment Sample at Roc de Marsal

Layer	fauna/lithic	lithic/bucket	artifacts/bucket
04	8.0	10.5	94.9
05	2.8	26.3	100.2
08	0.7	58.9	98.3

Table 3.10: Breakdown of the Bordian Types in Layer 04 at Roc de Marsal

Type #	Bordian tooltype	count	percent
1	Typical Levallois flake	30	3.9
2	Atypical Levallois flake	27	3.5
5	Pseudo-Levallois point	8	1.0
6	Mousterian point	2	0.3
8	Limace	2	0.3
9	Straight single scraper	47	6.1
10	Convex single scraper	191	24.6
11	Concave single scraper	11	1.4
12	Double straight scraper	3	0.4
13	Double straight-convex scraper	5	0.6
15	Double Convex scraper	11	1.4
19	Convex convergent scraper	14	1.8
21	Dejete scraper	16	2.1
22	Straight transverse scraper	5	0.6
23	Convex transverse scraper	67	8.6
24	Concave transvers scraper	2	0.3
25	Scraper on interior	12	1.5
26	Abrupt scraper	2	0.3
27	Scraper w/ thinned back	5	0.6
28	Scraper w/ bifacial retouch	5	0.6
29	Alternate scraper	4	0.5
30	Typical endscraper	6	0.8
31	Atypical endscraper	1	0.1
32	Typical burin	1	0.1
33	Atypical burin	2	0.3
34	Typical percoir	1	0.1
35	Atypical percoir	1	0.1
37	Atypical backed knife	1	0.1
38	Naturally-backed knife	53	6.8
40	Truncation	2	0.3
42	Notch	36	4.6
43	Denticulate	27	3.5
45	Retouch on interior	3	0.4
48	Abrupt/alternating retouch	145	18.7
54	End-notched flake	7	0.9
56	Rabot	1	0.1
60	Inverse chopper	1	0.1

Type #	Bordian tooltype		count	percent
62	Divers		2	0.3
64	Truncated-Faceted piece		12	1.5
65	Scraper on the platform		4	0.5
		Total	**775**	**100**

Table 3.11: Breakdown of the Core Types in Layer 04 at Roc de Marsal

core type		**count**	**percent**
Kombewa core		14	20.9
Disc core		2	3.0
Levallois core		3	4.5
Single surface core		10	14.9
Chopper		1	1.5
Tested block		2	3.0
Other		7	10.4
Informal core		19	28.4
N/A		9	13.4
	Total	**67**	**100**

The lithic assemblage from layer 04 stands out by the high number of tools it contains — almost 20% (Figure 3.37, for the breakdown of these tools, see Table 3.10). Cores and core fragments are rare (Table 3.11), as is shatter. Complete flakes and flake fragments make up the remainder of the material. Given that there are so few cores, it seems that either blanks and/or tools were brought into the site or that cores were exported from the assemblage. The latter is the less likely of the two, because shatter is relatively rare. In addition, there is relatively little cortex in the assemblage — slightly under 20% cortex — suggesting blanks and/or tools were prepared elsewhere and brought to the site. The pattern seen in layer 04 of Roc de Marsal is very similar to the one found in layer 4C at Pech IV.

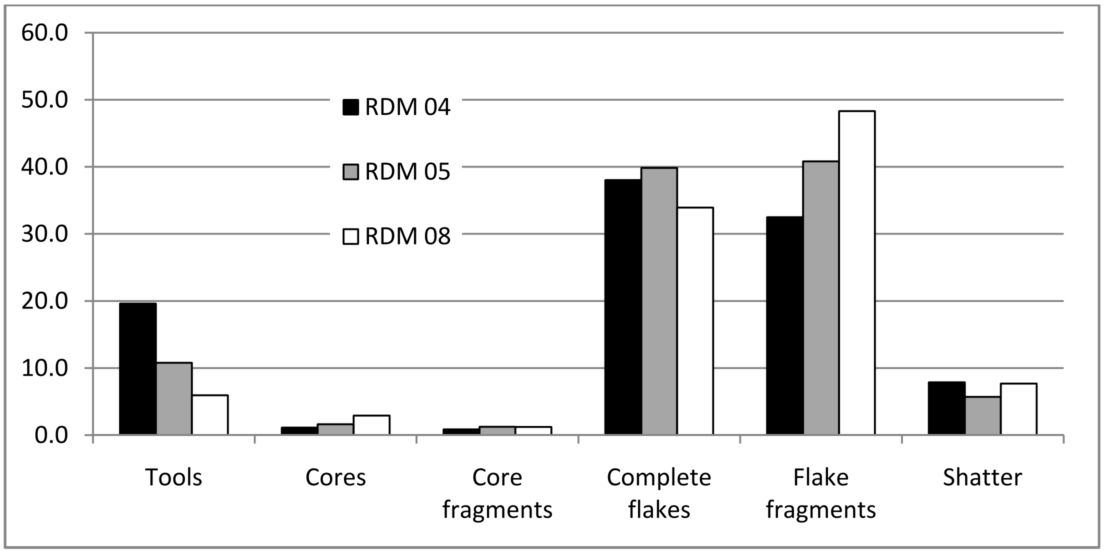


Figure 3.37: Breakdown of the lithic assemblages from Roc de Marsal into the major lithic artifact categories (RDM 04: n=2,579, RDM 05: n=1,541, RDM 08: n=1,548).

The comparison between Roc de Marsal (RDM) layer 04 and Pech IV layer 4C is all the more striking when the tools are subdivided into the major tool categories: scrapers, notched pieces, UP types, and other. It is very clear that scrapers dominate the assemblage, and, among the scrapers, single sidescrapers are the biggest category (Figure 3.38). Notched pieces are present. UP types form a minor component of the assemblage, as do other types of tools. Cores are very rare, as are blanks. Again the similarity with Pech IV layer 4C is striking and suggests that RDM layer 04 might also be used for some type of specialized activity. Even in the ratio of bone artifacts to lithic artifacts, the two layers seem similar. For Pech layer 4C, this ratio is 5.9 (the highest at Pech IV), and for RDM the ratio is slightly higher, at 8.0. At RDM this ratio is also the highest among the three layers from the site examined here.

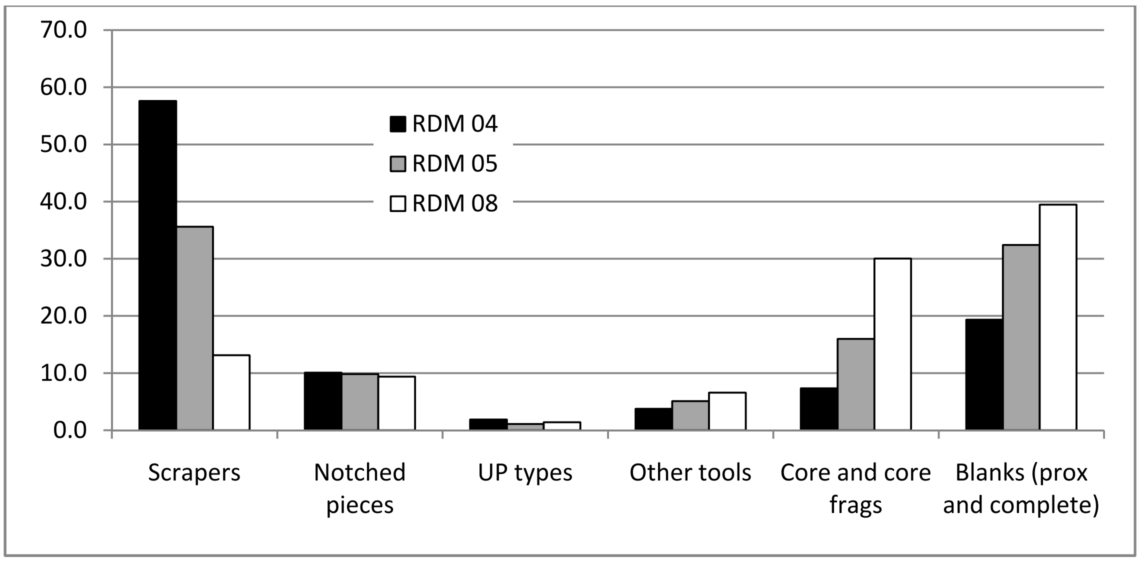


Figure 3.38: Breakdown of lithic assemblages at Roc de Marsal into four major types of tools, cores, and unretouched blanks. The vertical axis represents the percentage of each artifact category per layer. Note: the total blank count was divided by 10 to minimize its impact on the chart as a whole (RDM 04: n=694, RDM 05: n=275, RDM 08: n=213).

The Levallois indices (Table 3.12) show that layer 04 is not rich in Levallois products. Indeed, both the IL index and the ILty are exceedingly low. Interestingly, however, the cores show a somewhat different picture as there are 5.9% Levallois cores, which is the highest for RDM. Furthermore, layer 05 and 08 both have a much more pronounced presence of Levallois flakes. This somewhat peculiar pattern also is seen in layer 4C at Pech IV and hints that perhaps Levallois products form a significant component of Quina assemblages. However, for some reason, Levallois flakes are not typically discarded in this type of specialized activity context.

Table 3.12: Levallois Indices for Roc de Marsal

	RDM 04	RDM 05	RDM 08
IL	2.47	8.53	7.89
Ilty	7.35	29.02	37.94
Levallois core	5.9	4.5	1.6
Single surface core	25.5	54.5	56.3

The two measures of reduction intensity seem to match one another (Figure 3.39). On the one hand there is a high blank to core ratio and, on the other, there are few unretouched flakes to tools. Both indicators seem to clearly suggest that reduction was intense in layer 04. This pattern also matches the one we saw earlier for Pech IV layer 4C. However, in both Pech layer 4C and RDM layer 04 other indicators suggest that blanks and/or tools were probably imported ready-made. The high blank to core ratio then should be interpreted as simply an artifact of the exceeding paucity of cores (they must not have been brought into the site with any regularity). In other words, the blank to core ratio does not seem a very reliable indicator of core reduction at a site. In fact, it might be quite misleading if interpreted as reflecting reduction intensity alone as seems to be the case in layer 4C at Pech IV and layer 04 at RDM. The flake to tool ratio might be a bit more reliable in some ways, but the trouble with it is that “tool” can mean very different things. Scrapers, for example, seem to have some kind of specific function or functions and appear different from a number of other tools that, based on flake scar characteristics and sizes, align quite well with flake scars on cores overall.

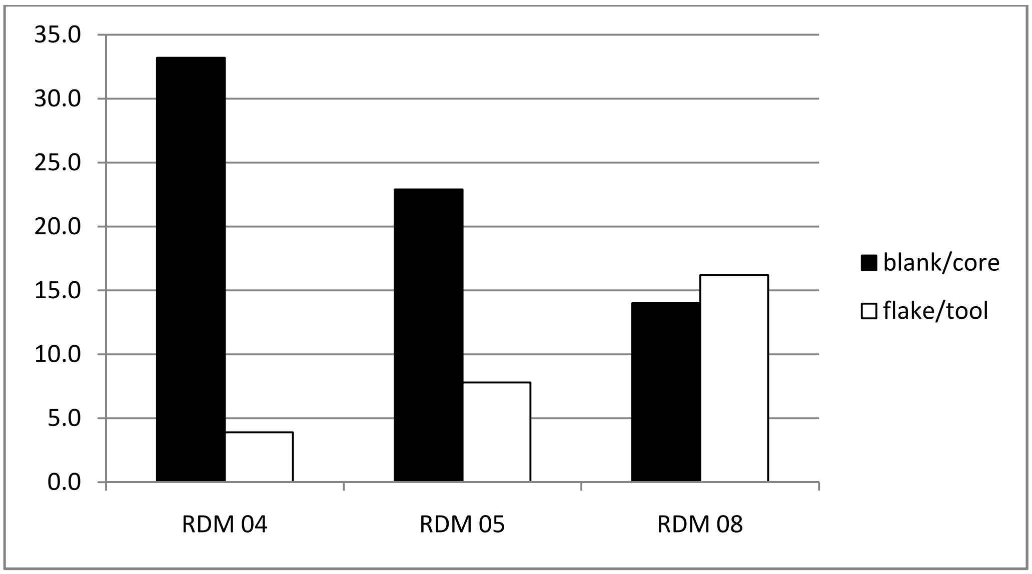


Figure 3.39: Blank to core and flake to tool ratios for Roc de Marsal

As seen in Figure 3.40, sizes of complete flakes, complete tools and cores overlap extensively. The pattern we saw at Pech IV is repeated here. In their length, flakes are shortest on average, complete tools longest, and cores fall in between. However, this is not the case in other size measures such as weight, width, and thickness. When weight, width, or thickness is used, the cores are the largest of the three categories of material, while unretouched flakes are the smallest.

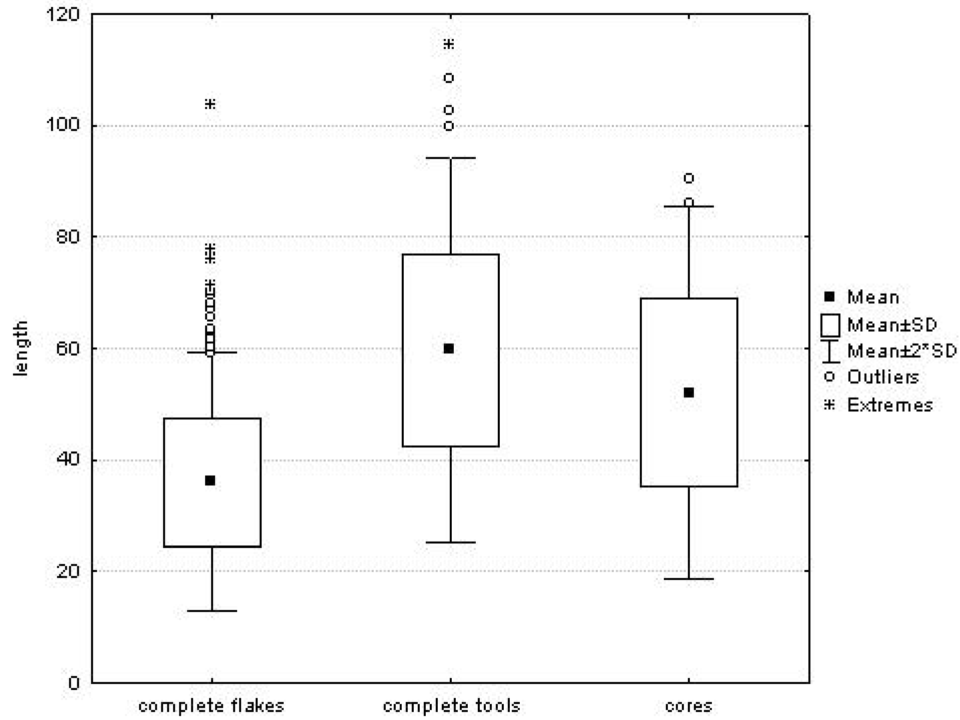


Figure 3.40: Box plots of the lengths of complete flakes (n=971), complete tools (n=277), and cores (n=29) from layer 04 at RDM.

Platform preparation at RDM layer 04 is dominated by plain platforms (Figure 3.41). Prepared platforms, such as dihedral and faceted platforms, make up less than 25% of the total in the complete flakes and slightly less still among the flake scars. It is striking to see that flakes and flake scars present a very similar pattern. To some extent this was unexpected, because there is evidence to suggest the blanks were brought into the site and therefore one might expect that whatever is locally produced (the evidence on the scars seem a good candidate) is different. However, the pattern is the same showing technological continuity between local production of flakes and those produced elsewhere. Flake scars fit with the rest of the assemblage and in some way seem to reflect a continuation of reduction, as there are fewer cortical platforms among the flake scars than there are in the assemblage as a whole.

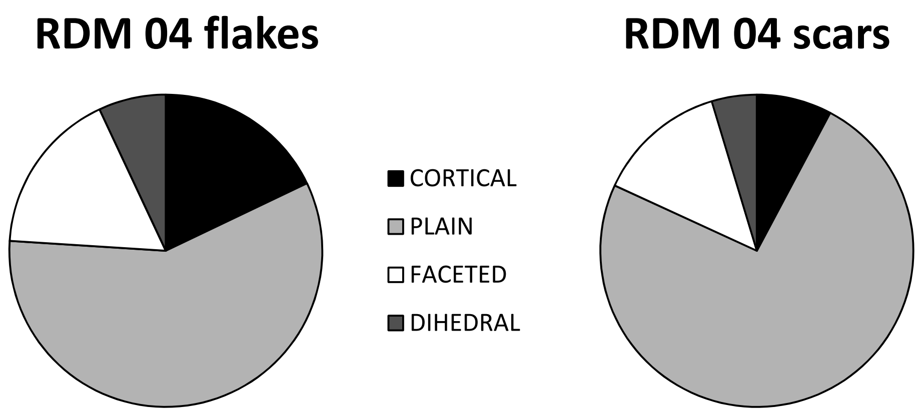


Figure 3.41: Frequency of the distribution of platform types on flakes (n=1,263) and flake scars (n=193) in layer 04 at RDM.

Figure 3.42 shows the distribution of flake scars in four different size categories and for four types of lithic objects including scrapers, cores, T-Fs and notches. The point of the graph is to examine if and how size is related to the type of artifact from which removals are taken. Removals from scrapers, for example, are limited to the first two size categories exclusively and are found predominantly in the smallest one. Notches are not limited to any particular size category and furthermore seem roughly equally represented in each. Cores show almost the opposite pattern of scrapers. With each increasing size category the percentage of flake scars on cores increases. Truncated-faceted (T-F) pieces seem to follow a “core pattern,” but at the same time it is clear that flake scars on T-Fs are smaller on average than those on cores. In this sense T-Fs lie somewhere between the pattern as seen for cores and the one we can observe for notches in layer 04 at Roc de Marsal.

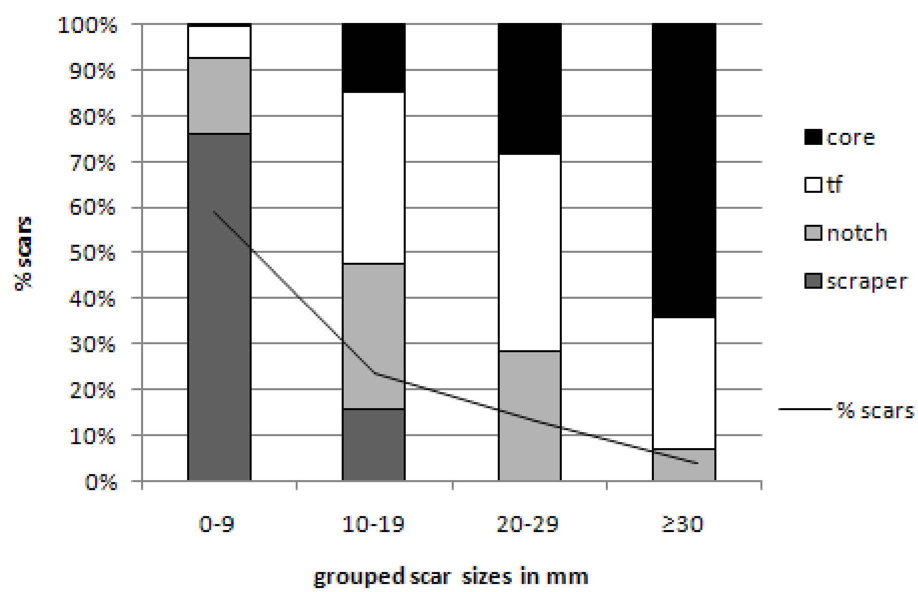


Figure 3.42: Distribution of flake scars on 4 categories of lithic artifacts by size in layer 04 at RDM.

Comparison of flake scars on cores and tools

The sizes of flake scars on cores and tools are compared in Figure 3.43. As the figure shows there is considerable overlap between the flake scars on tools and those on cores. In general the ones on tools are smaller than those on cores, which is a recurring pattern in all the layers examined. Furthermore, the distribution of complete flake sizes is larger on average. This pattern is to be expected given that the flake population at a site is the result of all stages of the reduction process including both larger flakes removed early on in the reduction as well as smaller ones predominantly removed as reduction proceeds. What this graph also shows effectively is that the sizes of flakes removed relatively late in the reduction process are often smaller than the size cutoff used to determine if flakes are to be piece provenienced and analyzed. If we can assume that those flakes from cores are desired products, then this graph helps to show that many of the artifacts that Neanderthals deliberately produced and used are currently escaping analysis. While removals on tools are still smaller than those on cores, a sizeable portion of the removals from tools falls well within the range of sizes removed from cores. This, along with the technical similarity between flakes produced from cores and flakes produced from tools, suggests that many, if not most, of the tools were actually one of the means to produce flakes rather than functional tools themselves. Notable exceptions in this regard are the scrapers, which are different in all respects studied here from removals seen on cores.

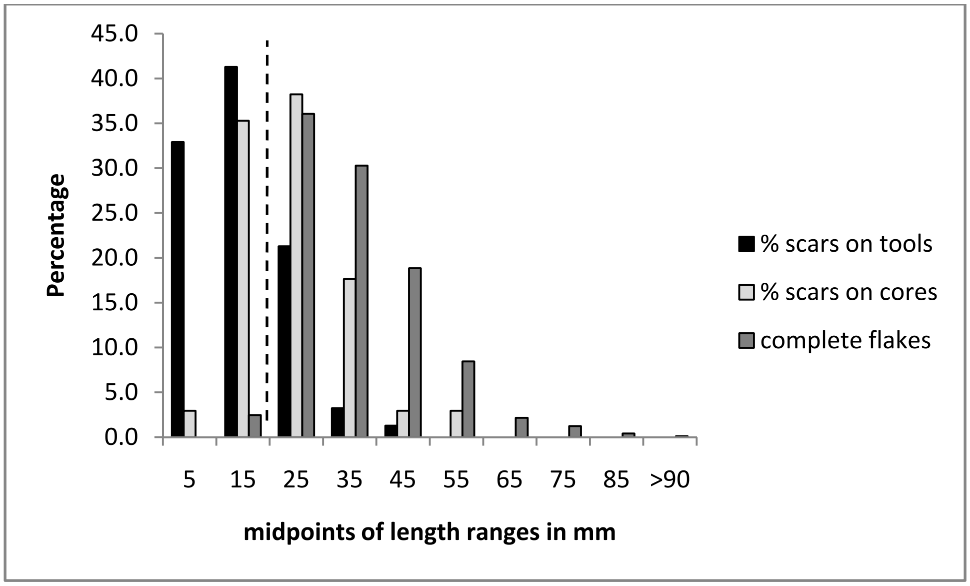


Figure 3.43: Distribution of artifact length by percentage scars on tools and cores as well as the distribution of complete flake sizes in layer 04 at RDM. Note: removals on scrapers are excluded from this graph. The dashed vertical line indicates the 2.5 maximum dimension cutoff that was used in the excavations to determine if artifacts would be piece-provenienced and analyzed.

Several types of removals on tools can be identified (Figure 3.44). Over 25% of them are categorized as core-like removals and slightly over 50% as notch removals. In Quina assemblages, such as layer 04, it has been suggested that notches serve to rejuvenate Quina scrapers (Bourguignon 1997), which might explain their ubiquity in this layer. However, an equally compelling argument might be that notch flakes were useful themselves. This interpretation seems supported by the fact that numerous notch removals turn out to be the last removal on the tool. Further, a total of 40 out of 75 notch removals are larger than 1cm and in the range of flake scar sizes on cores. This is unexpected. I assume further rejuvenation of the scraper edge obliterates the notch removals. Either each of the cases in which the notch is the last removal has to be explained away by arguing that they represent knapping failures of some sort (leading to artifact discard), or, an alternative explanation could be that the tool was used as a core. One way of examining the rate at which these “failures” takes place is to examine the incidence of scrapers that are secondarily classified as a notch, denticulate, or endnotch. There are a total of 48 scrapers that have such a secondary “notch” type in layer 04 at RDM or 12% of all scrapers. This seems a fairly high “failure” rate for a task routinely undertaken by Neanderthal flintknappers. Given that there is no question Neanderthals were expert flintknappers, the alternative explanation that these were cores is warranted.

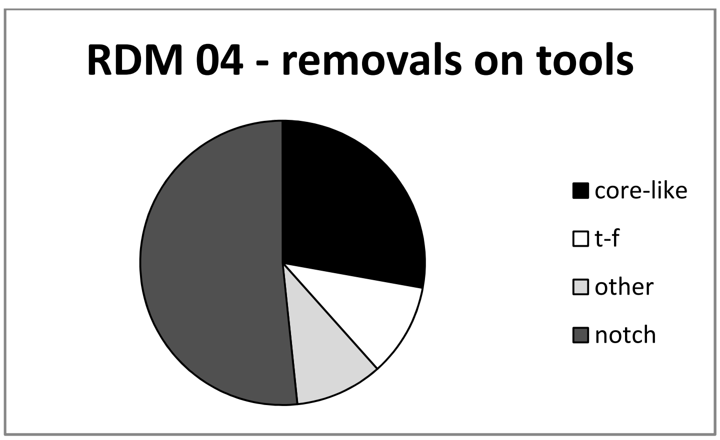


Figure 3.44: Frequency of the types of removals on tools (n=151) in layer 04 at RDM. Note: scraper removals are excluded from this graph.

The location of removals on tools, cores, and scrapers is shown in Figure 3.45. In layer 04 the removals on tools are intermediate between removals on cores and those on scrapers. As in the layers examined for Pech IV, the majority of scraper removals come from the lateral edges. However, a sizeable portion comes from the distal end as well. These are predominantly from the transverse scrapers which comprise 18% of all scrapers in this layer. Scars on tools also are predominantly from the lateral edges with the remainder equally divided between proximal and distal removals. Scars on cores are equally divided between lateral removals and proximal removals with a relatively minor role for distal removals.

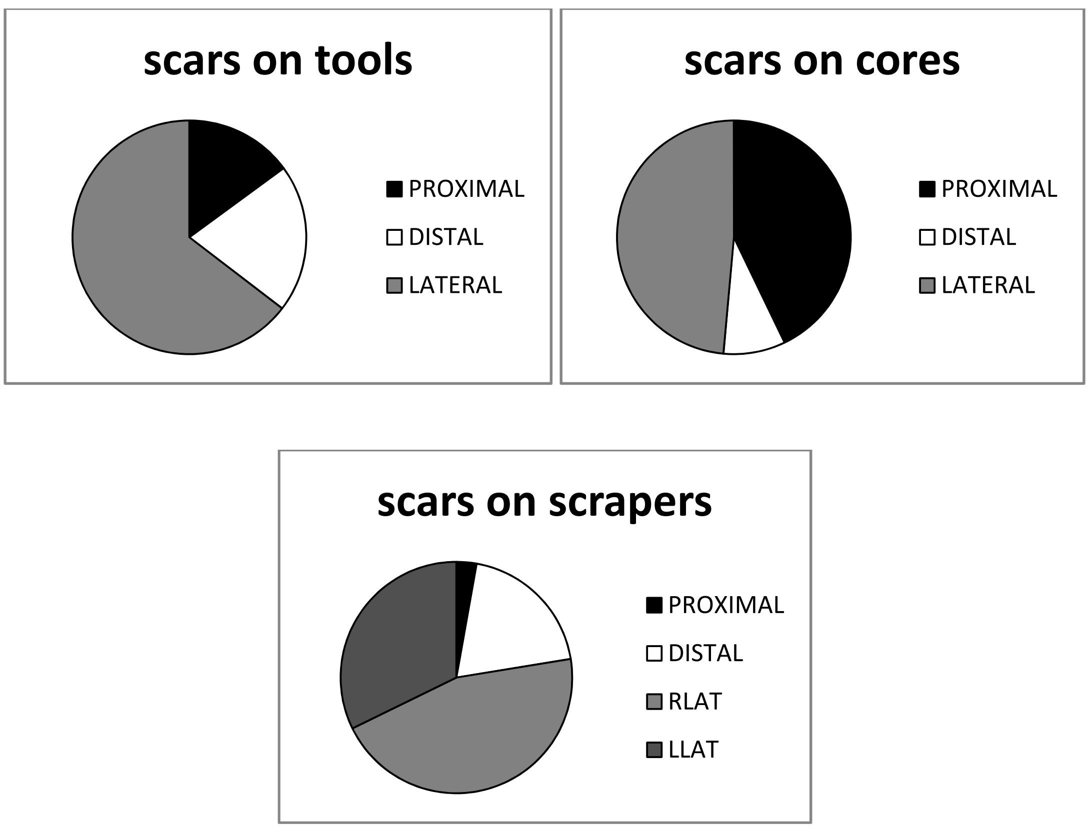


Figure 3.45: Frequency of the location of removals on tools (n=161), cores (n=35), and scrapers (n=214) in layer 04 at RDM.

The breakdown of removal surfaces of flake scars on cores and flakes are shown in Figure 3.46. There is a clear distinction between scrapers, on the one hand, and cores and tools excluding scrapers, on the other. The vast majority of scraper removals are located on the exterior of the flake. While the majority of removals on cores and tools is also on the exterior, this pattern is much less marked than it is for the scrapers. Tools show a higher percentage of removals on the interior than do cores.

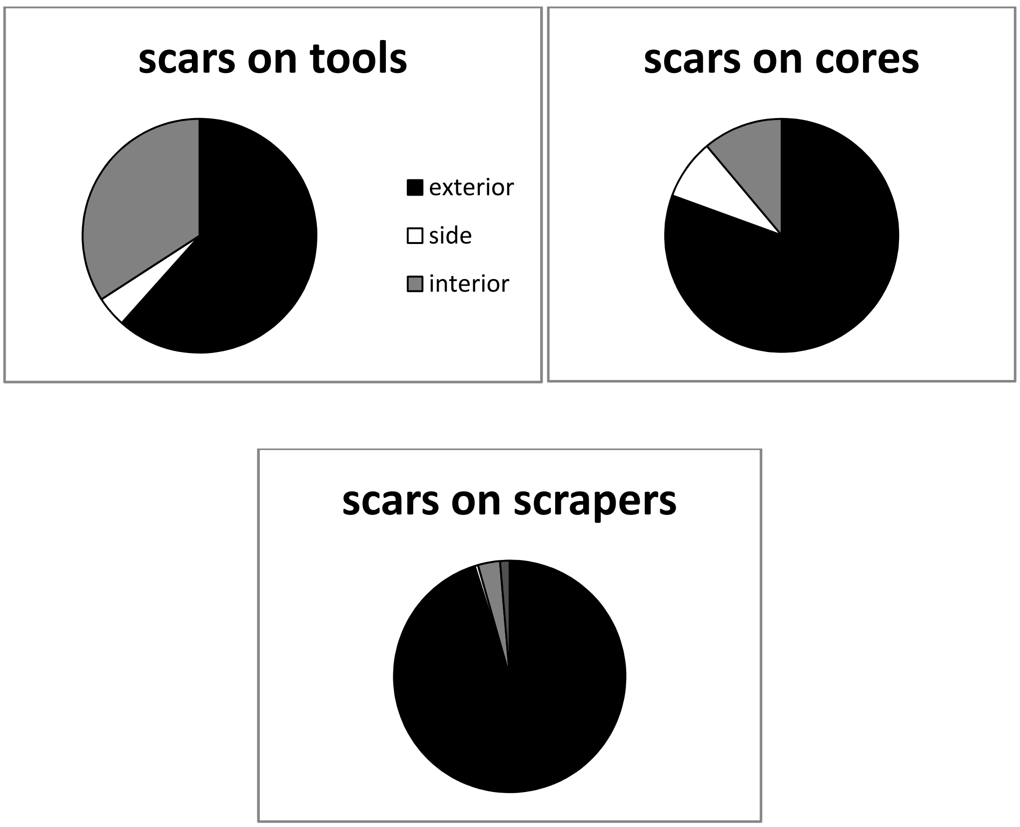


Figure 3.46: Frequency of the removal surfaces of flake scars on tools (n=164), cores (n=36), and scrapers (n=223) in layer 04 at RDM.

In addition to similarities in terms of types of removals and removal location, we can examine platform types as evidenced on cores and tools (Figure 3.47). Platform preparation, as indicated by flake scars, is quite similar for tools and cores. As could be expected from the Quina industry, the majority show plain platforms. Still about 25% of flakes and flake scars on cores show platform preparation. The percentage of tools with platform preparation is slightly lower but in general matches the pattern seen in cores and flakes. As would be expected, the number of cortical platforms on tools is slightly lower for both cores and tools as opposed to the platforms on flakes. This pattern is in line with what might be expected from removals that occur later in the reduction sequence.

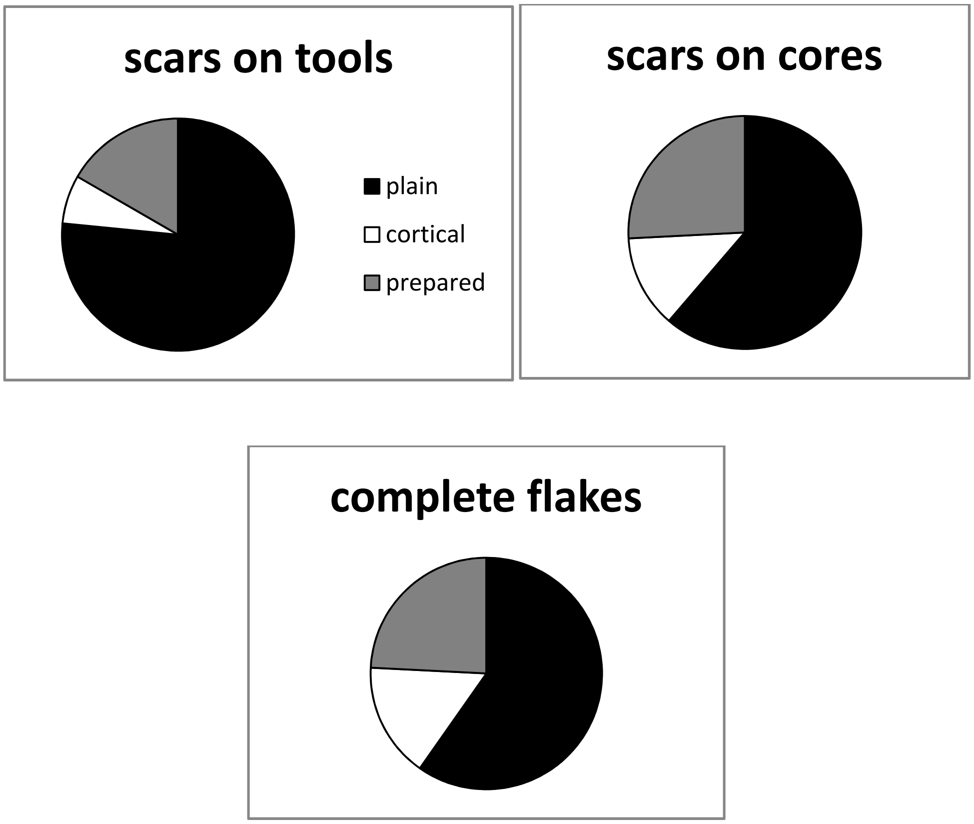


Figure 3.47: Frequency of the platform preparation on tools (n=162), cores (n=31) and flakes (n=723) in layer 04 at RDM. Note, scrapers are excluded from the tools as they exhibit almost exclusively plain platforms.

Layer 05

Assemblage composition

A total of 1,273 artifacts were examined from layer 05, of which 166 are tools and 44 are cores and core fragments. As explained above, the comparison of tools and cores to the unretouched assemblage is adjusted to reflect the study sample of unretouched blanks. A total of 80% of the unretouched assemblage was examined; therefore their numbers are increased by 20% to match the 100% of cores and tools that were studied.

Like layer 04, layer 05 is extremely rich in archaeological material (Table 3.9). However, there are some differences with the previous layer. While the total count of archaeological material larger than 2.5cm per seven liter sample is quite similar (just over 100 artifacts), the number of faunal remains is much lower and the amount of lithic artifacts more than double. The result is that the ratio of fauna to lithic artifacts (2.8) is less than half that of layer 04. In other words, the ratio is much more comparable to the Asinipodian layer (layer 6A) than it is to layer 4C at Pech IV.

The lithic assemblage from layer 05 is quite different from the one from layer 04 (Figure 3.37). There are about half as many tools (Table 3.13) and many more cores and core fragments (

Table 3.14) relative to other artifact types. Complete flakes and flake fragments also are higher, but shatter is lower. Together with the dramatic decrease in the number of bones, it seems that the activities taking place in layer 05 at Roc de Marsal are quite distinct from those in layer 04. By and large this layer is more comparable to layer 6A at

Pech IV with the exception of the ubiquity of cores in the latter. However, when considering the details of the tools in layer 05, it becomes clear layers 04 and 05 are in fact distinct.

Table 3.13: Breakdown of the Bordian Types in Layer 05 at Roc de Marsal

Type #	Bordian tooltype	count	percent
1	Typical Levallois flake	76	18.2
2	Atypical Levallois flake	44	10.6
4	Retouched Levallois point	1	0.2
5	Pseudo-Levallois point	9	2.2
7	Elongated Mousterian point	1	0.2
8	Limace	1	0.2
9	Straight single scraper	11	2.6
10	Convex single scraper	48	11.5
11	Concave single scraper	2	0.5
12	Double straight scraper	2	0.5
13	Double straight-convex scraper	3	0.7
15	Double Convex scraper	4	1.0
17	Double Concave-convex scraper	3	0.7
18	Straight convergent scraper	1	0.2
19	Convex convergent scraper	8	1.9
21	Dejete scraper	1	0.2
22	Straight transverse scraper	2	0.5
23	Convex transverse scraper	10	2.4
25	Scraper on interior	2	0.5
28	Scraper w/ bifacial retouch	1	0.2
34	Typical percoir	1	0.2
36	Typical backed knife	1	0.2
37	Atypical backed knife	1	0.2
38	Naturally-backed knife	43	10.3
42	Notch	17	4.1
43	Denticulate	8	1.9
44	Bec burinante alterne	1	0.2
48	Abrupt/alternating retouch (thick)	103	24.7
54	End-notched flake	2	0.5
64	Truncated-Faceted piece	10	2.4
	Total	**417**	**100**

Table 3.14: Breakdown of the Core Types in Layer 05 at Roc de Marsal

core type	count	percent
Kombewa core	5	10.9
Levallois core	2	4.3
Single surface core	22	47.8
Globular core	1	2.2
Other	2	4.3
Informal core	7	15.2
N/A	7	15.2
Total	**46**	**100**

Figure 3.38 shows the breakdown of the material into four different classes of tools. Scrapers remain the single biggest category of tools, more than three times larger than the next category, various types of notches and denticulates. This is, indeed, quite different from layer 6A at Pech IV, which has almost as many notches and denticulates as scrapers. Furthermore, while the number of cores and core fragments is double that of layer 04 at RDM, the amount of cores is less than half the amount at layer 6A of Pech IV, where the corresponding percentage of cores is over 40%. Proximal and complete blanks in layer 05 also are much more common than they are in layer 6A at Pech IV. In nearly all respects, layer 05 forms an intermediate between layer 04 and layer 08 at RDM.

However, this position of layer 05 (somewhere between the assemblages from layer 04 and layer 08 at RDM) is not supported by the presence of Levallois technology in the assemblage (Table 3.12). Though slightly lower than those from layer 08, the Levallois indices of layer 05 are much closer to those of layer 08 than they are to layer 04. The IL index is even slightly higher in layer 05 than it is in layer 08. By and large, however, there is more evidence of the use of Levallois technology in this layer than there was in layer 04.

The blank to core ratio and the flake to tool ratio in layer 05 (Figure 3.39) are situated between the values for those from layer 04 and layer 08. There are slightly less than 23 blanks per core and 7.8 flakes for each tool in layer 05. Both values are very similar to those observed for layer 4C at Pech IV. This similarity with layer 4C at Pech IV is intriguing and might indicate that layer 05 is still predominantly a special activity site while at the same time hosting a number of other activities. Import of already prepared blanks into the site might still have been the norm, a suggestion which seems further supported by the low overall average percentage of cortex in layer 05 (17.9%).

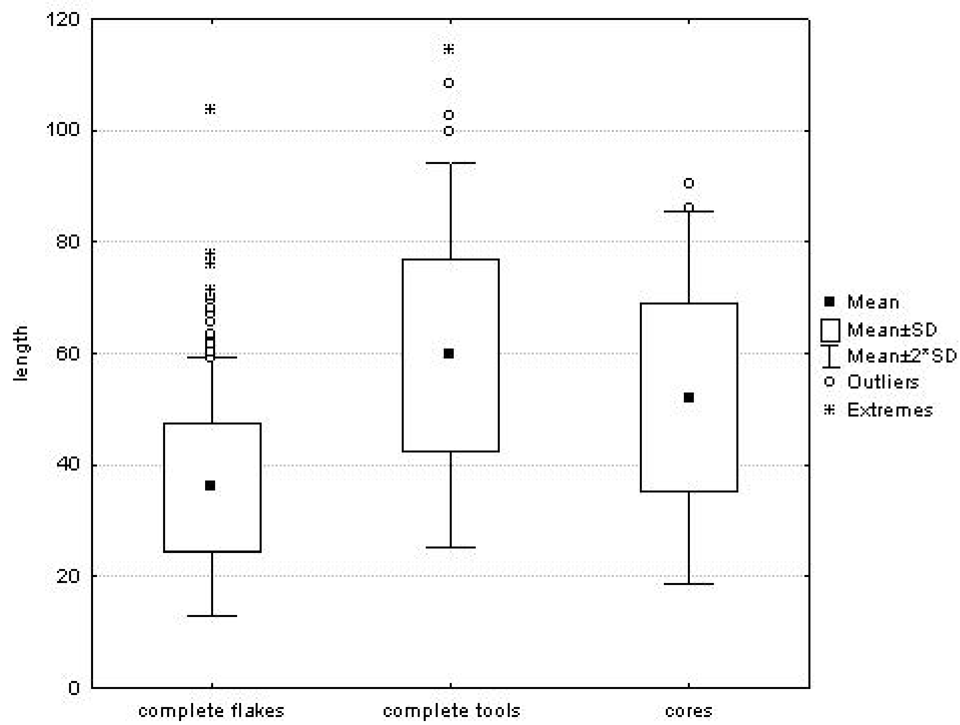


Figure 3.48: Box plots of the sizes of complete flakes (n=489), complete tools (n=91), and cores (n=25) in layer 05 at RDM.

On average, artifacts at RDM seem slightly bigger than those at Pech IV. This remains true for layer 05. Box plots of the size distribution of complete flakes, complete tools, and cores can be seen in Figure 3.48. The pattern is very similar again to the one in layer 4C at Pech IV. Flakes are slightly more than 2cm smaller than complete tools. In terms of length, the cores are shorter than complete tools, but not by much (less than a cm on average). This pattern, as shown in the figure, is clearer for layer 05 than it is for layer 04 where the average lengths for cores and complete tools are very close to one another. That the artifacts in each category at Pech IV are smaller on average than at RDM might be a reflection of the original sizes of the raw material available in the area or the distance to the source of the raw material. As has been demonstrated in the literature (Munday 1976; Marks et al. 1991; Hiscock 2007), as the distance to the source of the raw material increases, the resulting size of flakes, tools, and cores diminish. While the exact sources of the raw material in either Pech IV or RDM are unknown, what is clear is that raw material is available locally.[7]

Platform preparation between flakes and flake scars is fairly similar (Figure 3.49). Flake scars exhibit slightly more prepared platforms (faceted and dihedral platforms) and fewer cortical platforms. The majority of flakes and flake scars have plain platforms.

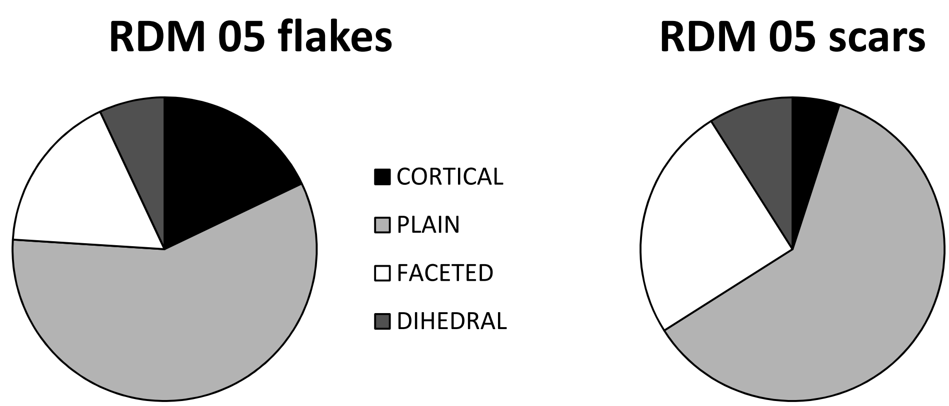


Figure 3.49: Platform preparation for flakes (n=652) and flake scars (n=100) in layer 05 at RDM.

[7] Raw material close to Pech IV might be slightly smaller than near RDM (Dibble et al nd).

Figure 3.50 shows the percentages of different types of flake scars for four different groups of flake scar length. The patterns are similar to the ones discussed for layer 04. Scrapers scars are smaller on average than other types of scars and are found exclusively in the first two size classes. Flake scars on cores show the opposite pattern and increase with each increasing size category. Flake scars on T-Fs best match the core pattern, but tend to be smaller than flake scars on cores. Notches are a bit different from layer 04 because they appear to more closely match the scars on scraper pattern for this layer, whereas in layer 04 the notches were closer to T-Fs.

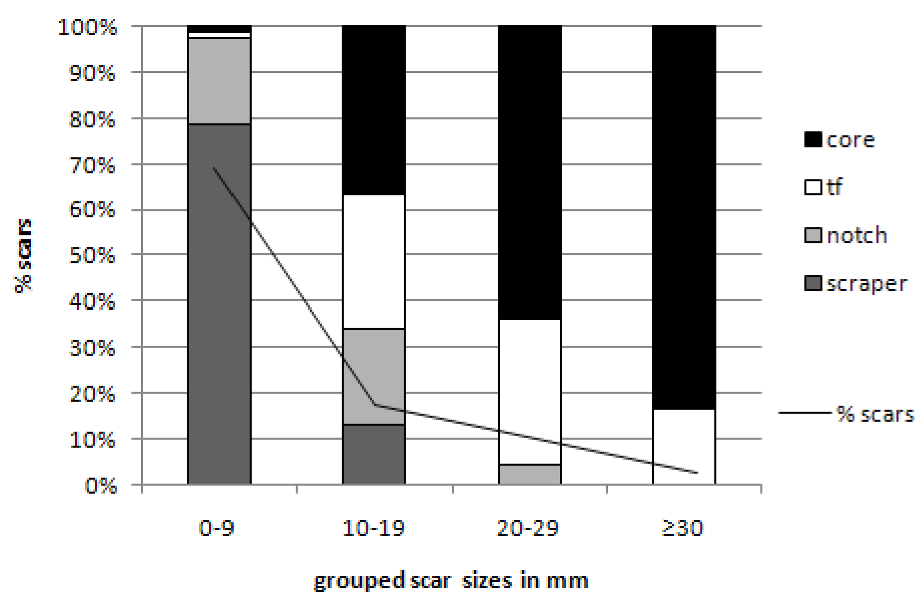


Figure 3.50: Distribution of flake scars on 4 categories of lithic artifacts by size in layer 05 at RDM.

Comparison of flake scars on cores and tools

The pattern observed for the three layers at Pech IV and layer 04 at RDM is repeated in layer 05. Flake scars on tools are smaller on average than flake scars on cores, which are in turn smaller than the distribution of complete flake sizes (Figure 3.51). At the same time each of the size distributions overlaps to some extent with the other distributions. Furthermore, the size cutoff (at 2.5cm) artificially truncates the distribution of flakes at a point that is still well within the range of the flake scars on cores and tools. In other words, because of the artificial cutoff archaeologists do not tend to study those flakes that are produced and used immediately prior to artifact discard. Presumably this methodological choice is one of the key factors structuring the archaeological record and warrants closer examination.

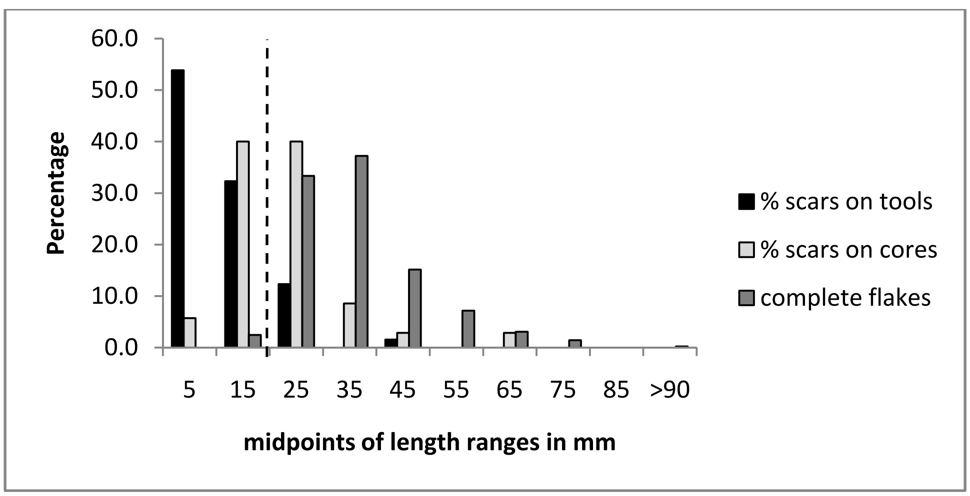


Figure 3.51: Distribution of artifact length by percentage scars on tools and cores as well as the distribution of complete flake sizes for layer 05 at RDM. Note: removals on scrapers are excluded from this graph. The dashed vertical line indicates the 2.5 maximum dimension cutoff that was used in the excavations to determine if artifacts would be piece-provenienced and analyzed.

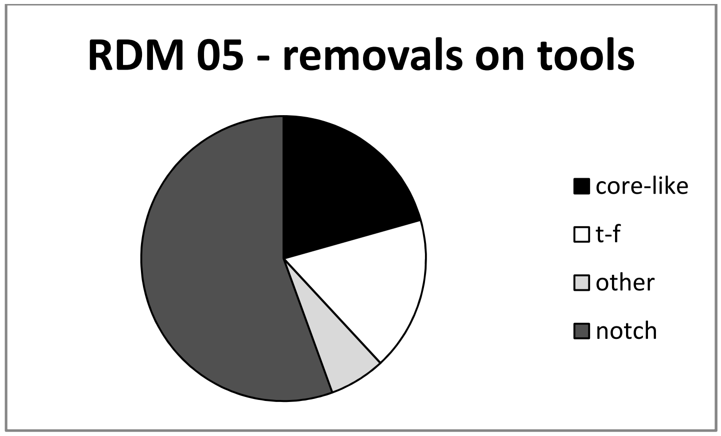


Figure 3.52: Breakdown of flake scar types on tools (n=63) in layer 05 at RDM

Flake scars on tools in layer 05, much like those in layer 04 are predominantly notch-like (Figure 3.52). The second largest category consists of the core-like removals closely followed by T-F flake scars. In layer 05 the scars on cores, tools, and scrapers are not really similar to each other in terms of their locations (Figure 3.53). The majority of scars on tools are from the lateral edges, but lateral removals are not as dominant as they are for scrapers. Flake scars on cores also are often initiated on the lateral edges, but equally often on the proximal end. Tools, however, show a low percentage of scars being initiated on the proximal side of the tool. Rather, they show more frequent distal removals. This pattern is a bit surprising as it bypasses the thicker bulbar area of the flake for one that is often rather thin. This suggests that at least some of the tools from layer 05 do not fit a core pattern of reduction

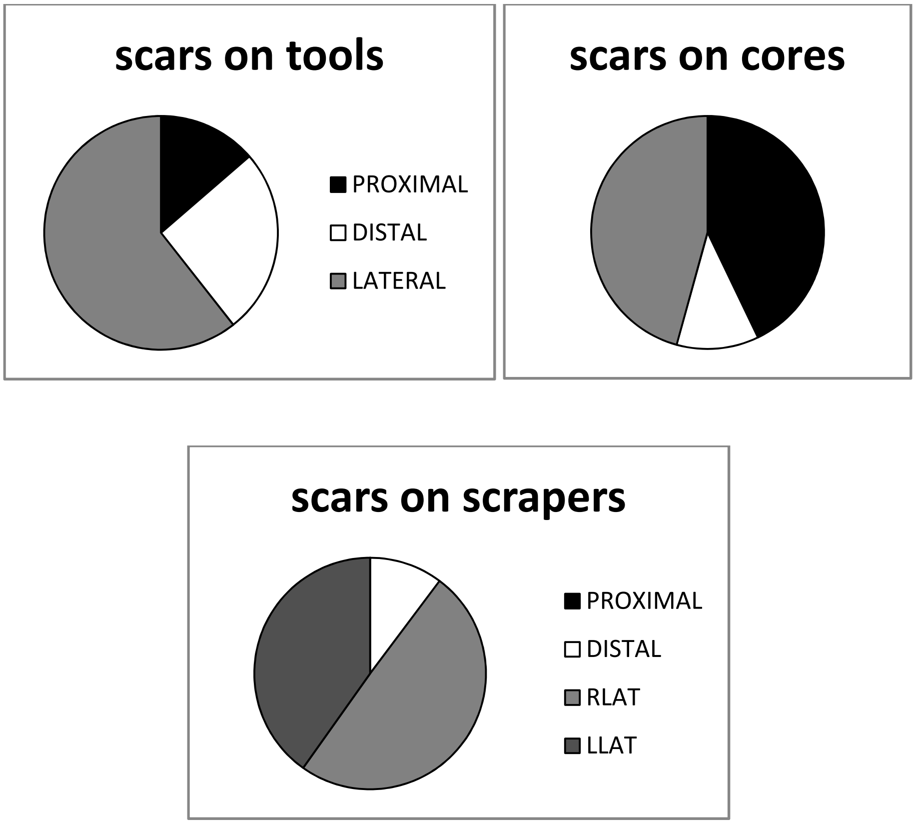


Figure 3.53: Frequency of the flake scars on tools (n=66), cores (n=35), and scrapers (n=117) in layer 05 at RDM.

Flake scars on cores (Figure 3.54) are dominated by exterior removals, which would be expected in technologies that primarily exploit single surfaces as is the case in layer 05. Removals from tools also come primarily from the exterior of the flake, although one third of the removals are from the interior of the flake. As we have seen in other layers, scrapers tend to be almost exclusively made by the removal of exterior flakes.

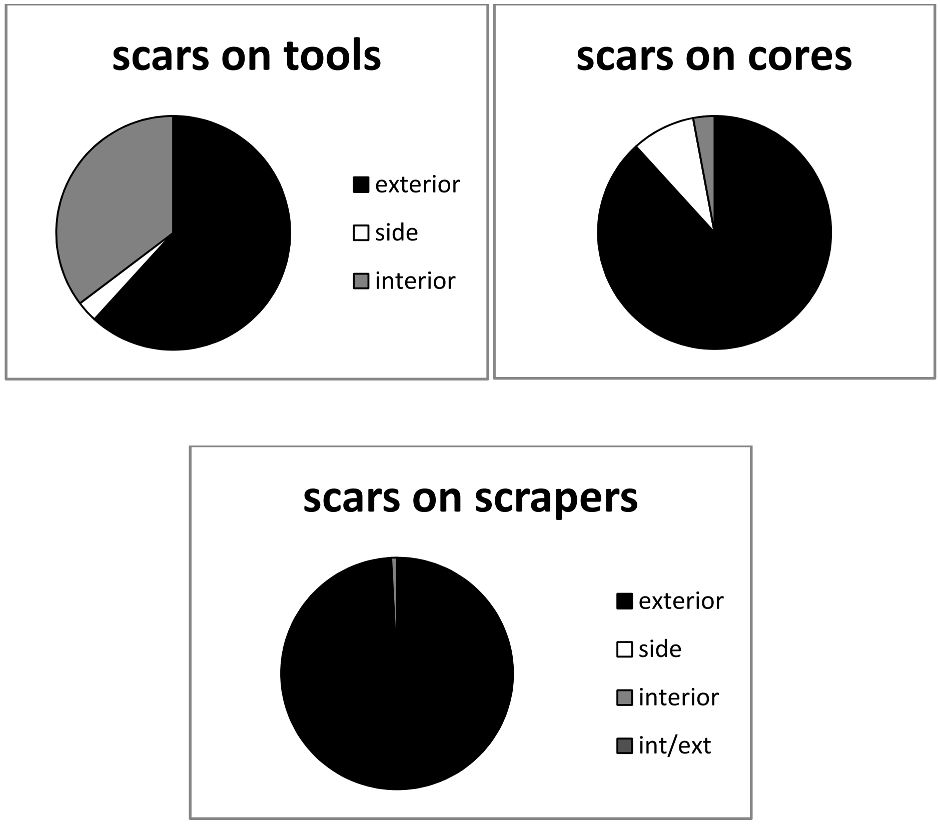


Figure 3.54: Frequency of the flake removal surfaces on tools (n=68), cores (n=34), and scrapers (n=124) in layer 05 at RDM.

The flake scar platform types are shown in the pie charts in Figure 3.55. Flake scars on tools are dominated by plain platforms, which are in sharp contrast to the flake scars on cores. The majority of platforms on cores are prepared. This pattern is rare, particularly when compared to the platform type distribution on flakes, and might lend credence to the suggestion that numerous flakes were actually brought into the site. On the other hand, the pattern observed for complete flakes is intermediate between flake scars on cores and flake scars on tools.

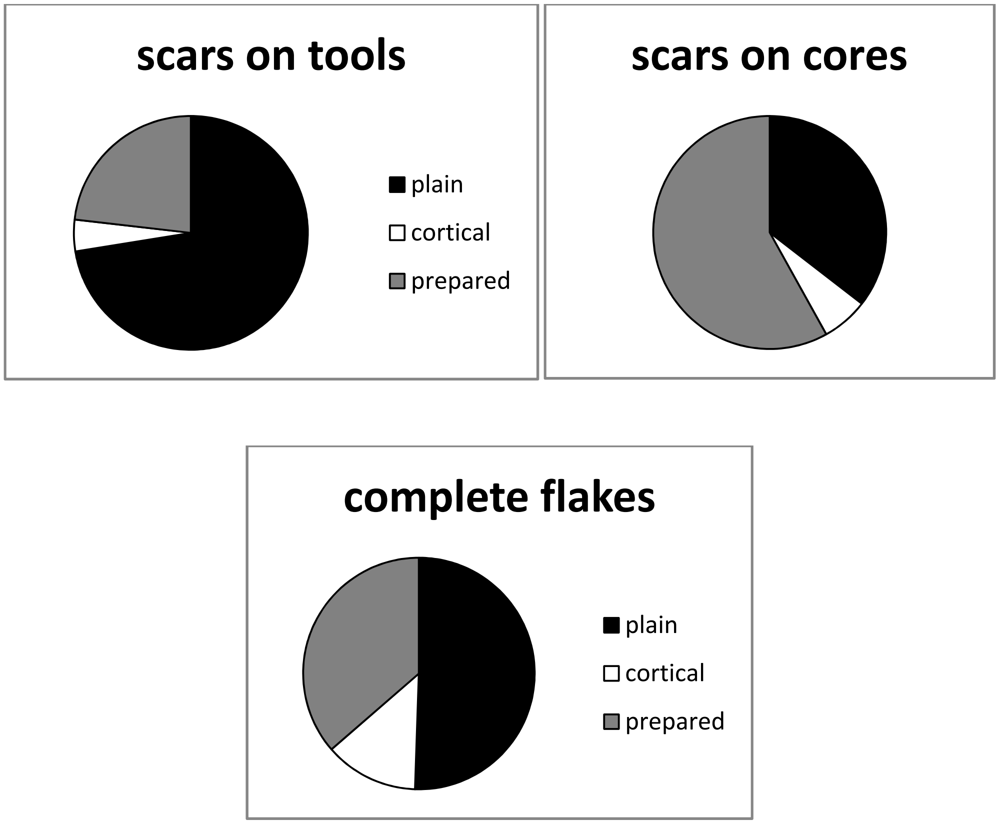


Figure 3.55: Frequency of the platform preparations of flake scars on tools (n=69), cores (n=31), and flakes (n=374) in layer 05 at RDM.

Layer 08

Assemblage composition

A total of 1,115 artifacts from layer 08 are incorporated into this study, of which 92 were tools and 64 cores and core fragments. As is the case for the preceding layers from this site, layer 08 is rich in archeological material. The overall richness of the layer is very comparable to those from layers 04 and 05 at an average of 98.3 artifacts per seven liter sediment sample (Table 3.9). However, there is a marked difference in terms of the material found in the layer. Over half the material in this layer consists of lithic artifacts, whereas bone only makes up 40% of the archeological artifacts greater than 2.5cm. The precise reason for this reversal in the importance of lithics vis-à-vis bone is not yet known, but it seems likely that the explanation might have to with Neanderthal activity at the site rather than taphonomic problems. The sedimentary environment at Roc de Marsal is well-suited for the preservation of bone, as layers 04 and 05 show, so any taphonomic disturbance would have had to occur prior to the deposition of those layers. There does not seem to be any evidence for this.

The lithic assemblage from layer 08 is quite different from the one in layers 04 and 05 (Figure 3.37). Layer 08 has the fewest tools (the breakdown of the tools is shown in Table 3.15) of the three layers examined here, the most cores (Table 3.16), and the highest number of flake fragments. In these respects the layer can best be compared to layer 8 in Pech IV. Incidentally, layer 08 at RDM, like layer 8 at Pech IV, is characterized by the presence of combustion features (Sandgathe et al. 2006; Dibble et al. nd). In addition to the micromorphological evidence for fire, the presence of burned lithic artifacts (24%) gives a clear indication of the presence of fire in layer 08; in layer 8 at Pech IV, the percentage of burned pieces is 31%. In contrast, RDM layers 04 and 05 show very little evidence of burning (2% and 7% respectively). It is tempting to the see the similarities in terms of the lithic assemblages in layers 08 at RDM and layer 8 at Pech as reflecting a functional similarity of the layers through the presence of the hearths.

Table 3.15: Breakdown of the Bordian Types in Layer 08 at Roc de Marsal

Type #	Bordian tooltype		count	percent
1	Typical Levallois flake		74	26.2
2	Atypical Levallois flake		30	10.6
3	Levallois point		3	1.1
5	Pseudo-Levallois point		9	3.2
9	Straight single scraper		3	1.1
10	Convex single scraper		15	5.3
11	Concave single scraper		2	0.7
13	Double straight-convex scraper		1	0.4
15	Double Convex scraper		2	0.7
19	Convex convergent scraper		3	1.1
23	Convex transverse scraper		1	0.4
24	Concave transvers scraper		1	0.4
33	Atypical burin		1	0.4
34	Typical percoir		1	0.4
37	Atypical backed knife		1	0.4
38	Naturally-backed knife		48	17.0
42	Notch		10	3.5
43	Denticulate		10	3.5
45	Retouch on interior		4	1.4
48	Abrupt/alternating retouch		49	17.4
60	Inverse chopper		1	0.4
64	Truncated-Faceted piece		13	4.6
		Total	**282**	**100**

Table 3.16: Breakdown of the Core Types in Layer 08 at Roc de Marsal

core type	count	percent
Kombewa core	14	18.9
Levallois core	1	1.4
Single surface core	35	47.3
Tested block	1	1.4
Pyramidal core	1	1.4
Other	1	1.4
Informal core	16	21.6
N/A	5	6.8
Total	**74**	**100**

While there are significant similarities with layer 8 at Pech IV, there are also some differences. One of these differences is the importance of scrapers in the assemblage. As shown in Figure 3.38 scrapers are still the largest category of tools, but they are only slightly more numerous than notches and denticulates. Layer 8 at Pech IV in contrast has more than four times as many scrapers as notches and denticulates. Layer 08 at RDM has the fewest scrapers of the French assemblages examined here. The percentage of notches and denticulates as well as the so-called Upper Paleolithic tool types are more or less similar across layers at RDM. Other tools, however, which include T-F pieces, are more numerous than in both layers 04 and 05 at RDM. In this sense layer 08 is more similar both to layers 6A and 8 at Pech IV. Core and core fragments are much more important in this layer than they are in layers 04 and 05. In the breakdown shown in Figure 3.38, they are almost double the amount of cores and core fragments in layer

05 and four times that of layer 04. Compared to the amount of cores and core fragments at Pech IV, however, layer 08 in RDM is not quite as rich.

When we examine the assemblage through a technological instead of a tool-typological lens (Table 3.12), it becomes clear that Levallois pieces are much more numerous in layer 08 than in layer 04 and slightly more numerous than in layer 05. However, as mentioned earlier, the percentage of Levallois cores is actually very low. From this perspective, the similarity with layer 8 at Pech IV is remarkable. All four values are more or less the same except for the slightly higher percentage of Levallois cores in layer 8 at Pech IV.

Blank to core and flake to tool ratios (Figure 3.39) from layer 08 continue the trend of layers 04 and 05. The blank to core ratio (14) is the lowest at Roc de Marsal, and the flake to tool ratio the highest (16.2). The flake to tool ratio is similar to the one observed for layer 8 at Pech IV. However, in layer 8 at Pech, the blank to core ratio is more than double the value observed for layer 08 at RDM.

Sizes of complete flakes, complete tools, and complete cores follow the now familiar pattern (Figure 3.56). Flakes are smallest on average, tools largest, and cores fall in between. These differences are all statistically significant ($p<0.01$). The same patterns are observed in layer 8 at Pech IV, but in each case the artifacts from Pech IV are smaller than those from RDM. These differences, however, are not statistically significant except for the comparison between the complete flakes from the two sites.

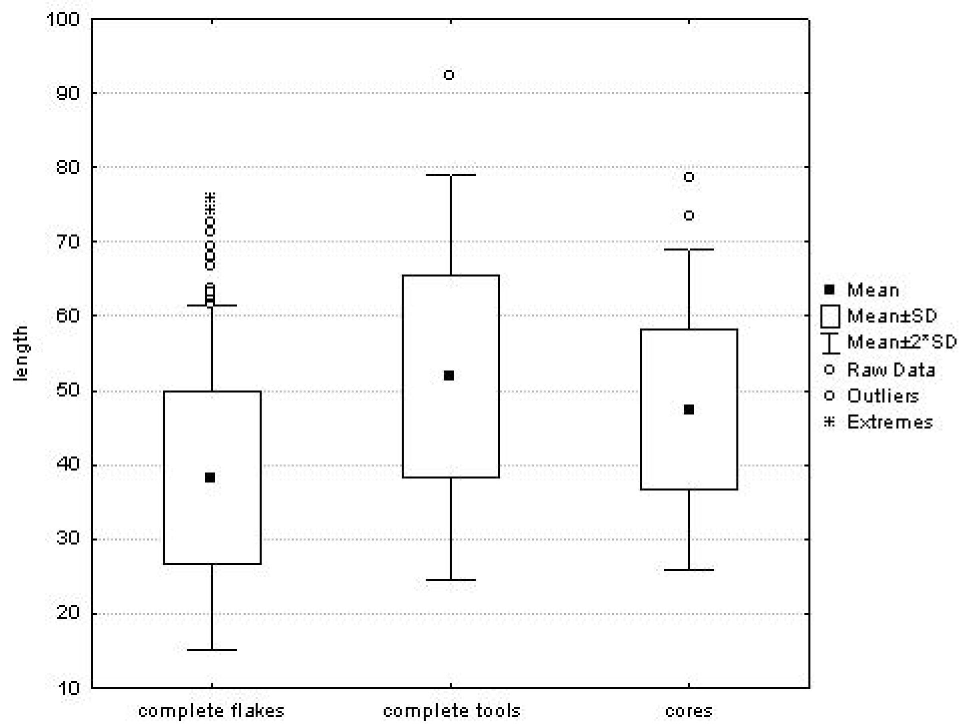


Figure 3.56: Sizes of complete flakes (n=363), complete tools (n=40), and cores (n=44) in layer 08 at RDM.

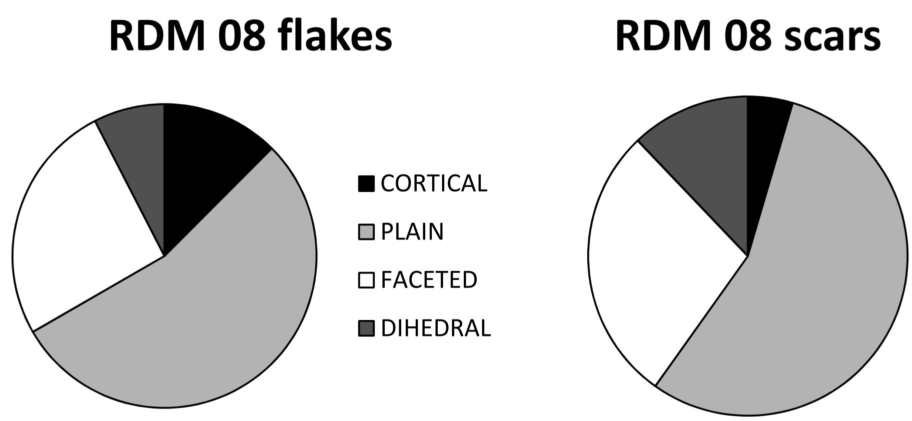


Figure 3.57: Comparison between the platforms on flakes (n=489) and on flake scars (n=132) in layer 08 at RDM

Platforms between flakes and flake scars are similar (Figure 3.57). In both cases the majority of platforms are plain and the second largest category, about one fourth of the total platforms, are faceted. Flakes exhibit more cortical platforms than do flake scars.

The distribution of flake scar sizes on different types of artifact categories shows a similar pattern to the ones seen earlier (Figure 3.58). Flake scars on cores are, on average, larger and match closest with the flake scars on T-Fs. Notches match fairly well with T-Fs, but tend to be smaller. The smallest types of scars are seen on scrapers, which are more or less limited to the smallest flake scar size category. The sizes of flake scars on T-Fs consistently overlap extensively with those on cores. This pattern confirms the argument Dibble and McPherron (2006, 2007) made which suggests that T-Fs should be interpreted as cores for the removal of small flakes. The same might be true for a large portion of items that have traditionally been called “tools.” In other words, tool typology could be simply an extension of the technology of blank production, not a separate realm of functionally used “tools.” The functionally important artifacts in this interpretation are the unretouched flakes; they might be the ones used as tools primarily. The one clear exception to this interpretation would be scrapers which are clearly different in terms of the sizes of the flake scars removed from them, but also different in terms of the location of the removals, as well as the details of their technical production (i.e., in their platform preparation).

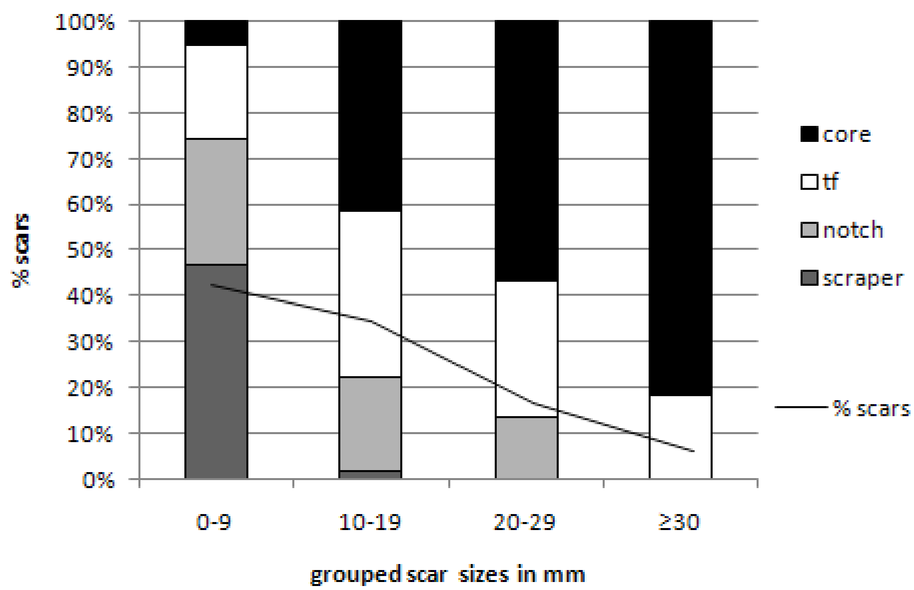


Figure 3.58: Distribution of flake scars on 4 categories of lithic artifacts by size in layer 08 at RDM.

Comparison of flake scars on cores and tools

The distribution of flake scars on cores and tools in layer 08 shows the same pattern observed for all the other layers so far examined (Figure 3.59). Flake scars on tools are the smallest, but overlap considerably with those on cores. Furthermore, both overlap with the distribution of the sizes of complete flakes.

The majority of flake scars on tools in layer 08 are notch-like (Figure 3.60). The second largest category consists of T-F-like removals, followed by core-like removals. The importance of T-F removals in this layer is markedly higher than in layers 04 and 05. Similarly there is a spike in the number of T-F pieces in this layer.

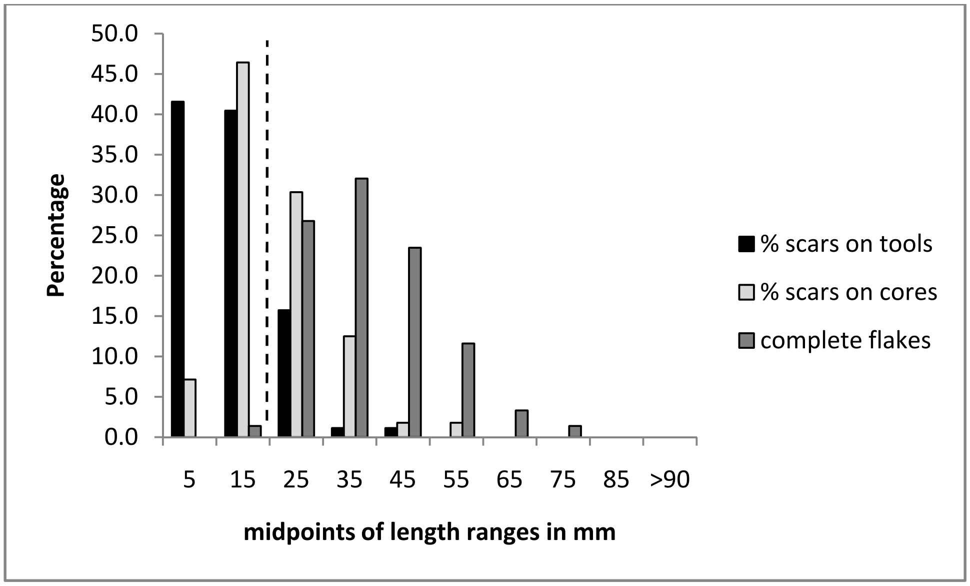


Figure 3.59: Distribution of artifact length by percentage scars on tools and cores as well as the distribution of complete flake sizes for layer 08 at RDM. Note: removals on scrapers are excluded from this graph. The dashed vertical line indicates the 2.5 maximum dimension cutoff that was used in the excavations to determine if artifacts would be piece-provenienced and analyzed.

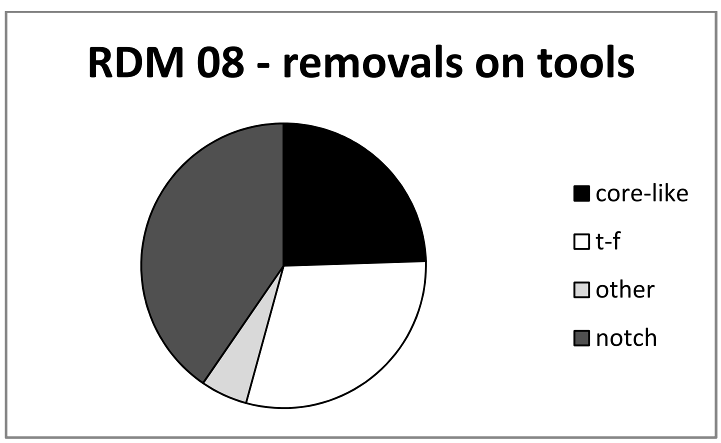


Figure 3.60: Breakdown of flake scar types on tools (n=94) in layer 08 at RDM

The locations of flake scars on tools and flake scars on cores are similar. The majority of flake scars are from the lateral edges of the cores. The second most favored location to start a removal is the proximal portion of cores and tools. This pattern is quite different from the ones on scrapers which mostly make use of the lateral sides and to a lesser extent of the distal portion of flakes.

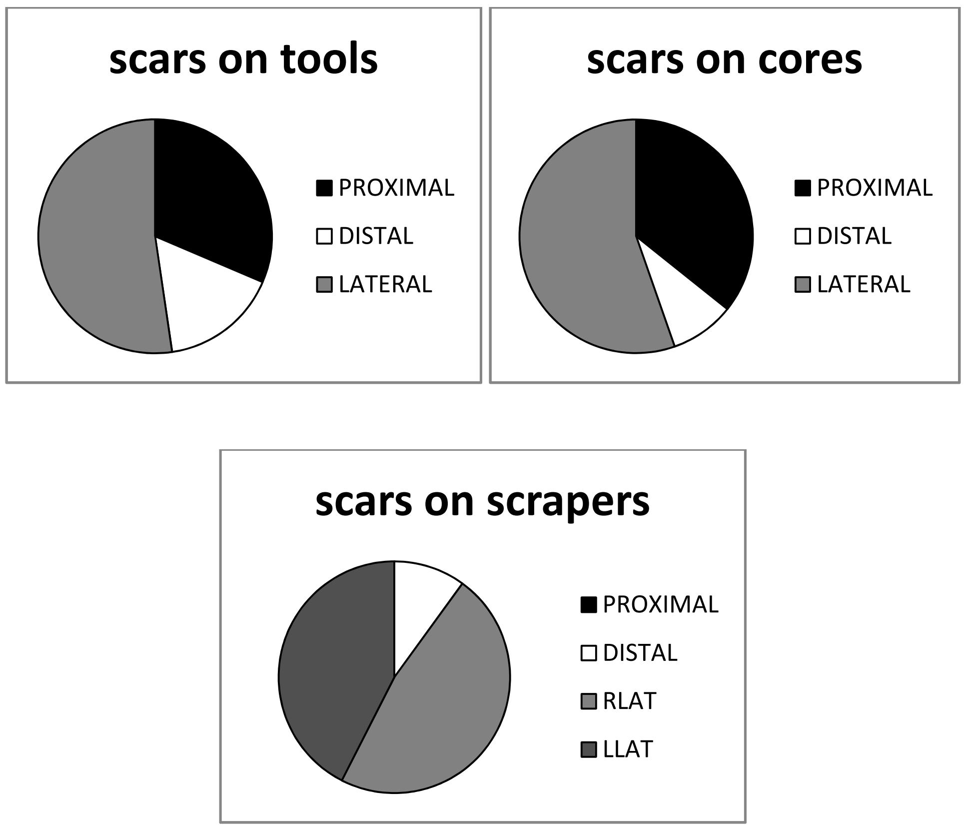


Figure 3.61: Frequency of the locations of flake scars on tools (n=86), cores (n=56), and scrapers (n=40) in layer 08 at RDM.

Another way to locate flake scars is to identify their removal surfaces (Figure 3.62). Interestingly, on tools there are numerous removals from the interior surface, more so than from the exterior. On cores, the majority of scars are located on the exterior. This is not unexpected given that a sizeable portion of the industry is characterized by single surface cores, which would automatically be identified as the exterior surface of the core. Scrapers are retouched predominantly on the exterior surface (much as we have seen in other layers). There are, however, some removals on the interior surface as well.

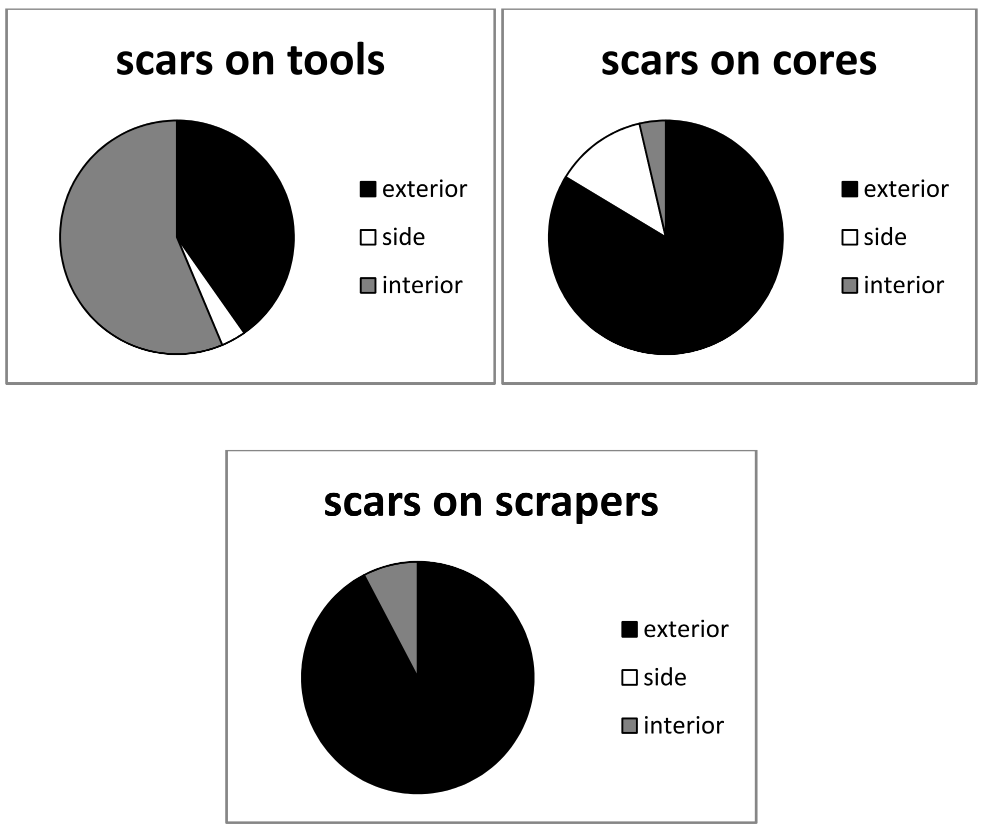


Figure 3.62: Frequency of the removal surfaces of flake scars on tools (n=87), cores (n=55), and scrapers (n=39) in layer 08 at RDM.

Figure 3.63 shows the breakdown of platform types for flake scars on tools and cores and compares these in turn to complete flakes. The platform preparations on tools and cores are very similar with the majority of the removals having plain platforms followed by a quite extensive amount of flake scars which show platform preparation. The similarity between the platform preparation on cores and tools suggests that both are guided by a similar reduction philosophy, different from that of scrapers, which are almost exclusively dominated by plain platforms.

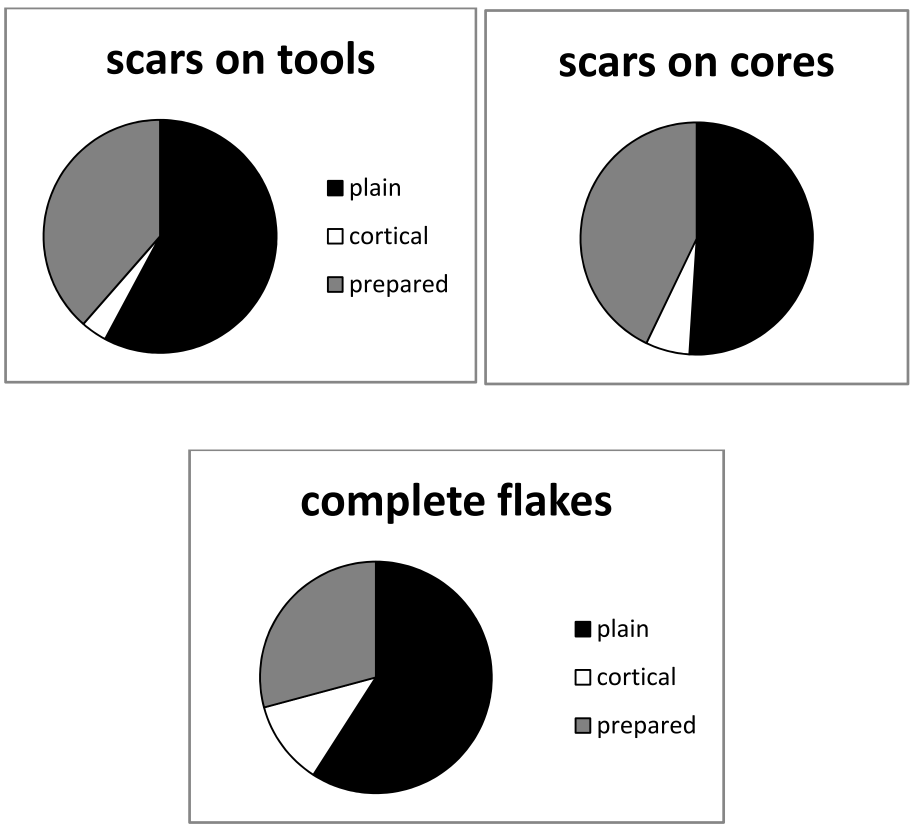


Figure 3.63: Frequency of the platform preparations as visible on flake scars on tools (n=83), flake scars on cores (n=49), and the platform preparation seen on complete flakes (n=281).

Combe Capelle Bas

Layer I-1E

Assemblage composition

A total of 1,158 artifacts from layer I-1E are incorporated in this study, including 171 tools and 86 cores. This site presents a very different picture from the cave sites of Pech de l'Azé IV and Roc de Marsal. As mentioned in chapter 2, Combe Capelle Bas (CC) is an open air site and conforms to patterns observed at other open air sites — there are virtually no faunal remains preserved. Therefore, data in Table 3.17 are limited to the average counts of lithic artifacts per bucket (adapted from data in Dibble and Lenoir 1995). However, a significant discrepancy between the richness of the archaeological record at the cave sites and at Combe Capelle Bas remains even when we consider lithic remains exclusively. The least dense of the layers from the cave sites (layer 4C at Pech IV) still has about 50% more artifacts per seven liter sample than the densest of the layers at Combe Capelle (layer I-1E).

Table 3.17: Number of Lithic Artifacts per Seven Liter Sediment Sample

layer	lithic/bucket
I-1E	4.34
I-2A	3.81
I-2B	2.39

Table 3.18: Breakdown of the Bordian Types in Layer I-1E at Combe Capelle Bas

Type #	Bordian tooltype	count	percent
1	Typical Levallois flake	6	0.9
2	Atypical Levallois flake	5	0.7
5	Pseudo-Levallois point	1	0.1
9	Straight single scraper	11	1.6
10	Convex single scraper	31	4.5
11	Concave single scraper	4	0.6
13	Double straight-convex scraper	2	0.3
15	Double Convex scraper	6	0.9
19	Convex convergent scraper	3	0.4
21	Dejete scraper	1	0.1
22	Straight transverse scraper	2	0.3
23	Convex transverse scraper	14	2.1
25	Scraper on interior	5	0.7
27	Scraper w/ thinned back	1	0.1
28	Scraper w/ bifacial retouch	1	0.1
29	Alternate scraper	1	0.1
32	Typical burin	2	0.3
33	Atypical burin	2	0.3
34	Typical percoir	2	0.3
37	Atypical backed knife	1	0.1
38	Naturally-backed knife	21	3.1
40	Truncation	3	0.4
42	Notch	40	5.9
43	Denticulate	30	4.4
44	Bec burinante alterne	1	0.1
45	Retouch on interior	13	1.9
48	Abrupt/alternating retouch	106	15.5
50	Bifacial retouch	1	0.1
54	End-notched flake	7	1.0
61	Chopping-tool	1	0.1
62	Divers	6	0.9
64	Truncated-Faceted piece	11	1.6
	Total	**341**	**100**

Table 3.19: Breakdown of Core Types in Layer I-1E at Combe Capelle Bas

core type	count	percent
Kombewa core	5	6.0
Disc core	3	3.6
Levallois core	2	2.4
Single surface core	16	19.3
Double surface core	2	2.4
Tested block	2	2.4
Globular core	5	6.0
Pyramidal core	1	1.2
Other	12	14.5
Informal core	26	31.3
N/A	9	10.8
Total	**83**	**100**

The composition of the lithic assemblage in layer I-1E of Combe Capelle Bas also is quite different from the one observed at Roc de Marsal and Pech IV. Perhaps the most striking of these differences is the large number of cores and core fragments present at the site (Figure 3.64). Secondly, the site has a surprisingly consistent (across layers) and high percentage of tools. Flake and flake fragments are somewhat lower, and shatter hovers around 10% (which is not unlike the cave sites).

Among the tools (Figure 3.65 and Table 3.18), the pattern in layer I-1E is perhaps closest to the one in layer 08 at RDM and layer 6A in Pech IV. The category of scrapers is as ubiquitous as notches and denticulates. The Upper Paleolithic types are rare and other tools a bit more abundant. It is striking that cores (Table 3.19) as a category are more important than scrapers, a pattern only seen in layer 08 at RDM and layer 6A in Pech IV. The number of blanks in layer I-1E is low compared to other sites.

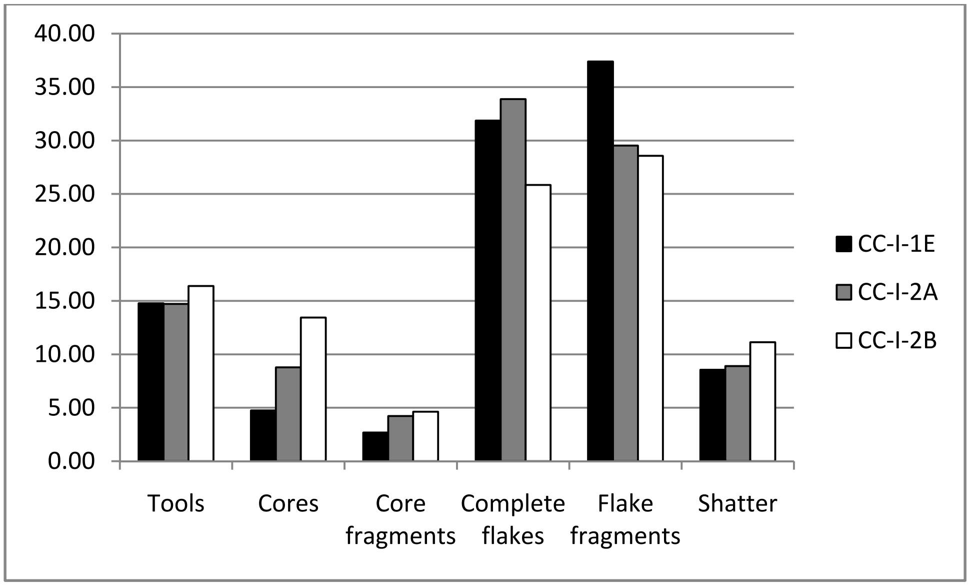


Figure 3.64: Breakdown of the lithic assemblage from Combe Capelle Bas into the major lithic artifact categories (CC 1E: n=1,158, CC 2A: n=877, CC 2B: n=476).

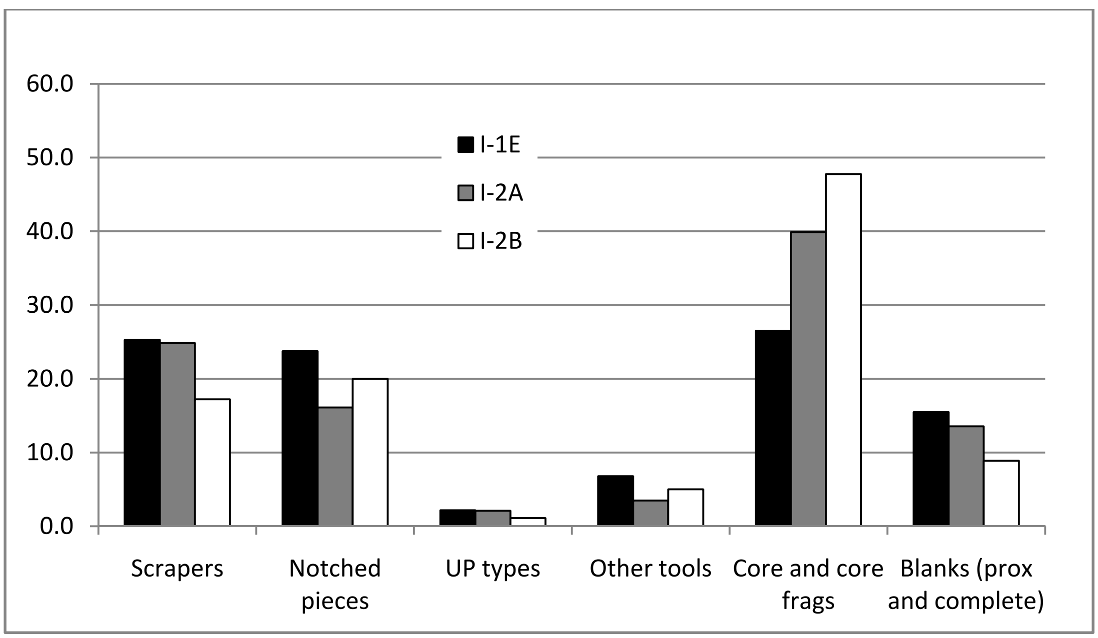


Figure 3.65: Breakdown of lithic assemblages at CC into four major types of tools, cores, and unretouched blanks. The vertical axis represents the percentage of each artifact category per layer. Note: the total blank count was divided by 10 to minimize the impact of this category on the graph as a whole (CC 1E: n=324, CC 2A: n=286, CC 2B: n=180).

Technologically this site also is quite different from most of the layers examined so far. Levallois technology is very rare at the site in general, including layer I-1E (Table 3.20). The assemblages that are closest to layer I-1E technologically are RDM layer 04 and layer 4C at Pech IV, but neither one of them is quite this devoid of Levallois elements. Dibble and colleagues argue that the technology is best described as a Quina technology (Dibble and Lenoir 1995). Typologically, however, the site cannot be described as Quina even though some Quina scrapers are present. This is due to the large amount of notches and denticulates at the site.

Table 3.20: Levallois Indices for Combe Capelle Bas

	CC-I-1E	CC-I-2A	CC-I-2B
IL	1.14	1.91	0.6
Ilty	3.23	5.49	1.52
IL core	2.3	4.4	2.3
Single surface core	22.1	28.1	14

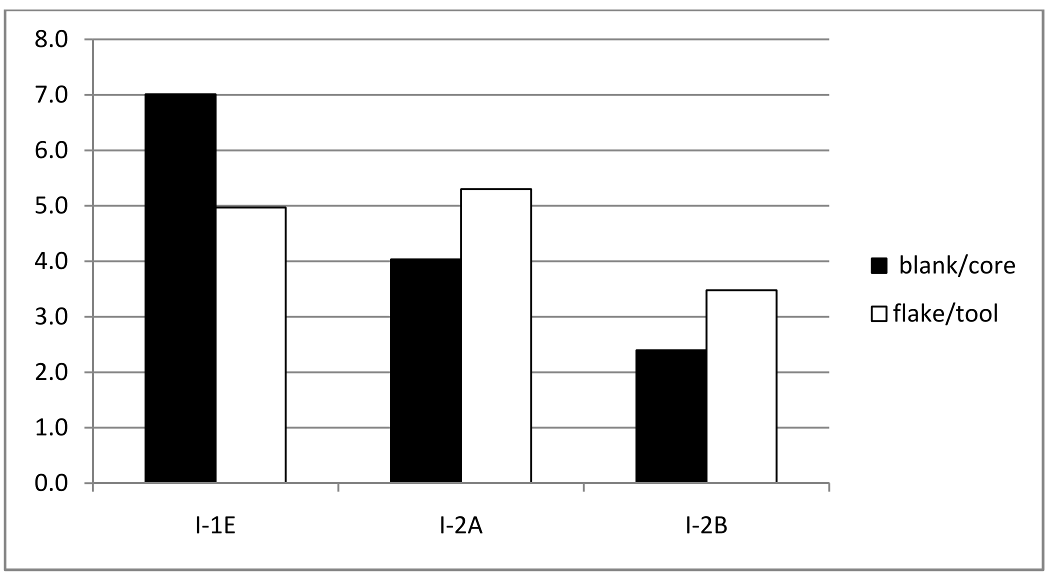


Figure 3.66: Blank to core and flake to tool ratios at Combe Capelle Bas.

The blank to core ratio in layer I-1E is different from most values seen in layers from Roc de Marsal and Pech IV (Figure 3.66). That is, the ratio is really low. There are only 7 blanks per core; a value this low is only seen in layer 6A at Pech IV. It is unclear exactly why. On the one hand, this pattern might be related to the export of blanks from Combe Capelle Bas. Another possibility is that the ready availability of raw material at the site results in a limited reduction of each core. A third possible explanation for the low blank to core ratio might be that the number of cores are elevated because many of the flakes are used as cores. In fact, 18.5% of the cores in layer I-1E are made on flakes, rather than unmodified blocks of raw material as one might expect. Another 13% were identified as “n/a,” which often means it was unclear if the material was originally a flake or a natural cobble. If we consider the large size of the raw material available at Combe Capelle Bas, this strategy appears reasonable because the large blocks are quite unwieldy. In other words, it would make sense to reduce a larger cobble into smaller more manageable flakes. Depending on the extent of reduction, each of these flakes might no longer be identifiable as a flake, and, regardless, they would be classified as a core unless the piece clearly could be categorized as one of the tool types in the Bordian typelist. The interpretation of the low blank to core ratio at Combe Capelle Bas and its implications for understanding lithic assemblages will be further discussed in chapter 4.

The flake to tool ratio in layer I-1E is very low. In fact, only layer 04 at RDM has fewer flakes relative to tools than layer I-1E. In other words, there are very many tools in this layer, but unlike layer 04 in Roc de Marsal, these tools are not dominated by scrapers, but rather include as many notches and denticulates as scrapers. This high number of "tools" at Combe Capelle Bas is surprising, not in the least because Combe Capelle Bas is an open air site and these types of sites typically tend to have lower numbers of tools (Barton and Clark 1993). Another reason why fewer tools might be expected at this site is that the site itself is a raw material source. Tools tend to be rarer at such sites. The explanation offered for this apparent discrepancy has been that the site is not simply a raw material extraction site, but rather more like a habitation site which happens to also be a source location for raw material (Dibble and Lenoir 1995). In other words, Neanderthals lived there and did not use the site simply to obtain raw material and move on. This interpretation seems reasonable. An alternative explanation might be that many of the tools seen at the site did not serve as tools in the traditional functional sense, but rather served the purpose of producing blanks.

The size distribution of complete flakes, complete tools, and cores is slightly different from the pattern observed elsewhere (Figure 3.67). What is typical is that flakes are on average the smallest of the three categories. What is not typical is that the largest category does not consist of the complete tools, but rather the cores. The distributions of complete tools and cores are significantly different from the distribution of complete flakes ($p<0.01$). Complete tools and cores are not significantly different in terms of length (p=0.36). The same pattern is observed when considering width, but not when weight or thickness is used as a size indicator. Then differences are significant (p<0.02).

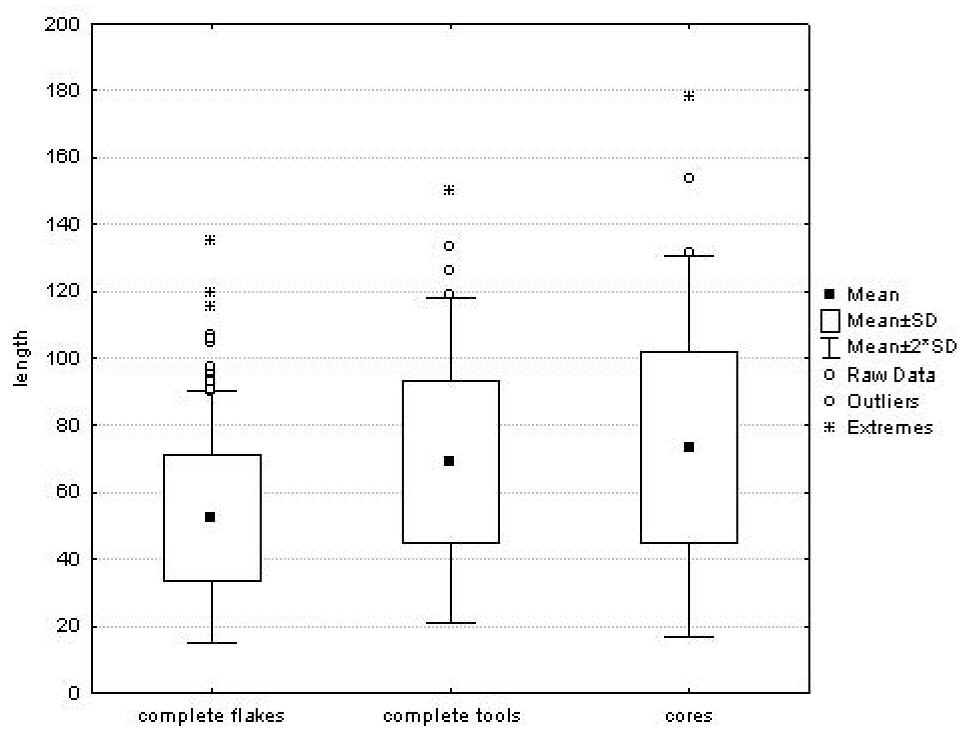


Figure 3.67: Box plots of the distribution of lengths of complete flakes (n=368), complete tools (n=81) and cores (n=55) in layer I-1E at Combe Capelle Bas.

The breakdown of platform preparation types on flakes and flake scars is similar (Figure 3.68). A large majority of platforms are plain, which is typical for Quina industries (Turq 1992; Bourguignon 1997). Prepared platforms (dihedral and faceted) are present, and cortical platforms are more prevalent on flakes than they are on flake scars.

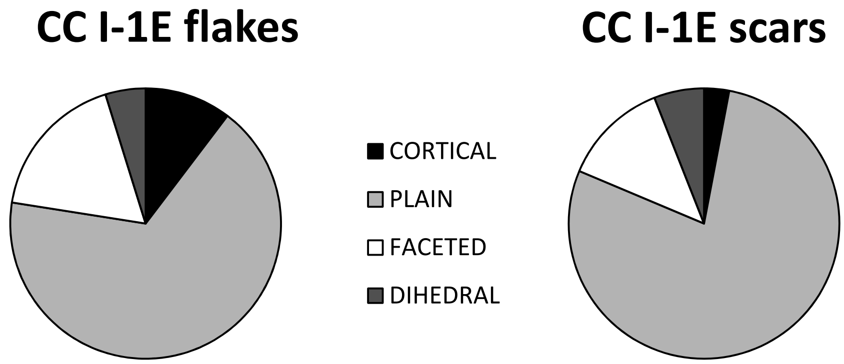


Figure 3.68: Frequency of platform types for flakes (n=542) and flake scars (n=134) in layer I-1E in Combe Capelle Bas.

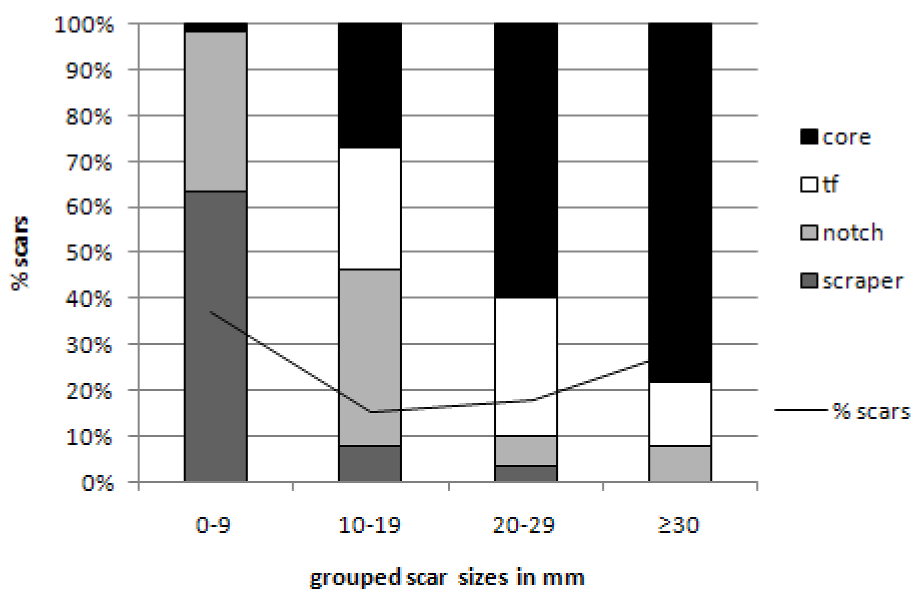


Figure 3.69: Distribution of flake scars on 4 categories of lithic artifacts by size in CC 1E.

Flake scars on cores are on average the longest (Figure 3.69). However, as we have seen in other layers, they overlap considerably with flake scars on other types of artifacts, most notably with T-Fs, but also with flake scars on notches (including denticulates and end-notches). Scrapers also overlap to some extent with T-Fs and notches, but by and large they are restricted to the smallest category of flake scar length. Note that in this graph the distribution of the percentage of scars (line on the graph) increases for the 2-3cm and >3cm categories. In general flake scars in layer I-1E are larger than they are in either Pech IV or Roc de Marsal. The same is true for the sizes of complete flakes, complete tools, and cores.

Comparison of flake scars on cores and tools.

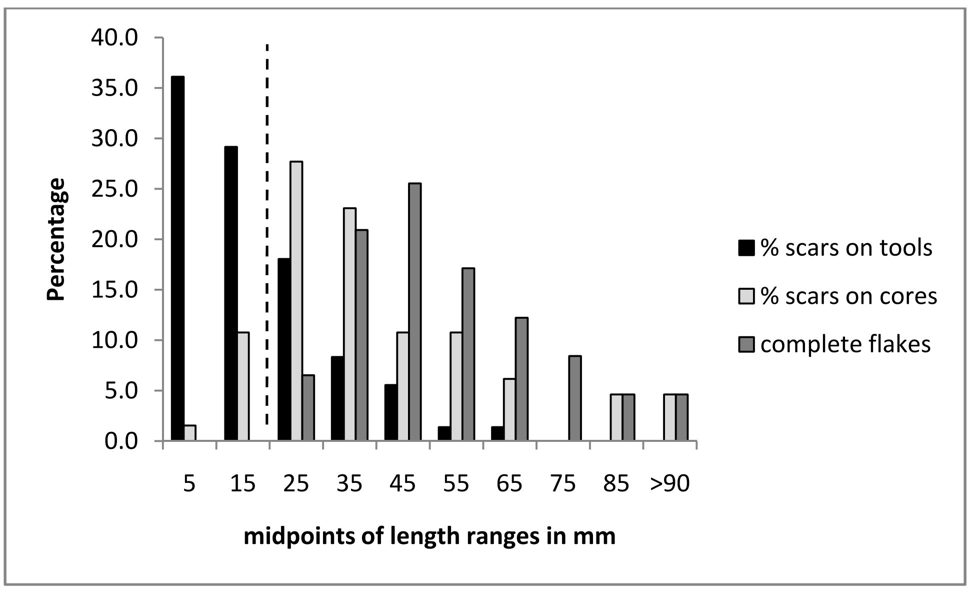


Figure 3.70: Distribution of artifact length by percentage scars on tools and cores as well as the distribution of complete flake sizes for layer I-1E at CC. Note: removals on scrapers are excluded from this graph. The dashed vertical line indicates the 2.5 maximum dimension cutoff that was used in the excavations to determine if artifacts would be piece-provenienced and analyzed.

The pattern observed in Figure 3.70 is similar to the patterns seen thus far. There are three overlapping distributions. Complete flakes are on average longer than flake scars on cores, which are in turn longer than flake scars on tools. Some of the longest flake scars on tools are quite large (between 6 and 7cm).

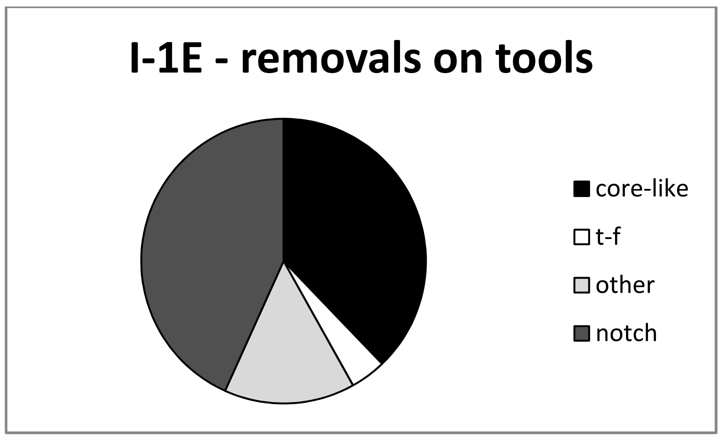


Figure 3.71: Frequency of flake scar removal types as they are found on tools (n=74) in I-1E at CC.

The types of flake scars on tools consist of two major categories (Figure 3.71): core-like removals and notch removals. T-F removals are rare in this layer. That so many of the removals on tools are core-like lends credence to the suggestion that at least a portion of blanks derive from flake scars on tools.

The majority of flake scars on cores, tools, and scrapers are located on the lateral edges (Figure 3.72). The total percentages are very similar to one another. The second largest area from which flakes are removed on cores is the proximal portion. However, for scrapers it is the distal portion of the flake. The pattern for tools lies in between, with about equal portions of removals from the distal and from the proximal areas of the tool. The clear presence of distal removals in the scrapers is related to the elevated number of transverse scrapers in this assemblage. Fully 8.5% of the tools are transverse scrapers. In terms of the relationship between single scrapers and double/transverse scrapers (the Scraper Reduction Index – Dibble 1995a) layer I-1E, with a value of 0.37, is at the low range of layers with high values for this index. In other words, there are relatively numerous transverse scrapers relative to single scrapers. It is tempting to see the scrapers at Combe Capelle Bas as resulting from discard coinciding with tool/blank replacement at a raw-material-rich location. However, no clear patterns to document this possibility are apparent.

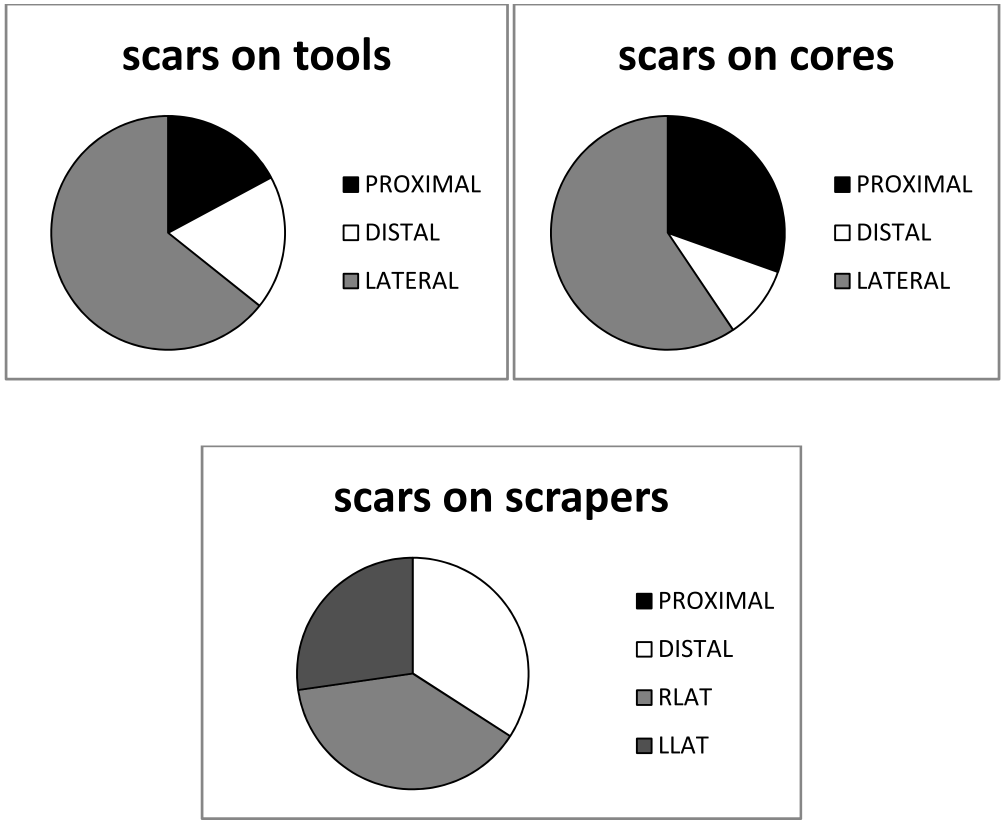


Figure 3.72: Frequency of the locations of flake scars on tools (n=70), cores (n=69), and scrapers (n=44) in layer 1E at CC.

Examining the location of flake scars in relation to the interior and exterior parts of the flake (Figure 3.73) shows that material is removed most frequently from the exterior for all three categories. However, for scrapers almost all flake removals are on the exterior side, whereas for cores and tools it is less than 75% of the scars. The difference between cores and tools in terms of the location of removals is minimal. Tools have slightly more interior removals than cores do; cores have more removals from their sides. This pattern is not surprising given that cores are significantly thicker on average than are tools (core average thickness = 33 ± 19mm; tool average thickness = 17 ± 9mm; t = 6.7, df.= 134, $p<0.01$).

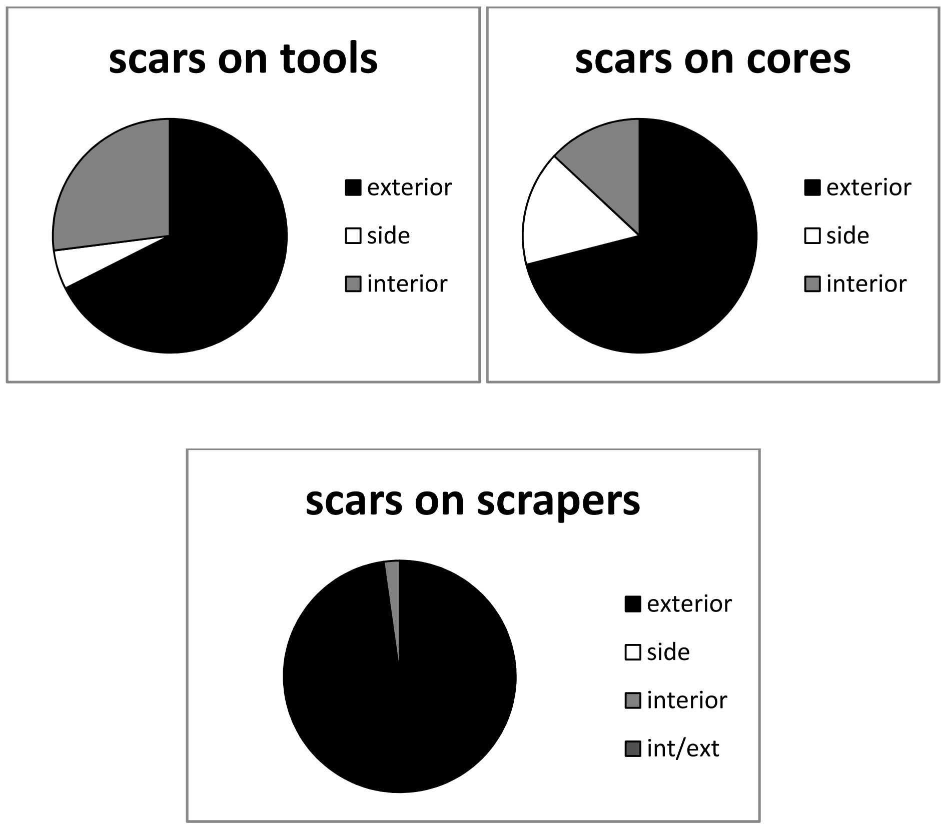


Figure 3.73: Frequency of the removal surfaces of flake scars on tools (n=74), cores (n=69), and scrapers (n=45) in layer I-1E.

Platform preparation of flake scars on cores and tools also match each other fairly well (Figure 3.74). The majority of platform scars are plain. The second largest platform types are prepared platforms. Cortical platforms are minor for both flake scars on cores and tools. When we compare flake scars with the platforms on complete flakes it is clear that they are compatible with each other.

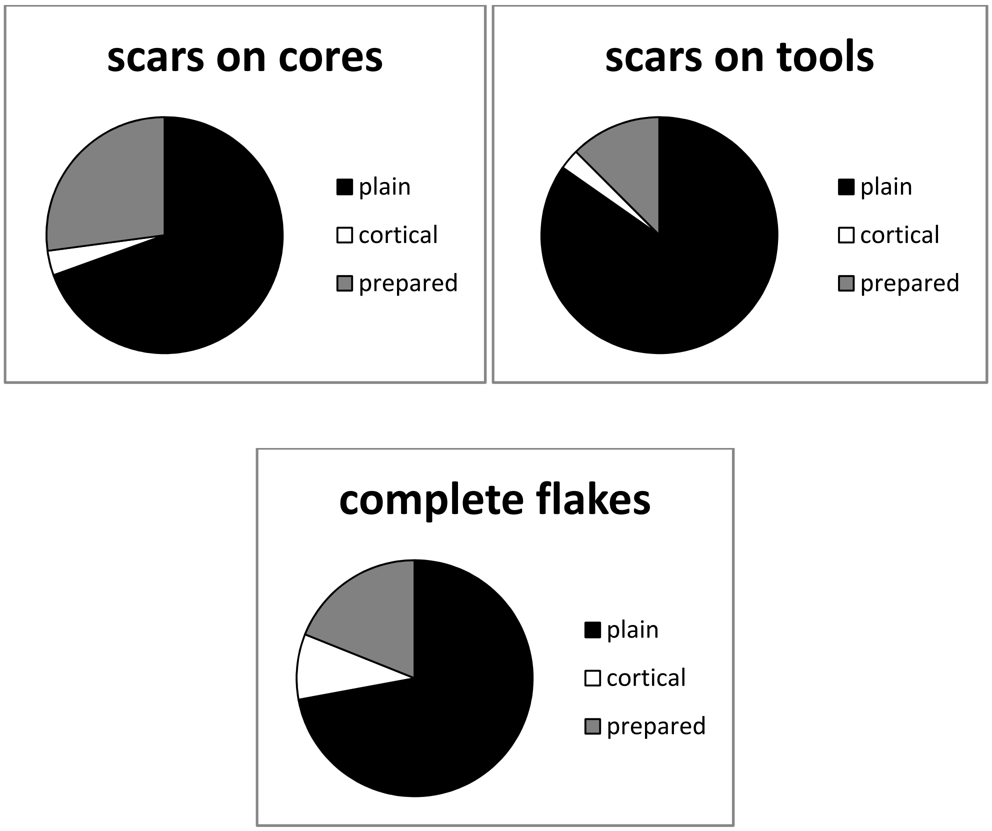


Figure 3.74: Frequency of the types of platforms for complete flakes (n=301) and for flake scars on tools (n=72) and cores (n=59) in layer I-1E at CC.

Layer I-2A

Assemblage composition

A total of 877 artifacts from layer I-2A were examined, of which 129 are tools and 114 cores. Layer I-2A is slightly less dense in lithic artifacts than layer I-1E. The latter, as shown above, was already the least dense when compared to layers from the cave sites examined in France. The lithic assemblage from this layer (Figure 3.64) is quite similar to that from layer I-1E. Tools are quite numerous in the assemblage, as are cores and core fragments. In fact, there are more cores and core fragments in this layer than in I-1E. Complete flakes are also slightly more abundant in I-2A than they were in the layer above it, but flake fragments are less so.

The breakdown of tools from layer I-2A shows a pattern similar to the one found in the layer above it (Figure 3.65, Table 3.21). Scrapers are a bit more common and quite often consist of transverse scraper types. In fact, the Scraper Reduction Index is the highest among all layers examined: 0.49. Notched pieces are quite abundant, but slightly less so than in I-1E. Upper Paleolithic types and other types of tools are relatively rare. Quite remarkable is the very high density of cores and core fragments in this layer (Figure 3.65, Table 3.22). In the weighted breakdown shown in Figure 3.65, this category is dominant over all the other classes of artifacts. Note that the importance of blanks is downplayed in this type of graph. Nonetheless, this pattern, that the category of cores and core fragments is larger than one tenth of blanks, occurs only in one layer (6A at

Pech IV) of the six examined from the two cave sites. At Combe Capelle Bas all three of the layers show this pattern. This fact is important; I will return to it in the discussion.

Table 3.21: Breakdown of the Bordian Types in Layer I-2A at Combe Capelle Bas

Type #	Bordian tooltype		**count**	**percent**
1	Typical Levallois flake		9	3.8
2	Atypical Levallois flake		4	1.7
9	Straight single scraper		9	3.8
10	Convex single scraper		30	12.7
11	Concave single scraper		2	0.8
13	Double straight-convex scraper		1	0.4
15	Double Convex scraper		1	0.4
19	Convex convergent scraper		2	0.8
21	Dejete scraper		2	0.8
22	Straight transverse scraper		7	3.0
23	Convex transverse scraper		10	4.2
25	Scraper on interior		1	0.4
26	Abrupt scraper		2	0.8
28	Scraper w/ bifacial retouch		3	1.3
29	Alternate scraper		1	0.4
30	Typical endscraper		2	0.8
32	Typical burin		2	0.8
34	Typical percoir		1	0.4
36	Typical backed knife		1	0.4
38	Naturally-backed knife		15	6.3
40	Truncation		1	0.4
42	Notch		25	10.5
43	Denticulate		16	6.8
45	Retouch on interior		3	1.3
48	Abrupt/alternating retouch		72	30.4
50	Bifacial retouch		1	0.4
51	Tayac point		1	0.4
54	End-notched flake		4	1.7
56	Rabot		1	0.4
61	Chopping-tool		1	0.4
62	Divers		3	1.3
64	Truncated-Faceted piece		4	1.7
		Total	**237**	**100**

Table 3.22: Breakdown of the Core Types in Layer I-2A at Combe Capelle Bas

core type	count	percent
Kombewa core	2	1.8
Disc core	1	0.9
Levallois core	5	4.4
Single surface core	27	23.9
Double surface core	3	2.7
Tested block	6	5.3
Globular core	5	4.4
Pyramidal core	1	0.9
Other	10	8.8
Informal core	39	34.5
N/A	14	12.4
Total	**113**	**100**

In short, this type of pattern seems to occur when on-site flake production is the main function of a site. These layers are also the ones where, perhaps counter intuitively, the blank to core ratio is quite low. This is counterintuitive because one might, at such sites, expect many blanks relative to the number of cores, but in fact it may be that we should expect very many cores at these sites. When raw material is abundant there is no cost involved with exploiting fresh raw material nodules which in turn leads to high numbers of cores. Furthermore, as suggested earlier, some of the larger flakes might be reduced to the point that they are classified as cores themselves, further increasing the number of cores at the site. Finally, it is plausible that Neanderthals transported blanks, selected for future use, from the site, again further reducing the blank to core ratio.

Alternatively, when raw material is less abundant, the population from which chunks of raw material can be selected for exploitation is more restricted. In this case smaller and smaller pieces will be selected and many of the flakes potentially chosen for reduction might be reduced to the point they are no longer recognizable as flakes, but rather become cores. Each of the cores would be heavily reduced, but since they were not too large to begin with, the number of blanks that can be produced from them is limited. Again, a small blank to core ratio should be expected. Finally, the argument about preferential transport of blanks from the site applies in the limited raw material availability context as well (such as in layer 6A at Pech IV).

As in Layer I-1E, there is very little evidence for the presence of Levallois reduction in layer I-2A. Each of the Levallois indices is slightly higher than it was for layer I-1E, but still well below layers such as 05 and 08 at Roc de Marsal and layers 6A and 8 at Pech IV. Technologically this layer fits well with the Quina Mousterian, as has been argued by the site excavators (Dibble and Lenoir 1995).

The blank to core ratio in layer I-2A is lower than in layer I-1E, down to just 4 blanks per core. This ratio is almost the lowest of any of the layers studied (layer I-2B, also at Combe Capelle Bas, has a lower ratio). As mentioned above, this low blank to core ratio may be due to abundant raw material availability. Raw material is ubiquitous, and there is no cost associated with picking up new nodules for reduction and therefore turning them into cores. Furthermore, the large nodule size requires that blocks are reduced into larger chunks (flakes) which are then further reduced. Some of these will be interpreted as cores, as the original flake surface becomes obliterated by further reduction. Finally, some of the blanks produced are likely taken from the site leaving the cores behind. In other words, when archeologists study the material from the site, they find a very low blank to core ratio[8].

In addition, the flake to tool ratio in layer I-2A is low. That is, there are very many tools relative to the number of flakes. As I mentioned in the description of the material from layer I-1E, this pattern seems counterintuitive in a number of ways. However, an alternative view that considers some of the tools as cores for the production of flakes accounts for it. In other words, a low blank to core ratio and a corresponding low flake to tool ratio go hand in hand at Combe Capelle Bas and the same is true for the Asinipodian of layer 6A in Pech IV.

The lengths of complete flakes, complete tools, and cores show the same relationship to each other as they do in layer I-1E (Figure 3.75). Complete flakes on average are the shortest, cores the longest, and complete tools fall in between. Each of these differences is significant ($p<0.02$). What is interesting as well is that the average sizes of

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[8] Key to understanding the blank to core ratio is that cores really determine this ratio more than blanks do. Sites always tend to have many blanks, but there are not always very many cores on a site. Adding or subtracting a core to an assemblage has a significant impact on the blank to core ratio. For example, if a site has 50 flakes and 2 cores, the blank to core ratio would be 25. However, by adding a single core the blank to core ratio suddenly drops to 16.7. Adding one flake to the same assemblage has very little effect. In the latter case, the blank to core ratio would increase to 25.5 instead of 25.

the artifacts in layer I-2A are consistently bigger than those in layer I-1E. Dibble has argued that these differences can be related to the continued exploitation of the raw material available at Combe Capelle Bas. The argument is that larger blocks of raw materials are selected preferentially over smaller blocks which result in a decrease in the size of the nodules available at the site through time.

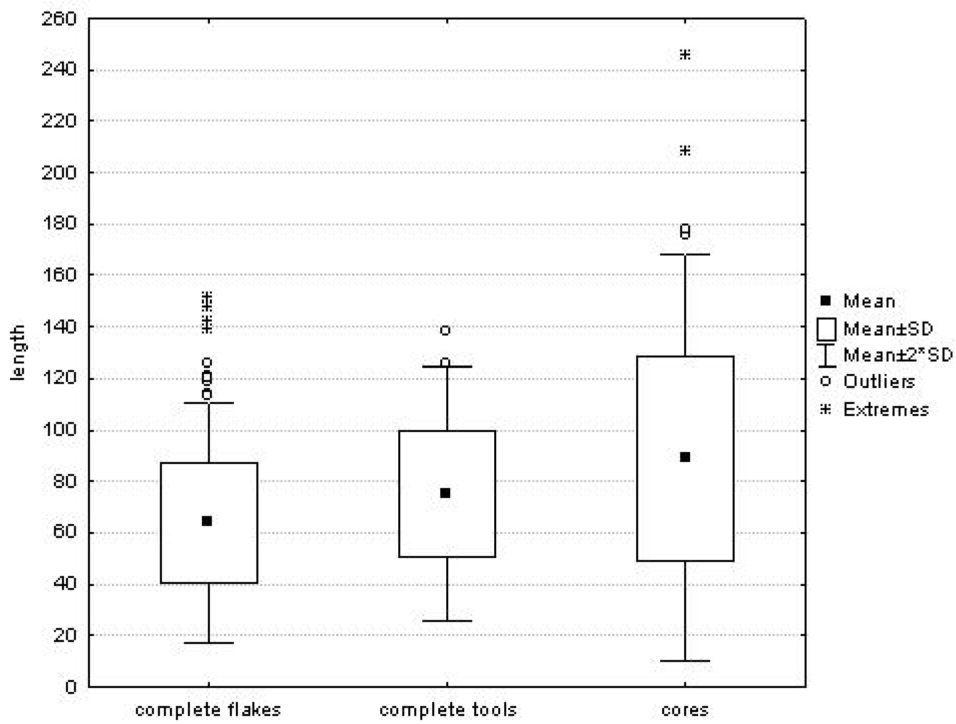


Figure 3.75: Box plots of the length distributions of complete flakes (n=292), complete tools (n=67), and cores (n=77) in layer I-2A.

The platform types on flakes and on flake scars in layer I-2A is shown in Figure 3.76. The pie charts show that platform types on flakes and flake scars are similar. The majority of platforms for both are plain, a pattern typical for Quina type industries. In addition, platform preparation is equally divided between dihedral and faceted types. Cortical platforms, on the other hand, are slightly more abundant in flakes than they are in flake scars. This pattern is consistent with our expectations as more cortical platforms would be expected early on in flake production, but then decrease as reduction of cores and flakes proceeds.

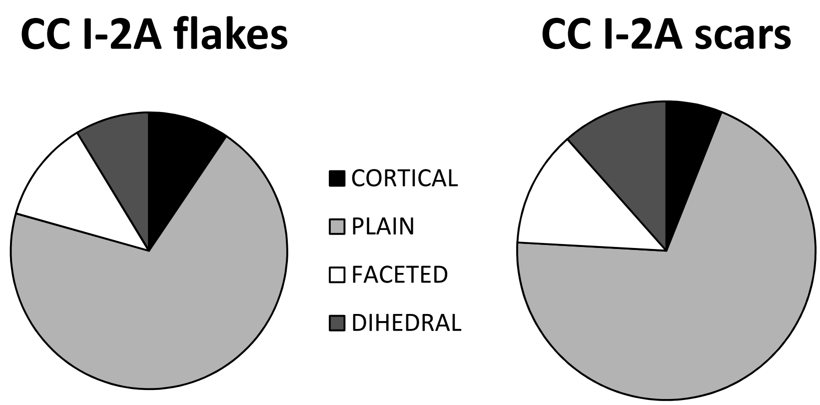


Figure 3.76: Frequency of platform types on flakes (n=402) and flake scars (n=199) in layer I-2A at Combe Capelle Bas

The distribution of scar sizes and their relation to the particular lithic artifact category on which the flake scars are found is consistent with patterns seen in other layers at CC, and in other layers at both Pech IV and Roc de Marsal. Scrapers tend to have scars that are slightly bigger than they were in most other layers, but their overall pattern remains the same. As bigger flake scars are considered in Figure 3.77, the percentage of scraper scars quickly drops off. The opposite pattern is seen in flake scars on cores, which increase with each subsequent size category. Notches and T-Fs fall somewhere in between, with notches slightly closer to the scraper pattern and T-Fs closer to the core pattern. The overlap between these is such that there is no reason to assume that T-F and notches are inherently different from cores. At the same time, some of the notches seem to fit better with scrapers.

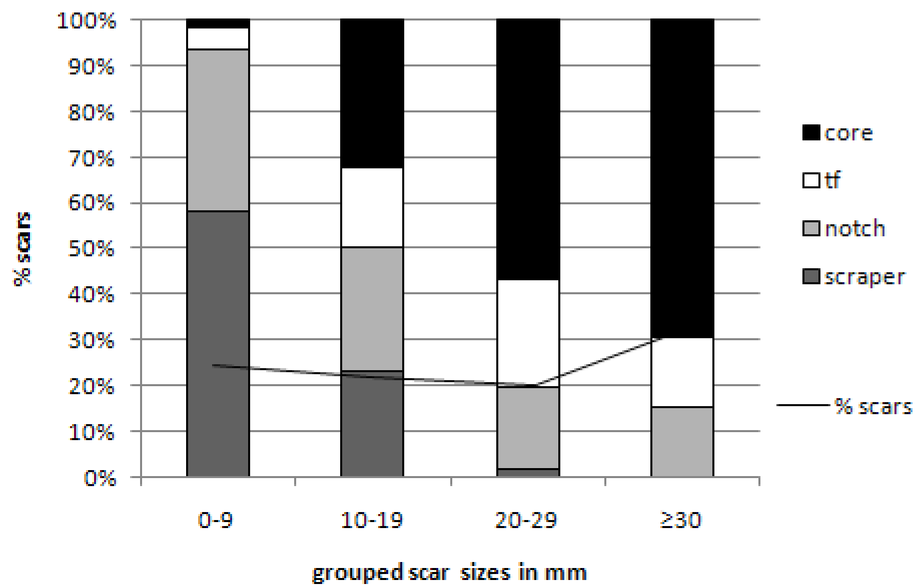


Figure 3.77: Distribution of sizes of flake removals separated into those from cores, T-Fs, notches, and scrapers in layer I-2A at Combe Capelle Bas

Comparison of flake scars on cores and tools

Results of a comparison of flake scars on cores and tools in layer I-2A (Figure 3.78) are similar to the results from other layers. The flakes are larger on average than scars on cores and scars on tools. The flake scars on cores also are larger on average than those on tools. What is very different in this graph as opposed to earlier ones is the size scale. Flakes at Combe Capelle Bas on average are much bigger than those in the cave sites. The tail of the flake size distribution is also much more gradual in its decline. Despite these differences, the patterns as observed in the cave sites hold. The distribution of flake scar removals on cores overlaps extensively with those of flakes themselves, even though the latter are bigger on average. The same is true for the flake scars on tools. Furthermore, even at a site such as Combe Capelle Bas, which is characterized by large flakes, a significant portion of flake scars is found in the size classes below the cutoff at which flakes would be considered for analysis. Yet, the presence of scars on cores strongly suggests that they also were part of the population of desired blanks at the site.

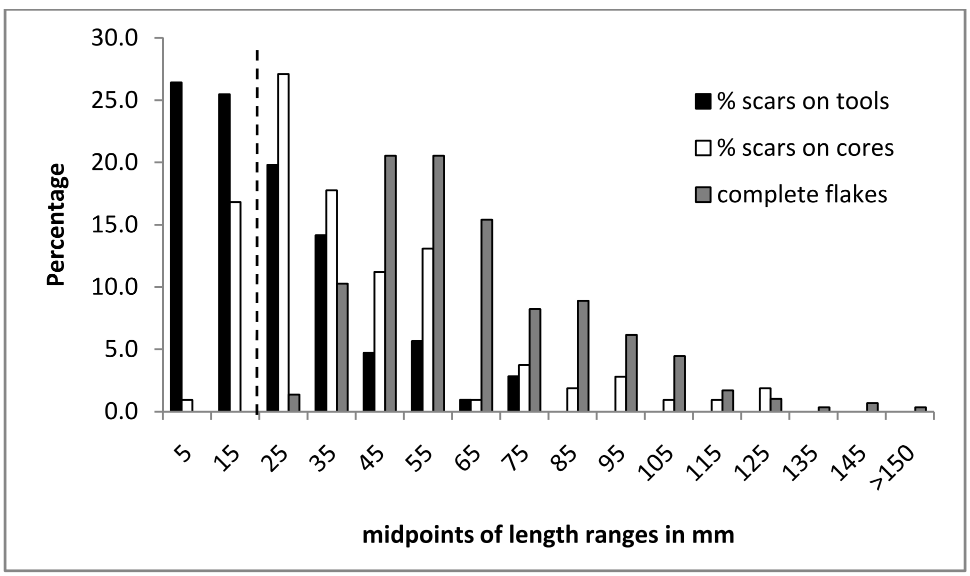


Figure 3.78: Distribution of artifact length by percentage scars on tools and cores as well as the distribution of complete flake sizes for layer I-2A at CC. Note: removals on scrapers are excluded from this graph. The dashed vertical line indicates the 2.5 maximum dimension cutoff that was used in the excavations to determine if artifacts would be piece-provenienced and analyzed.

Removals on tools further reinforce the idea that many of the flakes from them were desired blanks rather than waste in the production of a desired tool. Indeed, the largest category of removals, together with notch-like removals, can be categorized as core-like (Figure 3.79). In other words, they cannot be distinguished from removals on cores. Furthermore, flake scars on notches also suggest, as we saw in Figure 3.77, that they might in part represent blank production rather than tool production.

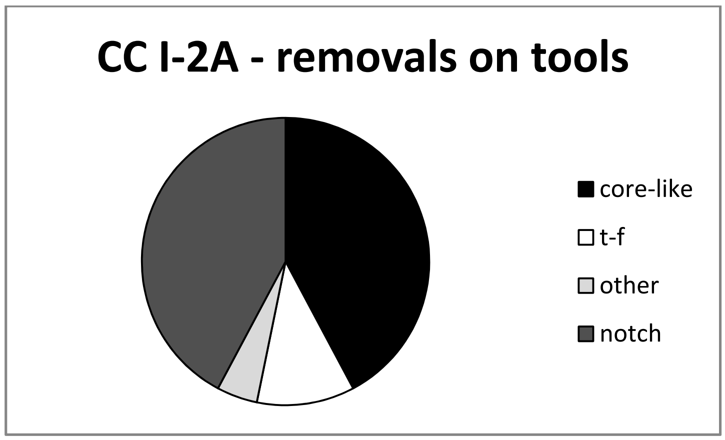


Figure 3.79: Frequency of the flake scar removal types on tools (n=109) in layer I-2A in CC

The location of removals on tools, cores, and scrapers show some similarities between each of the classes (Figure 3.80). The majority of scars in each category is found on the lateral sides of the artifact. This pattern is most pronounced for scrapers, somewhat less prominent on tools, and still less on cores. The second biggest class for both tools and scrapers are flake scars on the distal portion of the artifact, whereas on cores that class consists of proximal removals. It appears again that scars on tools are somewhat intermediate between those on scrapers and those on tools.

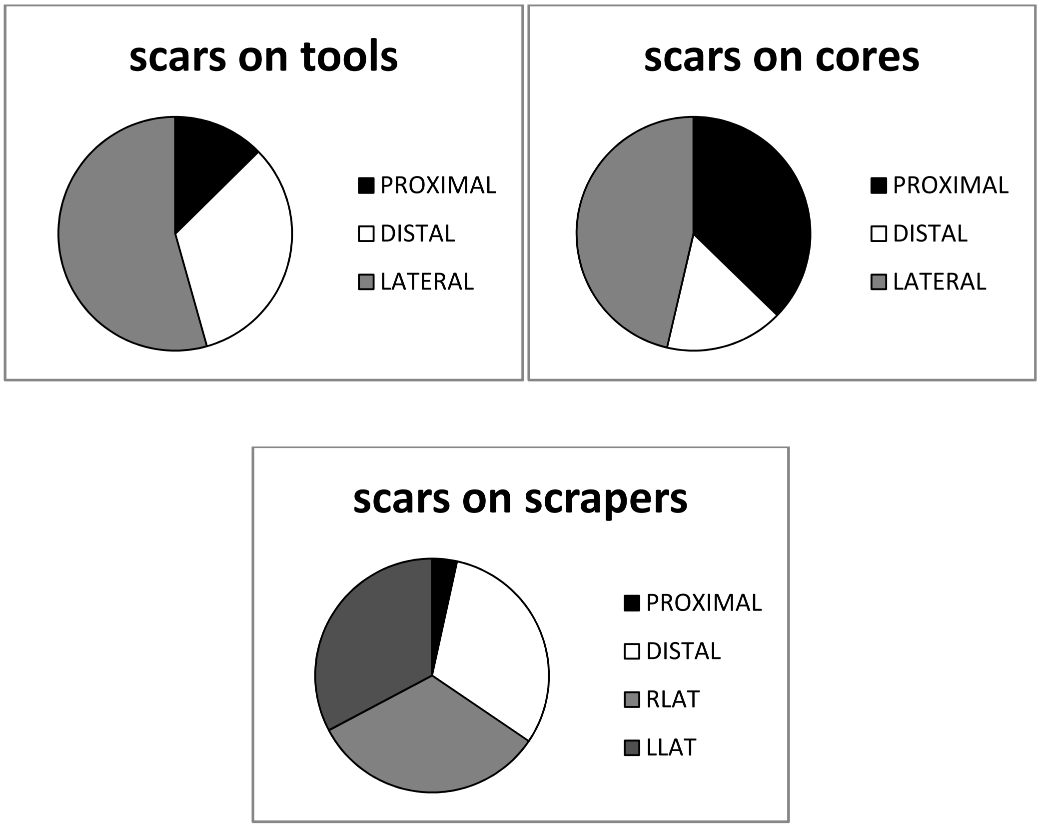


Figure 3.80: Frequency of the locations of flake scars on tools (n=103), cores (n=110), and scrapers (n=58) in I-2A

When we consider scar location from a different angle, whether scars are on the exterior or interior surface of artifacts, the similarity between scars on tools and cores is more pronounced (Figure 3.81). The majority of flake removals are found on the exterior, with smaller components of removals from the interior and side, respectively.

However, the relative importance of these latter two is reversed for tools and cores. This pattern is perhaps best understood in terms of the relative thickness of tools versus cores. Cores, as pointed out, are on average significantly thicker than are tools, a pattern which is evident in layer I-2A as well (average core thickness = 38 ± 19mm, average complete tool thickness = 19 ± 9mm; t-value = -7.6, df = 142, p<0.01). Flake scars on scrapers present a different pattern than they do in other layers and are almost exclusively characterized by removals from the exterior of the artifact.

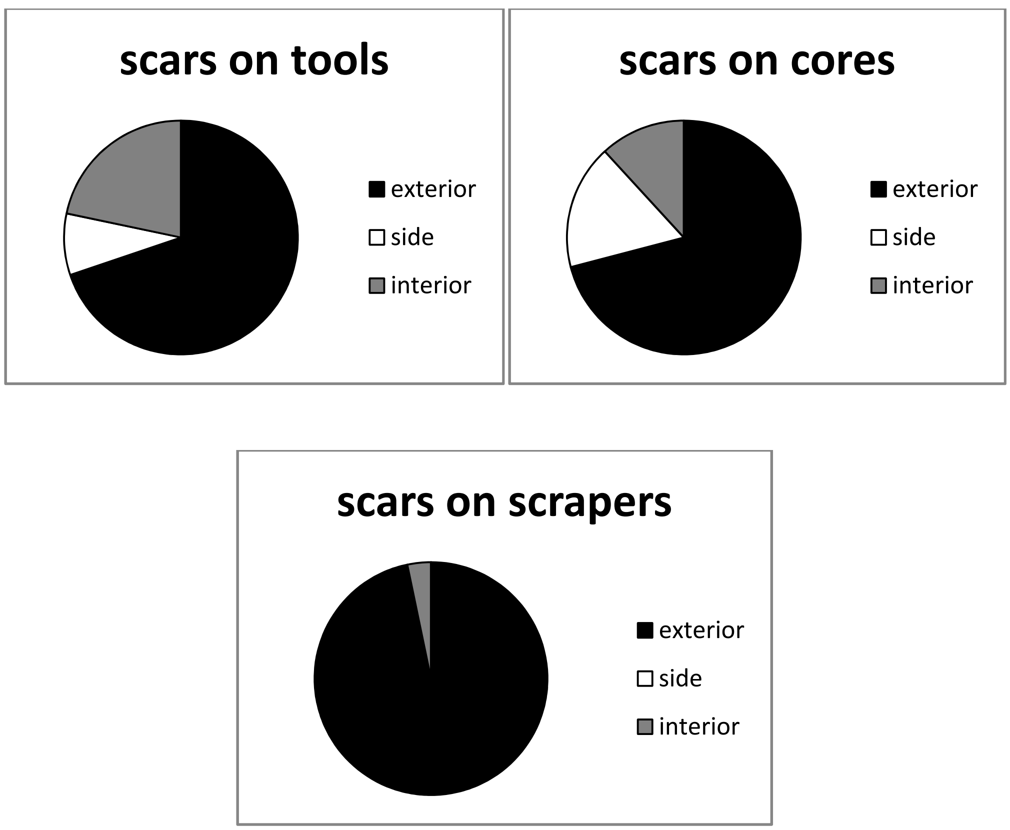


Figure 3.81: Frequency of the removal surfaces of flake scars on tools (n=106), cores (n=110), and scrapers (n=61) in I-2A at CC.

The platform preparation evident from the flake scars on tools and cores also is similar to each other (Figure 3.82). The majority of platforms are plain, with smaller components of prepared platforms and cortical ones. On cores, there are somewhat more flake scars with prepared platforms than there are on tools. As is also clear from Figure 3.85, the flake scars on both tools and cores match well with the pattern we observe on actual flakes in layer I-2A.

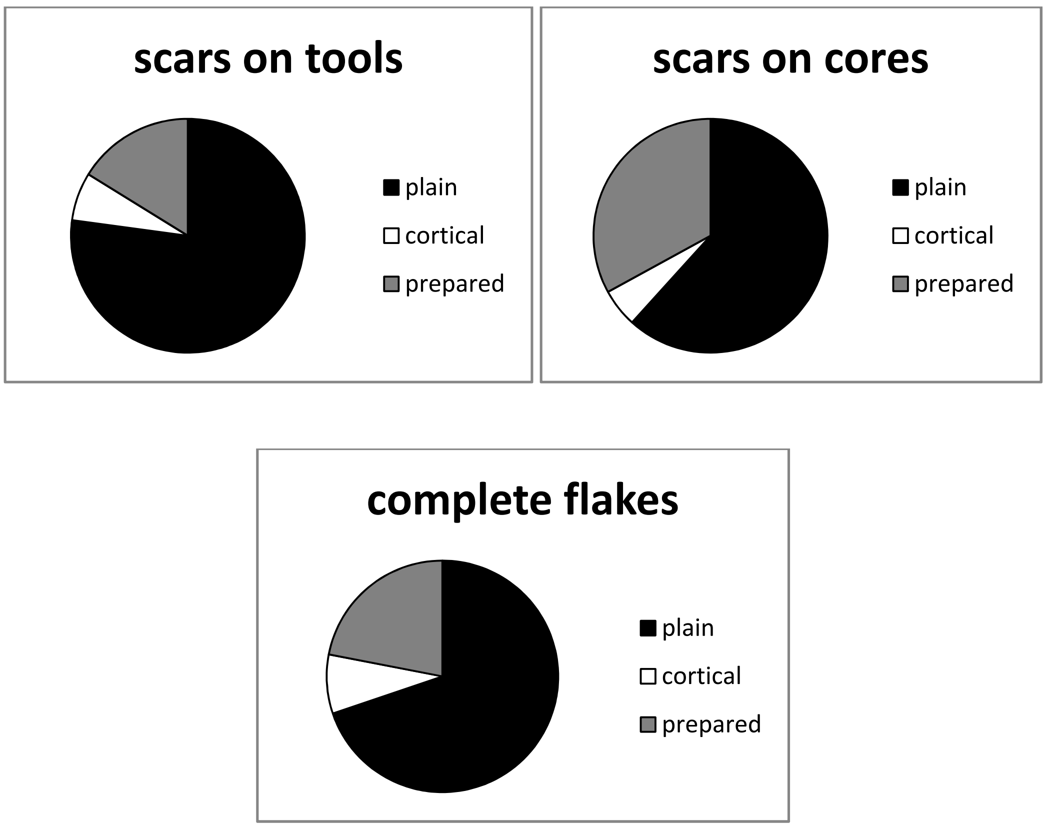


Figure 3.82: Frequency of flake scar platform types on tools (n=105) and cores (n=94) and a chart of the platform types on complete flakes (n=255) in I-2A at CC.

Layer I-2B

Assemblage composition

From layer I-2B at Combe Capelle Bas a total of 476 artifacts were examined, of which 132 are tools (Table 3.23) and 74 cores and core fragments (Table 3.24). As shown in Table 3.17, layer I-2B is the least dense of all layers examined in France. There are only 2.39 artifacts on average per seven liter sediment sample, which is quite low indeed.

Table 3.23: Breakdown of the Bordian Types in Layer I-2B at Combe Capelle Bas

Type #	Bordian tooltype		count	percent
2	Atypical Levallois flake		2	1.5
8	Limace		1	0.8
9	Straight single scraper		3	2.3
10	Convex single scraper		15	11.4
11	Concave single scraper		2	1.5
15	Double Convex scraper		1	0.8
21	Dejete scraper		4	3.0
23	Convex transverse scraper		4	3.0
26	Abrupt scraper		2	1.5
32	Typical burin		1	0.8
34	Typical percoir		1	0.8
38	Naturally-backed knife		6	4.5
40	Truncation		2	1.5
42	Notch		21	15.9
43	Denticulate		13	9.8
45	Retouch on interior		3	2.3
48	Abrupt/alternating retouch		43	32.6
54	End-notched flake		2	1.5
61	Chopping-tool		1	0.8
62	Divers		2	1.5
64	Truncated-Faceted piece		3	2.3
		Total	**132**	**100**

Table 3.24: Breakdown of Core Types in Layer I-2B at Combe Capelle Bas

core type		count	percent
Kombewa core		3	4.1
Disc core		3	4.1
Levallois core		2	2.7
Single surface core		7	9.5
Double surface core		1	1.4
Tested block		1	1.4
Globular core		11	14.9
Pyramidal core		2	2.7
Other		1	1.4
Informal core		30	40.5
N/A		13	17.6
	Total	**74**	**100**

The lithic assemblage from this layer is by and large very similar to the assemblages from the other layers of Combe Capelle Bas (Figure 3.64). Tools are slightly more common in this layer, as is shatter. Perhaps the biggest difference with the other layers is that the cores and core fragments are more common than in the two layers above it. Complete flakes and flake fragments are less common.

The breakdown of tools from this layer also is similar to those from the layers immediately above it (Figure 3.65). Compared to those other layers, Upper Paleolithic types are rarer, and both notches and other tools fall between the percentage for layer I-1E and I-2A. Cores and core fragments, along with scrapers, show the greatest difference with the other layers. The former are more common, whereas the latter are less common. Finally, blanks also are less common in the assemblage.

The Levallois indices of layer I-2B (shown in Table 3.20) show a pattern much like the one in the other layers at the site — Levallois is quite rare. However, it is important to point out that Levallois is not absent altogether. This pattern is similar to that in other layers that are part of the Quina Mousterian, such as layer 04 at Roc de Marsal.

The blank to core ratio in layer I-2B is the lowest among the layers examined (Figure 3.66). This pattern fits with what might be expected from a site with readily available high quality stone raw material. Furthermore, it also fits with a scenario in which blanks are transported from the site for use elsewhere. The flake to tool ratio is the lowest of the layers. That is, there are more tools in this layer relative to the amount of flakes than there are in any other layer at Combe Capelle Bas. This pattern suggests that many of the so-called tools are best understood as cores.

The lengths of complete flakes, complete tools, and cores (Figure 3.83) are significantly different from one another ($p<0.02$). In their relative patterning to each other, this layer is exactly like the others at CC. The flakes are shortest on average, the cores longest, and the complete tools fall in between.

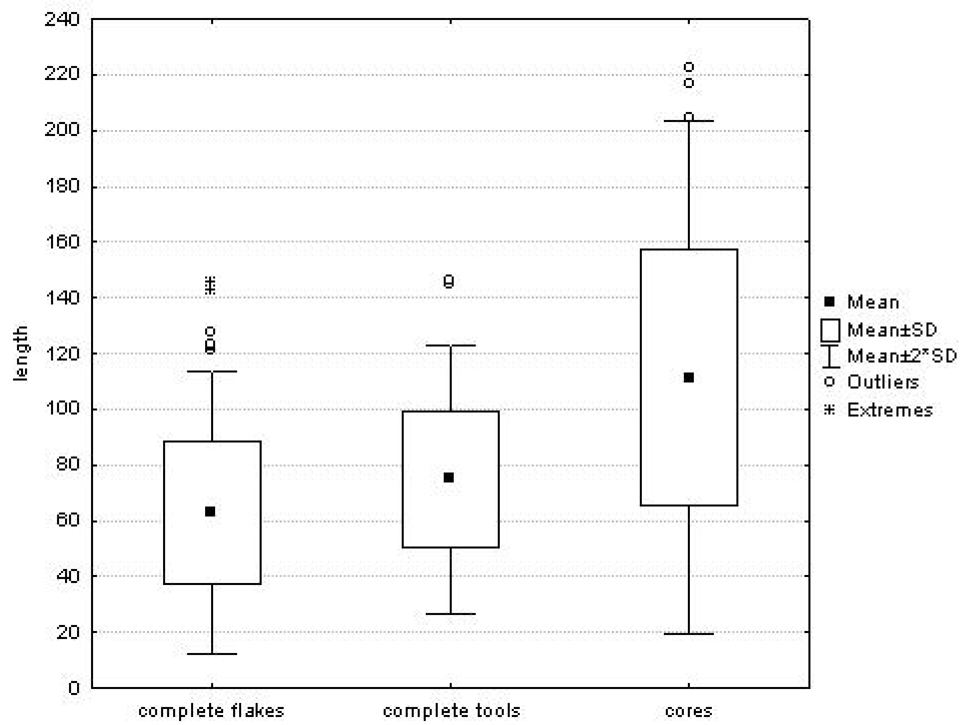


Figure 3.83: Box plots of the lengths of complete flakes (n=118), complete tools (n=38) and cores (n=63) in layer I-2B at Combe Capelle Bas

A comparison of platform types between flakes and flake scars shows that they are very similar to each other (Figure 3.84). As expected in a Quina assemblage, the majority of platforms are plain, whereas the next group consists of prepared platforms (dihedral and faceted). There is a difference between the relative importance of cortical platforms in flakes and flake scars. Cortical platforms are rare on flake scars and abundant on flakes. This pattern fits well with expectations, given that the flake scars represent a category that is further along the reduction continuum at the site. As reduction continues, not only would flakes become smaller, but they also would exhibit fewer cortical platforms.

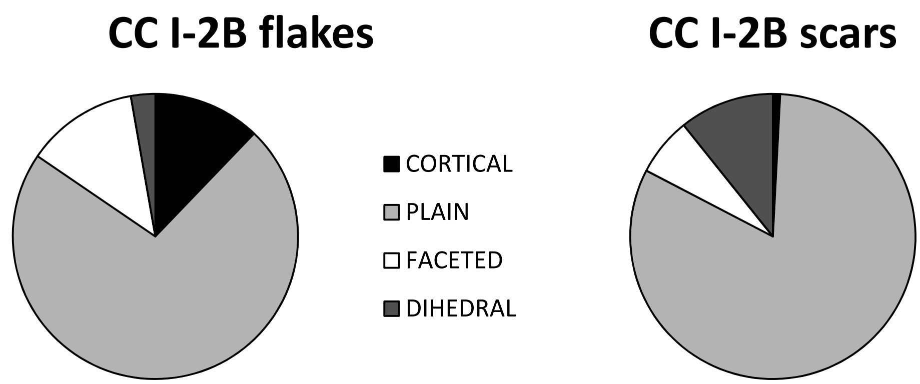


Figure 3.84: Frequency of platform types for flakes (n=181) and flake scars (n=121) in layer I-2B in Combe Capelle Bas.

The distribution of the sizes of flake scars and the type of “host” artifact is a now familiar distribution (Figure 3.85). Flake scars on scrapers are small and often found almost exclusively in the shortest flake scar size category. Flake scars on cores, on the other hand, are much larger and tend to dominate the longest flake scar category. The two other categories, flake scars on T-Fs and on notches, lie somewhere in between. The T-Fs tend to match the scars on cores best, although they are markedly smaller. The size distribution of notches is often similar to T-Fs.

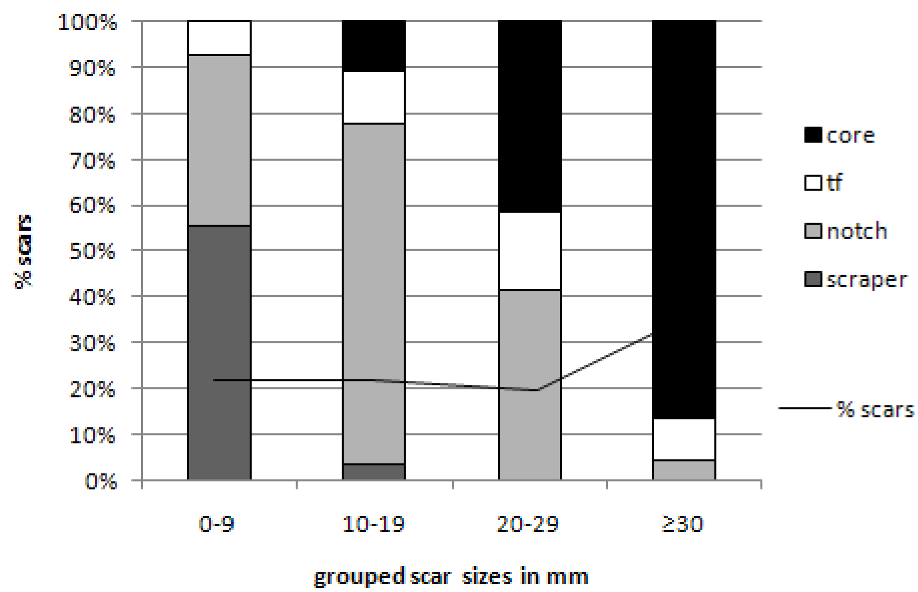


Figure 3.85: Distribution of sizes of flake removals separated into those from cores, T-Fs, notches, and scrapers in layer I-2B at Combe Capelle Bas

Comparison of flake scars on cores and tools

The comparison of flake scars on tools and cores shows a pattern similar to the one seen before (Figure 3.86). Scars on tools are smallest. Scars on flakes are larger, but smaller than the sizes of actual flakes in the assemblage. Typically, all three distributions overlap extensively, but, in layer I-2B, the overlap between the distributions of flakes and flake scars on tools is rather minimal. On the other hand, the overlap between the lengths of flake scars on cores and the lengths of complete flakes is extensive. As in layer I-2A, the overall size of the material from this layer is much bigger in general than material from the two cave sites. To accommodate this difference, the graph has to be adjusted to allow for larger size categories to be represented. One interesting aspect of this particular layer is that the size distribution of complete flakes starts to drop off before the artificial size cutoff of 2.5cm employed in the analysis of the material at the site. Exactly how this pattern can be explained is unclear, particularly because there is clear evidence that flakes of these sizes have been made, based on the size evidence of the flake scars on cores and tools. One possibility is that these flakes were intentionally removed from the site. However, this is not the expected pattern as there is ample evidence to show that larger blanks were typically selected from flake populations, rather than smaller ones.

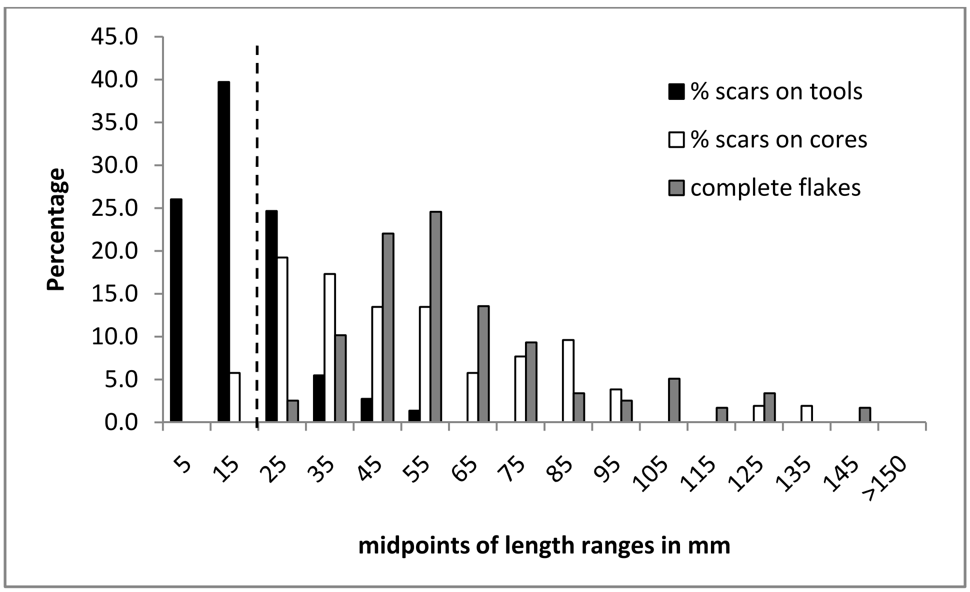


Figure 3.86: Distribution of artifact length by percentage scars on tools and cores as well as the distribution of complete flake sizes for layer I-2B at CC. Note: removals on scrapers are excluded from this graph. The dashed vertical line indicates the 2.5 maximum dimension cutoff that was used in the excavations to determine if artifacts would be piece-provenienced and analyzed.

The distribution of flake scar types for tools is shown in Figure 3.87. As was evident in layer I-2A, layer I-2B also is characterized by a significant emphasis on notch and core-like removals. This suggests that some flakes removed from tools might indeed have been the desired end product rather than the tool itself.

The location of flake scars on tools and cores are quite different from each other (Figure 3.88). The largest category among the tools consists of removals struck from the lateral sides of the artifact, while the proximal removals dominate among the cores. Furthermore, the relative contribution of flake scars originating from the distal end is quite different among tools and cores. The pattern on scrapers is quite different as well, but itself matches the pattern seen in layer I-2A. Lateral removals dominate in scrapers, but about a third of the removals are struck from the distal end. This pattern is due to the significant presence of transverse scrapers in the assemblage. Like in layer I-2A, the Scraper Reduction Index for layer I-2B is quite high: 0.43.

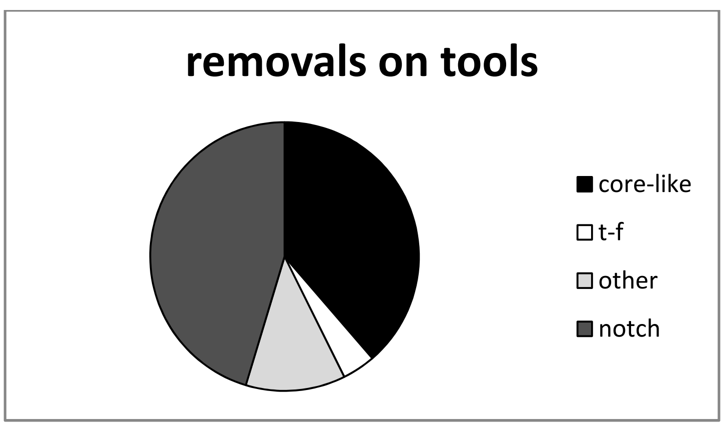


Figure 3.87: Frequency of the flake scar removal types on tools (n=75) in layer I-2B in CC

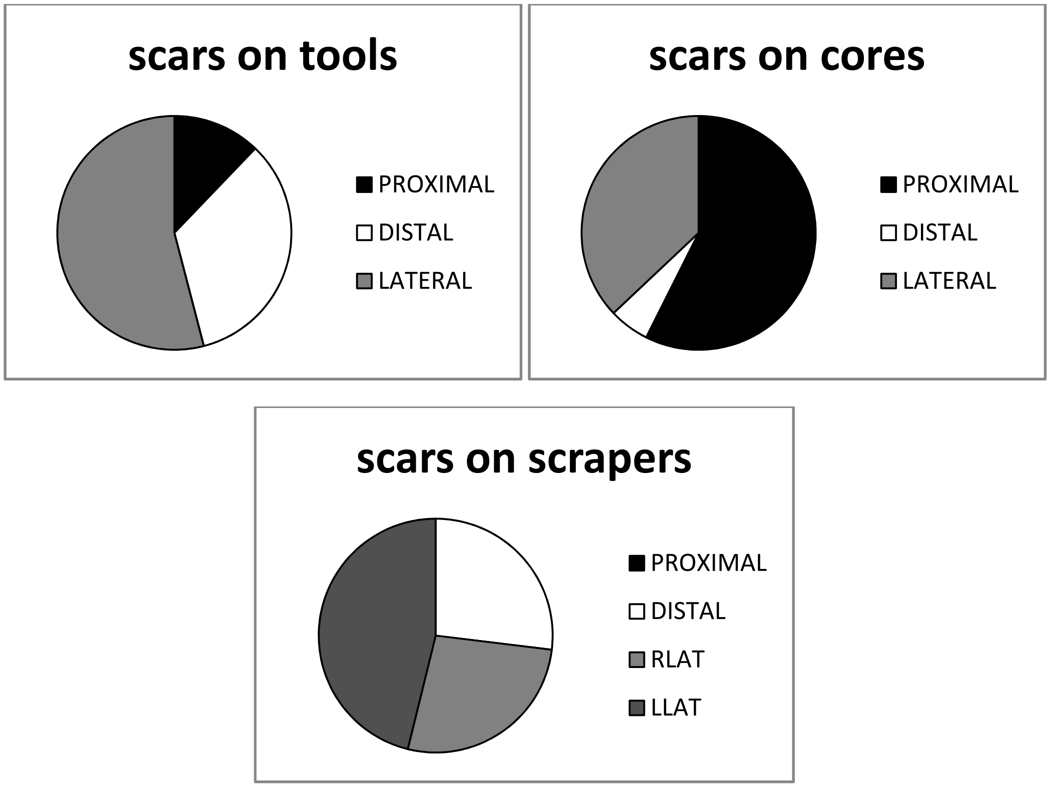


Figure 3.88: Frequency of the locations of flake scars on tools (n=74), cores (n=54), and scrapers (n=26) in I-2B at CC.

The removal surfaces of flake scars on cores and tools match each other better than the locations of the flake scars (Figure 3.89). The largest proportion of flakes is struck from the exterior with smaller roles for both interior and side removals. However, the contribution of side removals is much greater in cores than it is in tools. The relative thickness of the artifact might play a role here (average core thickness = 56 ± 27mm; average complete tool thickness = 19 ± 8mm, t-value = -8.0, df = 99, $p<0.01$). Matching the pattern in other layers, the scars on scrapers in I-2B consist exclusively of exterior removals.

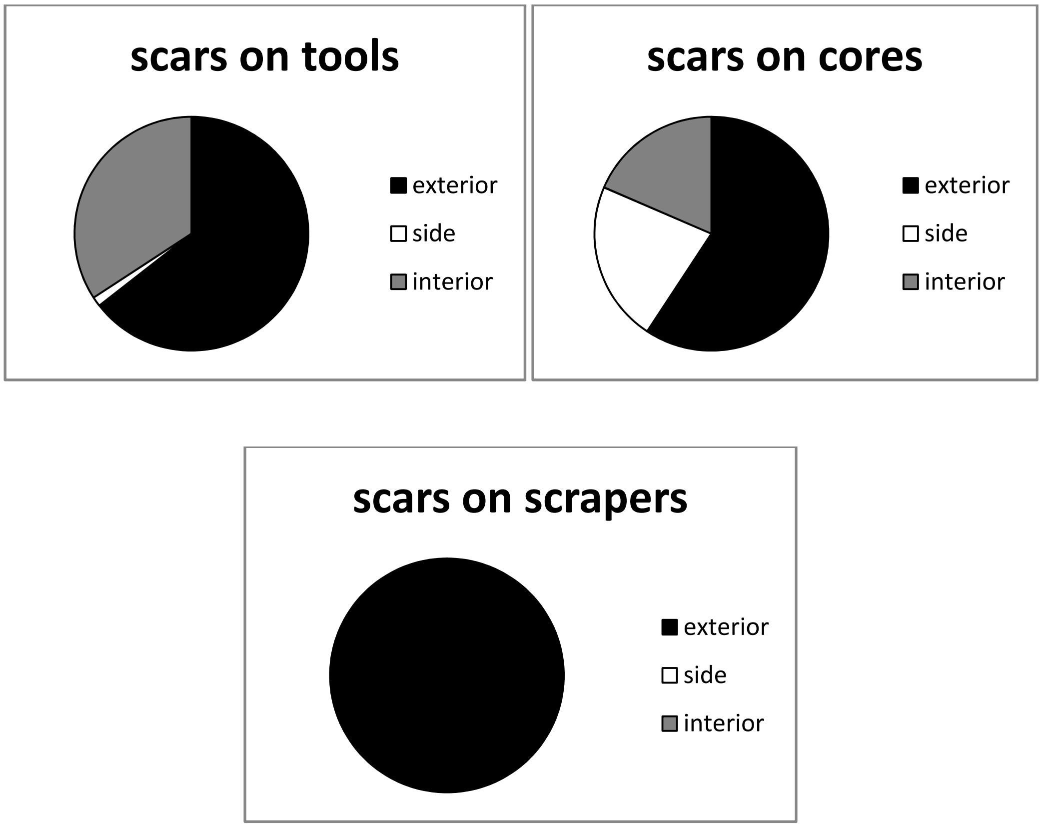


Figure 3.89: Frequency of the removal surface of flake scars on tools n=76), cores (n=54), and scrapers (n=27) in I-2B at CC.

By and large, plain platforms dominate the flake scar data, as well as the complete flake data (Figure 3.90). However, among the flake scars on tools, there are fewer prepared platforms than there are among the flake scars on cores. The complete flakes also show more cortical platforms than do either the flake scars on tools and cores.

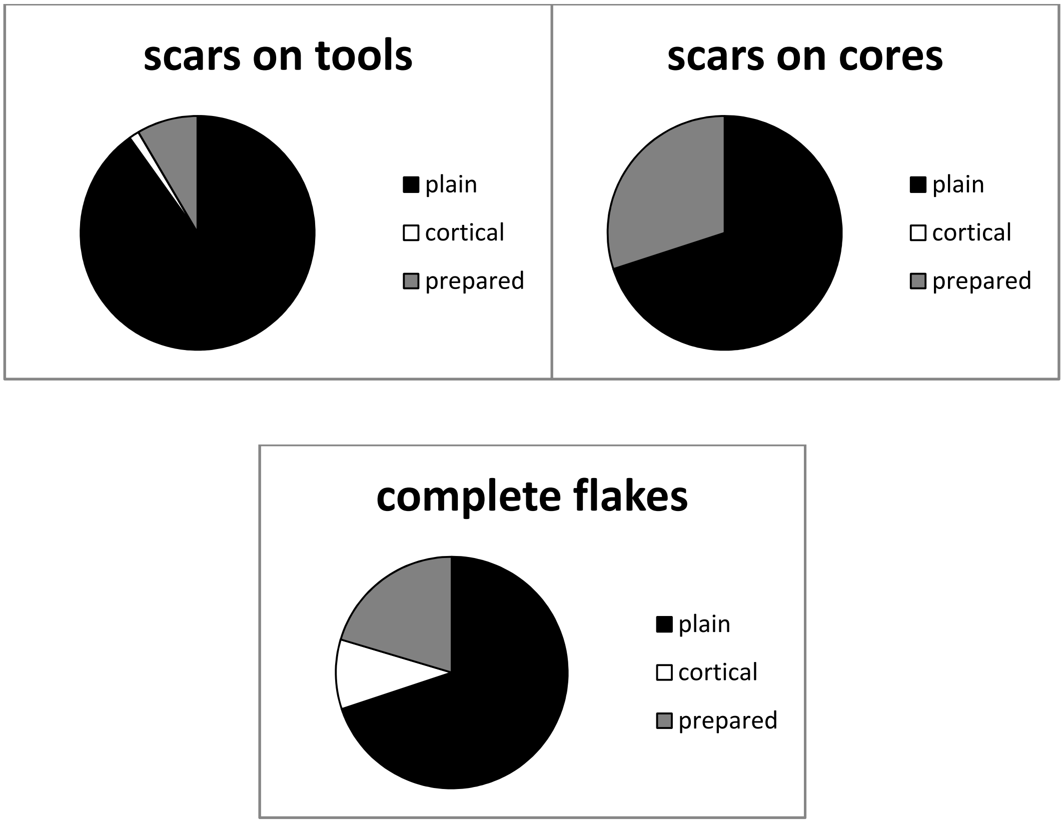


Figure 3.90: Frequency of flake scar platform types on tools (n=71) and cores (n=50) and a chart of the platform types on complete flakes (n=103) in I-2B at CC.

Contrebandiers Cave

Aterian layers

Assemblage composition

The assemblage from Contrebandiers Cave (CB) studied consists of the Aterian layers from the old collections at the site, including the excavations from Roche in the 1950s and from Roche and Texier in the 1970s and 1980s. In addition, where necessary, I will draw on some of the data gathered during the renewed excavations at the site in 2007. This more recent data, for example, allows me to describe the density of the archaeological material at the site, as well as the relationship between faunal and lithic remains. Because the entire old collections from the site have not been studied, this study relies exclusively on the material from Roche's layer III when comparisons of tools to the unretouched assemblage are undertaken. However, when examining tools (Table 3.26) and cores (

Table 3.27) by themselves, I draw on the study of all the material.

Correlations between the various stratigraphies proposed for the site do not currently exist. For this reason, the Aterian assemblages were examined as a single group. This approach was also necessary to obtain sufficient sample sizes, given that the site is not very rich in terms of artifacts per bucket of sediment excavated (see Table 3.25[9]). Renewed excavations show that such a grouping of the material is possible, as there is a

[9] These data are derived from the renewed excavations at the site which began in 2007.

good correspondence between the assemblages from different layers and, more importantly, a good fit between the old collections, on the one hand, and the collections from the new excavations, on the other hand[10].

As Table 3.25 shows, the site is not very rich in archaeological material. The best comparison in terms of the density of artifact per seven liter sediment sample is Combe Capelle Bas. There are about two lithic artifacts and two faunal artifacts per bucket of sediment. The ratio of fauna to lithics is low and only slightly higher than layer 8 at Pech IV and layer 08 at Roc de Marsal. It is currently unclear to what extent preservation issues might have contributed to the low count of faunal remains per unit sediment at the site.

Table 3.25: Density of the Archaeological Assemblage in the Aterian Layers at Contrebandiers Cave Relative to Seven Liter Sediment Samples

Contrebandiers	fauna/lithic	lithic/bucket	artifacts/bucket
Aterian	1.01	2.07	4.17

[10] Despite this feasibility, the results should be taken as preliminary and will be further elaborated upon as the renewed excavations continue and new samples excavated using modern excavation techniques become available.

Table 3.26: Breakdown of the Bordian Types in the Aterian Layers at Contrebandiers Cave

Type #	Bordian tooltype	count	percent
1	Typical Levallois flake	18	5.9
2	Atypical Levallois flake	7	2.3
3	Levallois point	1	0.3
4	Retouched Levallois point	1	0.3
5	Pseudo-Levallois point	1	0.3
6	Mousterian point	4	1.3
9	Straight single scraper	10	3.3
10	Convex single scraper	26	8.5
11	Concave single scraper	2	0.7
13	Double straight-convex scraper	1	0.3
15	Double Convex scraper	1	0.3
19	Convex convergent scraper	2	0.7
21	Dejete scraper	2	0.7
22	Straight transverse scraper	1	0.3
23	Convex transverse scraper	3	1.0
25	Scraper on interior	5	1.6
26	Abrupt scraper	1	0.3
28	Scraper w/ bifacial retouch	3	1.0
29	Alternate scraper	1	0.3
30	Typical endscraper	2	0.7
31	Atypical endscraper	6	2.0
32	Typical burin	2	0.7
33	Atypical burin	2	0.7
34	Typical percoir	8	2.6
35	Atypical percoir	3	1.0
37	Atypical backed knife	1	0.3
38	Naturally-backed knife	20	6.5
40	Truncation	3	1.0
42	Notch	49	16.0
43	Denticulate	44	14.3
45	Retouch on interior	9	2.9
48	Abrupt/alternating retouch	21	6.8
51	Tayac point	2	0.7
54	End-notched flake	5	1.6

57	Tanged point	6	2.0
58	Tanged tool	14	4.6
59	Chopper	3	1.0
Type #	**Bordian tooltype**	**count**	**percent**
61	Chopping-tool	2	0.7
64	Truncated-Faceted piece	12	3.9
65	Scraper on the platform	3	1.0
	Total	**307**	**100**

Table 3.27: Breakdown of the Core Types in the Aterian Layers at Contrebandiers Cave

core type	count	percent
Kombewa core	3	2.3
Disc core	1	0.8
Levallois core	6	4.5
Single surface core	53	39.8
Double surface core	4	3.0
Chopper	2	1.5
Tested block	17	12.8
Globular core	5	3.8
Pyramidal core	1	0.8
Other	11	8.3
Informal core	25	18.8
N/A	5	3.8
Total	**133**	**100**

The lithic assemblage at Contrebandiers Cave differs in one respect compared to the assemblages examined in France. The contribution of shatter to the assemblage is significantly larger than it was in the French sites (Figure 3.91). For Contrebandiers Cave, the percentage shatter is well over 25% of the entire assemblage. The frequency of tools in the assemblage also is low, and can best be compared to the material from layer 8 at Pech IV and layer 08 at Roc de Marsal. To better understand the high incidence of shatter in the assemblage, we can turn to the raw material types used at CB. Unlike the

French sites, the assemblage at CB is characterized by a high diversity of raw materials. These include fine grained raw materials, such as various types of chert and chalcedony, and coarse grained materials, which are predominantly quartzite and quartz. It is this last category (quartz) which is absent on all the other sites studied, and can account in part for the high percentage of shatter. As opposed to fine grained raw materials, quartz is a difficult raw material to knap, as it is less predictable in its fracture patterns. Furthermore, quartz at CB is particularly heterogeneous and, therefore, often shatters as it is being reduced. At CB quartz only makes up 18% of the entire assemblage, whereas it comprises fully 46% of the shatter. In addition to the large contribution of quartz to the shatter at the site, if we look only at the fine grained raw material, there still is about three times more shatter in CB than in the French sites (27%).

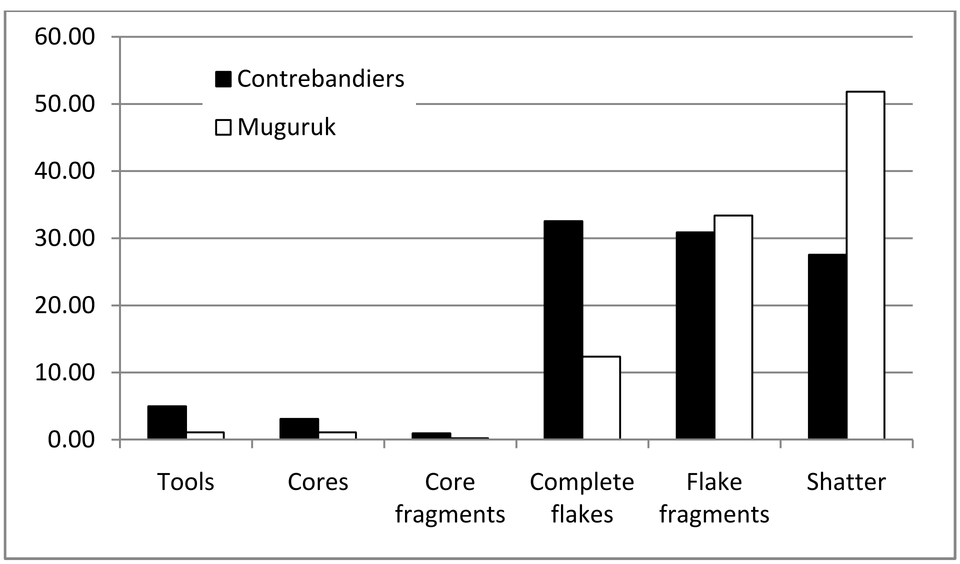


Figure 3.91: Breakdown of the lithic assemblages into major artifact categories at Contrebandiers Cave (n=1,263) and Muguruk (n=6,253). Note, counts of complete flakes, flake fragments and shatter for Muguruk are derived from McBrearty 1988.

Figure 3.92 ignores shatter and highlights the relationships between four tool categories, cores, and blanks in the assemblages. A slightly different pattern emerges. At Contrebandiers Cave, scrapers are not nearly as important as they are in the French assemblages examined, even for the layers where scrapers form a smaller component of the industry, as in layer 08 at Roc de Marsal and layer 6A in Pech de l'Azé IV. In both those assemblages, scrapers account for more than 13% of the assemblage[11], whereas, in Contrebandiers Cave, they are below 6%. Notches, on the other hand, are the largest tool category in CB, and are twice as important as the contribution of scrapers in the tool category. Upper Paleolithic types remain low but are higher than in the French assemblages. Other tools are even more important than the UP types, and contain the stemmed points and stemmed tools diagnostic for the Aterian. The largest category at CB, when shatter is excluded and the contribution of blanks downplayed, consists of cores and core fragments. The layers where this is the case in France are layer 6A in Pech IV and the three layers from Combe Capelle Bas. However, the relative contribution of blanks is much greater at Contrebandiers than it is for Combe Capelle Bas or for layer 6A at Pech IV.

[11] Assemblage here is defined as the combination of all tools, cores and core fragments, and 10% of all proximal and complete blanks at a site. Other possible approaches would be to include all artifacts (adding shatter and flake fragments other than the proximal flakes) or to define assemblage as the essential or real tool lists of Bordes (1961)

Levallois indices for the site of Contrebandiers are shown in Table 3.28. The indices indicate that Contrebandiers has relatively few artifacts that are representative of Levallois technology at the site. However, single surface cores are quite well represented at 45% of the total core assemblage.

Table 3.28: Values for Various Types of Levallois Indices at Muguruk and Contrebandiers Cave. Note Counts of Levallois Flakes are Derived from McBrearty 1988.

	Muguruk	Contrebandiers
IL	2.25	2.44
Ilty	27.62	21.36
IL core	34.1	4.5
Single surface core	61	45.1

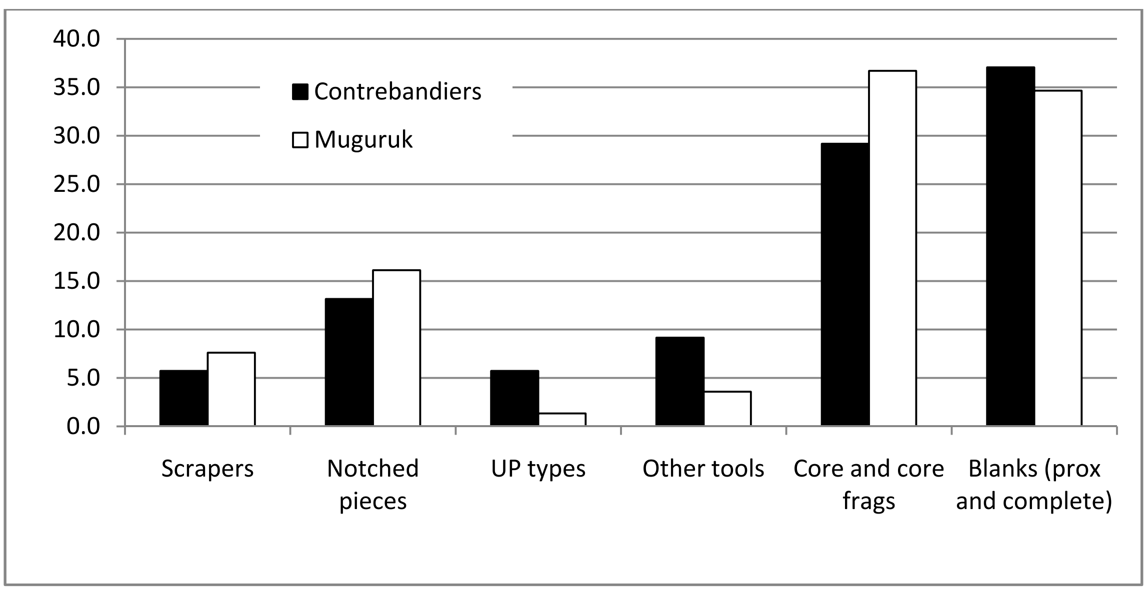


Figure 3.92: Breakdown of lithic assemblages at Contrebandiers Cave (n=175) and Muguruk (n=223) into four major types of tools, cores, and unretouched blanks. The vertical axis represents the percentage of each artifact category per layer. Note: the total blank count was divided by 10 to minimize the impact of this category on the graph as a whole; the total blank count for Muguruk relies exclusively on complete flakes as no counts for proximal pieces are available.

The blank to core ratio at Contrebandiers Cave falls between the values seen for the various layers in France (Figure 3.93). The value is at least double that observed in the layers at Combe Capelle Bas, but quite a bit lower than those at layer 04 and 05 at Roc de Marsal and layers 4C and 8 at Pech IV. The layer closest to the value seen in Contrebandiers Cave is layer 08 at Roc de Marsal. Even if we take raw material into account, the blank to core ratio remains around the same value, which, as we will see, is not the case for the flake to tool ratio.

The flake to tool ratio is quite high in Contrebandiers Cave (Figure 3.93). In fact, it is highest for any of the sites examined thus far. In other words, there are relatively few tools, a pattern that is typical for many African assemblages (McBrearty and Tryon 2006; McBrearty and Brooks 2000)[12]. When examining the effect of the different raw materials on the flake to core ratio, we notice a marked difference between fine grained

[12] That pattern can be associated with the relative lack of scrapers in African assemblages in general. Unlike the French sites, at Contrebandiers less than 1% of the entire assemblage consists of scrapers. In comparison, the site with the fewest scrapers, layer 08 at Roc de Marsal, still has about double the number of scrapers relative to the assemblage as a whole.

raw material and coarse grained material. For the fine grained material like chert, the flake to core ratio is 6.8, whereas, for the coarse grained material, this same ratio is 42.1. There is a clear desire to select finer grained raw materials for further reduction.

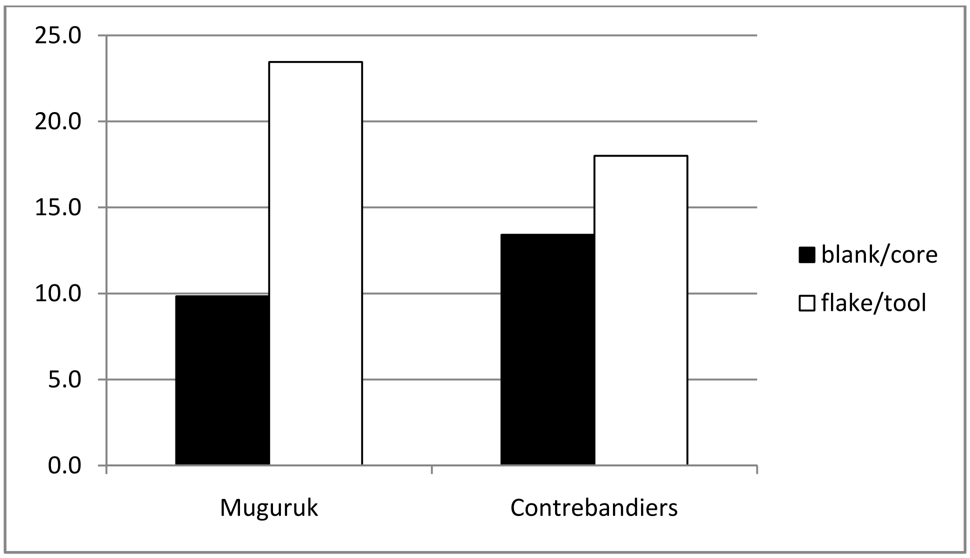


Figure 3.93: Blank to core and flake to tool ratios at Contrebandiers Cave and Muguruk. Note: Only counts for the complete blanks were used in Muguruk and are derived from McBrearty 1988).

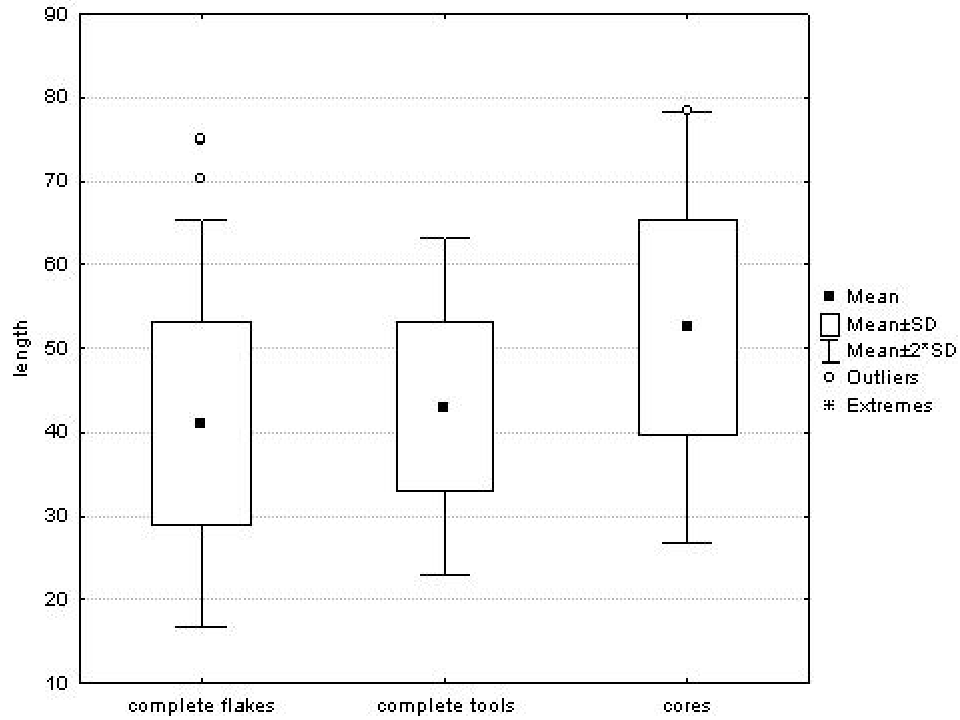


Figure 3.94: Box plots of the distribution of lengths of complete flakes (n=105), complete tools (n=25) and cores (n=26) for coarse grained raw materials in the Aterian layers at Contrebandiers Cave.

The sizes of complete flakes, complete tools, and cores are displayed in Figure 3.94 and Figure 3.95. The distribution of lengths for coarse grained raw material in Figure 3.94 shows a pattern much like the one for the different layers at Combe Capelle Bas, in which the complete flakes are shortest on average, the cores longest, and the complete tools fall somewhere in between. Differences between cores and the other two categories are significant ($p<0.01$), but not between complete flakes and complete tools.

The pattern for fine grained raw material shown in Figure 3.95 is different. While complete flakes are, on average, the shortest, the differences with complete tools and cores are small and statistically insignificant. Furthermore, the complete tools are slightly longer than the cores on average, a pattern that matches those in the cave sites examined in France, but not the one in Combe Capelle Bas. There is also a clear size difference between the fine grained and the coarse grained raw material. Flakes and tools each are about 1cm longer on average in coarse grained materials and cores 2cm larger. This difference is quite high considering that the average core length for the fine grained raw materials is only slightly larger than 3cm.

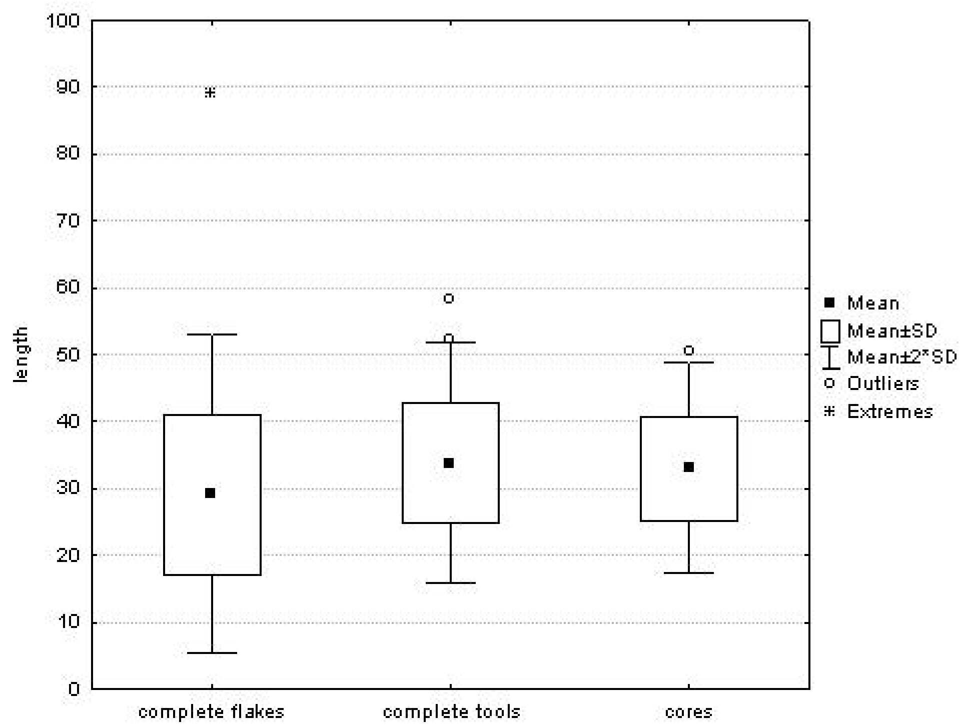


Figure 3.95: Box plots of the distribution of lengths of complete flakes (n=49), complete tools (n=46) and cores (n=22) for fine grained raw materials in the Aterian layers at Contrebandiers Cave.

The majority of platforms for both complete flakes and flake scars are plain, with a smaller proportion of prepared platforms (Figure 3.96). The biggest difference between the flake scars and the complete flake platforms is the relative importance of cortical platforms in each. Flakes tend to show a large component of cortical platforms, almost as high as the plain platforms, whereas fewer cortical platforms are evident in the flake scars.

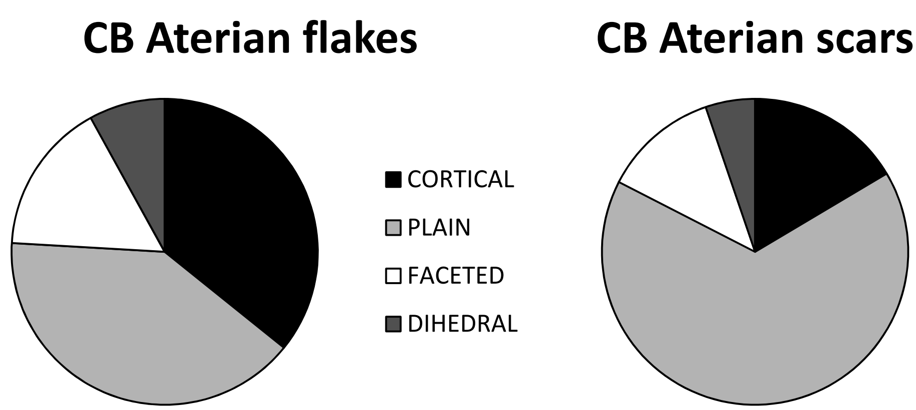


Figure 3.96: Frequency of platform types for flakes (n=299) and flake scars (n=401) in Contrebandiers Cave.

The distribution of flake scars for various artifact categories shows a pattern not unlike the one we saw in other layers (Figure 3.97). However, it seems that notches and T-F pieces have a very similar distribution. Flake scars on scrapers do extend into the slightly larger categories, but their contribution to the flake scars in those categories is minimal. Scraper flake scars, however, are much better represented in the smallest flake scar category. This pattern is exactly the same we have seen in other sites.

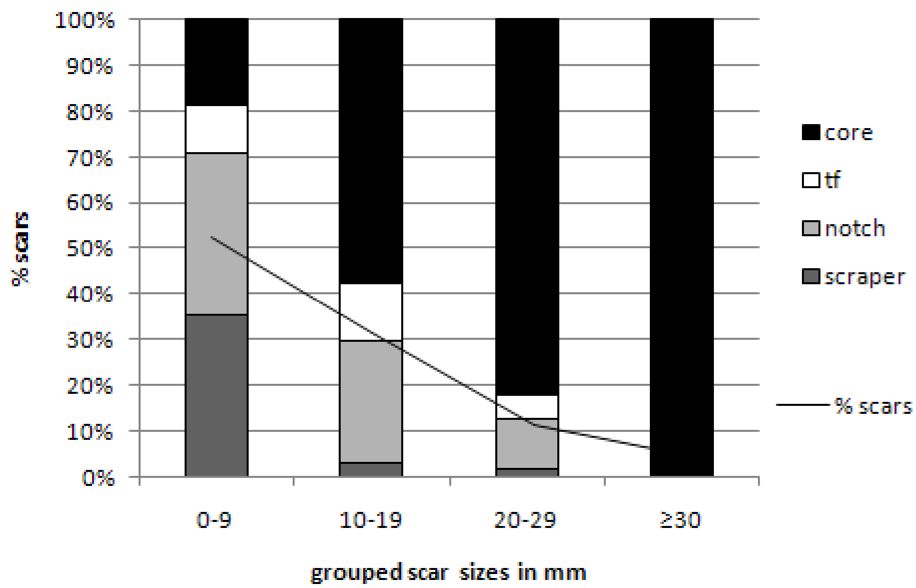


Figure 3.97: Distribution of flake scars on 4 categories of lithic artifacts by size for the Aterian layers at CB.

Comparison of flake scars on cores and tools

The point in comparing flake scars on cores and tools is to establish if scars on tools could be related to the production of useable flakes. To do so, we need to determine if the sizes of flake scars on cores overlap with those on tools. For CB, the answer is yes. This relationship is seen again in Figure 3.98, which shows the distribution of scars on tools and scars on cores. While it is clear that flake scars on cores are consistently larger than those on tools, it is also clear that the lower range of flake scars on cores overlaps considerably with the flake scars on tools. In other words, if the assumption is that flakes taken from cores were in some way desired, then there is no reason to assume this would not be the case for flakes removed from tools. This interpretation that tools might contribute to the population of desired flakes is further supported by the fact that flake scars of tools are often very similar to flake scars on tools technologically.

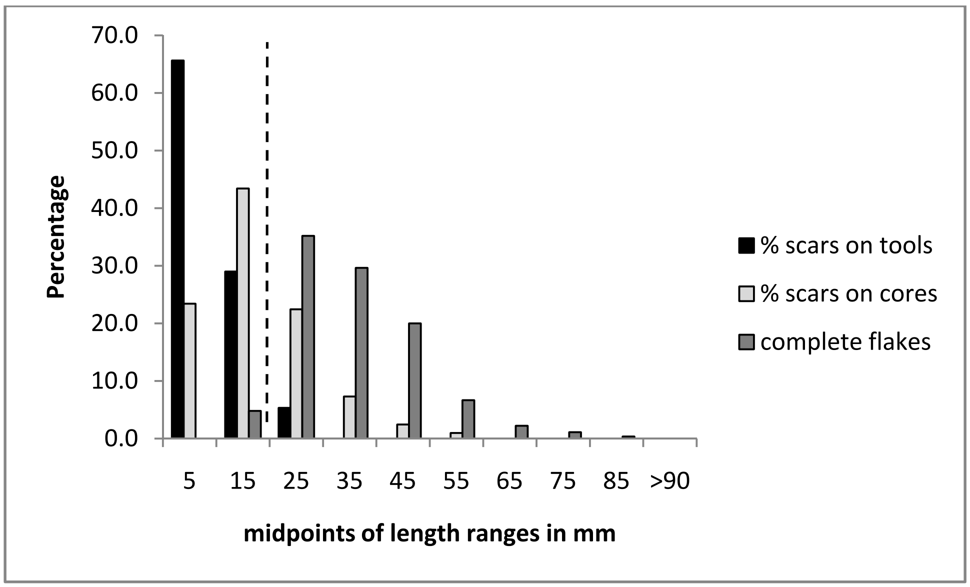


Figure 3.98: Distribution of artifact length by percentage scars on tools and cores as well as the distribution of complete flake sizes for the Aterian layers in CB. Note: removals on scrapers are excluded from this graph. The dashed vertical line indicates the 2.5 maximum dimension cutoff that was used in the excavations to determine if artifacts would be piece-provenienced and analyzed.

A pie chart with the types of removals found on tools is shown in Figure 3.99. The majority of the removals on tools are notch-like with smaller components of T-F, other, and core-like removals.

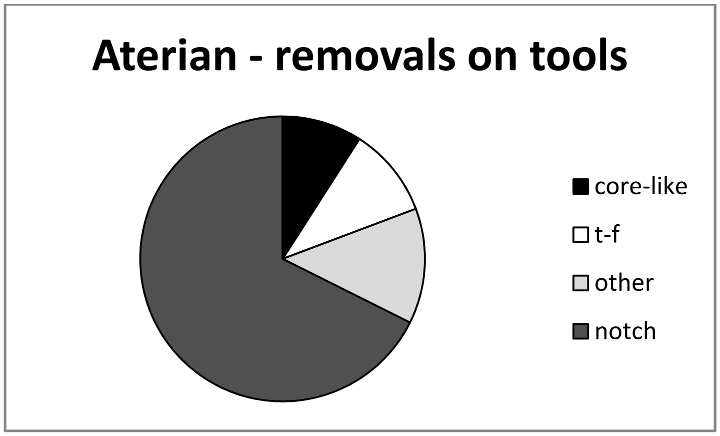


Figure 3.99: Frequency of flake scar removal types as they are found on tools (n=275) in Contrebandiers Cave.

The location of removals on tools is broadly comparable to those on cores and also to those on scrapers (Figure 3.100). The largest category of removals is located on the lateral portion of artifacts. This is most pronounced for scrapers, less so for tools, and the least for scars on cores. The second largest group for flake scars is proximal removals on cores and distal removals on tools and scrapers. As pointed out in chapter 2, cores are oriented based on their longest axis and major flaking area on the core. The latter is automatically placed to form the proximal portion of the artifact, biasing flake scars on cores towards proximal removals.

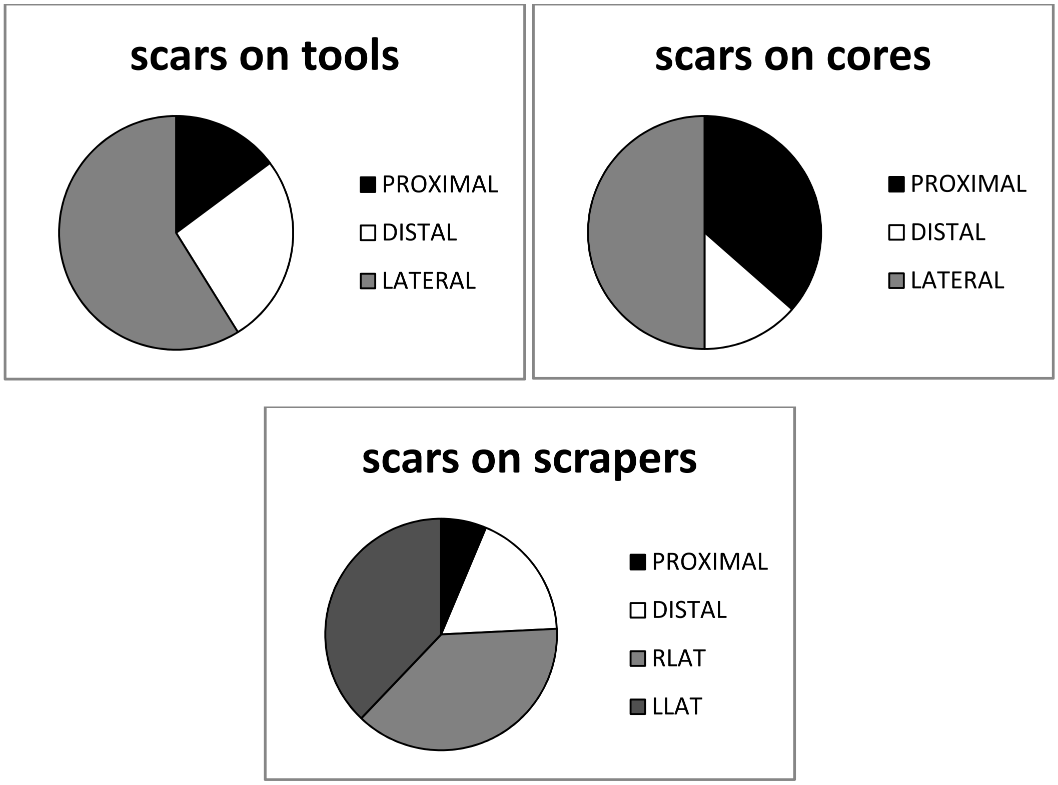
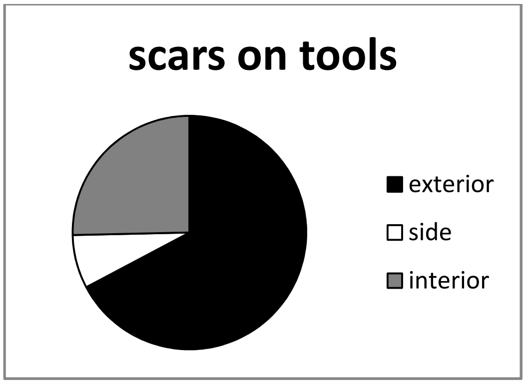
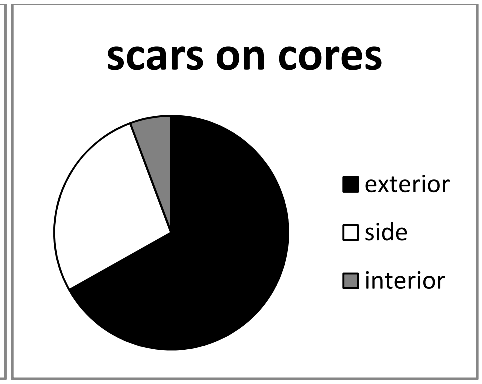


Figure 3.100: Frequency of the locations of flake scars on tools (n=243), cores (n=222), and scrapers (n=95) in the Aterian layers at CB.

Flake scar surfaces (Figure 3.101) are similar for tools, cores, and scrapers. For all three categories, the exterior is the preferred area of subsequent flake removals. Cores tend to have more removals on their sides and fewer on the interior surface. This latter pattern is best explained based on the difference between the thicknesses of these two classes of artifacts.





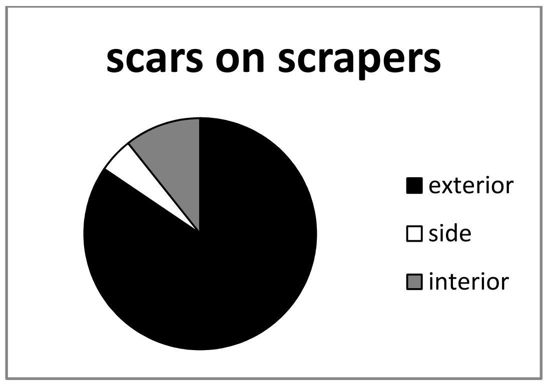


Figure 3.101: Frequency of the removal surfaces of flake scars on tools (n=229), cores (n=175), and scrapers (n=103) in the Aterian at CB.

The types of platforms between cores and tools match except for the almost complete absence of cortical platforms on tools (Figure 3.102). Cores, on the other hand, particularly those in quartzite, tend to show abundant cortex and this is reflected in their cortical platforms. Given that tools are much more abundant for the fine grained raw materials, it is perhaps not surprising that fewer cortical platforms exist.

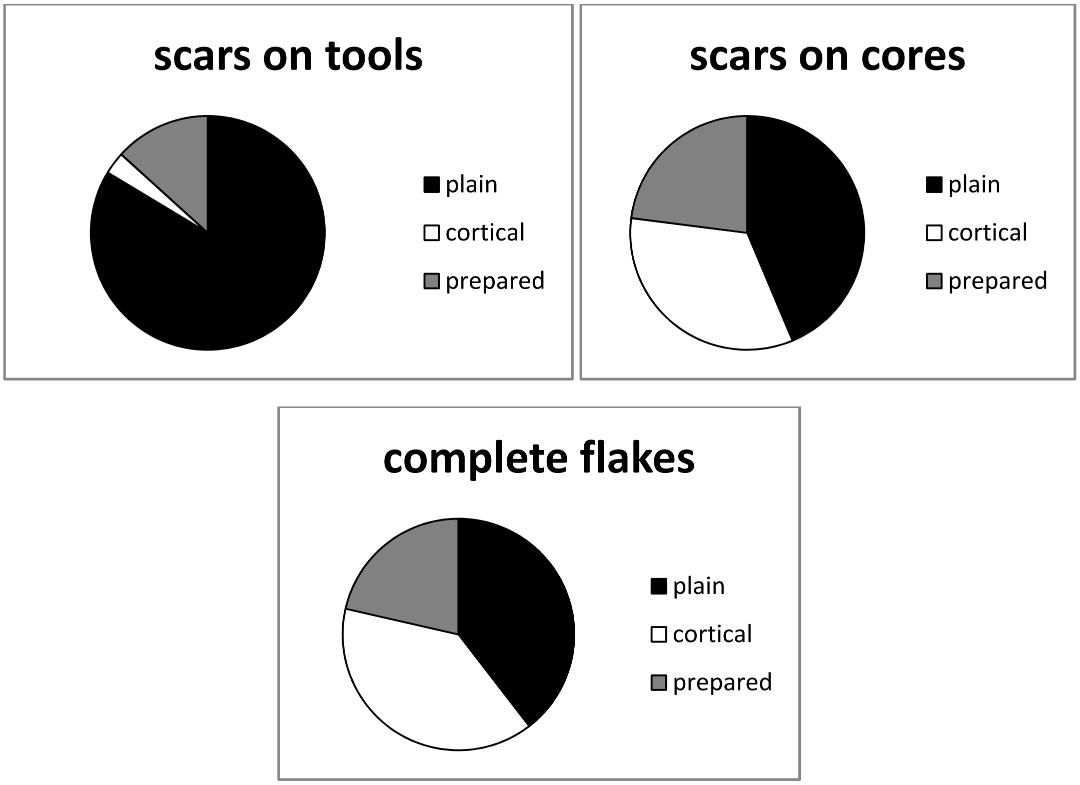


Figure 3.102: Frequency of the types of platforms for complete flakes (n=210) and for flake scars on tools (n=226) and cores (n=174) in the Aterian at CB.

Muguruk

Layer 4

Assemblage composition

The assemblage from Muguruk is the most difficult to compare to the other collections presented. The difficulty arises in part from the lack of data about the quantity of archaeological material per unit of excavated sediment. More importantly, however, this study was designed to look at tools (Table 3.29) and cores (Table 3.30) exclusively and sample the unretouched artifact component. Because comparisons of tools and cores to the full assemblage have become an integral part of the study, it has become necessary to derive the counts for unretouched flakes from the articles published for the site. The main publication for Muguruk by McBrearty (1988) has detailed tables with raw counts for the various artifacts encountered in the site[13]. Whenever data derived from the publication of the site are incorporated into graphs and various indices, this is indicated in the text and/or figures, as necessary.

Muguruk is located directly on a source of suitable raw material. The lithic assemblage from the site bears some resemblance to the site of Combe Capelle Bas, also located on a source of raw material. Tools, cores, and core fragments are very rare compared to complete flakes, flake fragments, and shatter (Figure 3.91). The counts for shatter are

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[13] As can be expected, however, the categories used in this study are not always identical to those used in McBrearty's publication. This situation makes comparison and data integration all the more difficult and is precisely why cores and tools for each of the assemblages presented here had to be studied firsthand in order to ensure compatibility of the artifact categories.

particularly high. Three possible explanations can be offered for this pattern. These are raw material properties, wear pattern, and analytical differences between observers. Each is briefly discussed in turn.

Table 3.29: Breakdown of the Bordian Types in Layer 4 at Muguruk

Type #	Bordian tooltype		count	percent
1	Typical Levallois flake		36	15.1
2	Atypical Levallois flake		29	12.1
3	Levallois point		1	0.4
5	Pseudo-Levallois point		1	0.4
9	Straight single scraper		2	0.8
10	Convex single scraper		9	3.8
12	Double straight scraper		1	0.4
21	Dejete scraper		1	0.4
23	Convex transverse scraper		2	0.8
25	Scraper on interior		1	0.4
26	Abrupt scraper		1	0.4
31	Atypical endscraper		2	0.8
37	Atypical backed knife		1	0.4
38	Naturally-backed knife		15	6.3
40	Truncation		2	0.8
42	Notch		20	8.4
43	Denticulate		10	4.2
44	Bec burinante alterne		1	0.4
45	Retouch on interior		8	3.3
48	Abrupt/alternating retouch (thick)		85	35.6
54	End-notched flake		6	2.5
61	Chopping-tool		3	1.3
64	Truncated-Faceted piece		2	0.8
		Total	**239**	**100**

Table 3.30: Breakdown of Core Types in Layer 4 at Muguruk

core type	**count**	**percent**
Disc core	1	1.2
Levallois core	28	32.9
Single surface core	21	24.7
Tested block	4	4.7
Globular core	2	2.4
Pyramidal core	1	1.2
Other	7	8.2
Informal core	17	20.0
N/A	4	4.7
Total	**85**	**100**

First, the raw material – Ombo Phonolite — is rather coarse grained and, from personal experience, not the easiest to knap. At the same time, it is not nearly as difficult to knap as quartz, and clearly the humans working with this material were expert knappers. However, it is quite possible that, on average, more shatter might be generated when knapping Ombo Phonolite then fine grained material, such as chert or obsidian. This interpretation is supported by the many flake fragments at the site. Second, due to the extensive wear patterns on the material, it was often difficult to identify flake landmarks. When such landmarks could not be identified, the artifact in question may have been classified as shatter. Therefore, some portion of the shatter would have actually been flakes but are no longer identifiable as such. A third possible explanation that might contribute to the elevated shatter counts compared to those from the other sites is analyst bias. While lithic specialists ideally classify the same material similarly, archaeologists rarely test this assumption (but see Dibble 1995c; Fish 1978). It is possible that slight analytical differences in how shatter is categorized could result in dramatic differences in counts of flake fragments and shatter. There is no telling if and how extensively each of these possible reasons has contributed to the final result. The closest assemblage to Layer 4 in Muguruk in terms of the ubiquity of shatter is Contrebandiers Cave. At that site, quartz, another difficult raw material to knap and analyze, accounts for the majority of the shatter, suggesting the interpretation that raw material might play a significant role in the high shatter count.

When we look at Figure 3.92 (which ignores shatter and highlights relationships between scrapers, notches and denticulates, Upper Paleolithic types, other tools, cores, and blanks in the assemblages) a slightly different pattern than the one characterized for all artifacts emerges. Scrapers, as at Contrebandiers Cave, are underrepresented compared to the assemblages from the Dordogne, notches are quite numerous, Upper Paleolithic types virtually absent, and other tools rare. By and large, there are few tools in the assemblage, a pattern that is quite typical for African industries as a whole. Cores and core fragments as a category are more numerous than the tools and also than one tenth of the total blanks (Figure 3.95). This pattern only occurs at Combe Capelle Bas and layer 6A at Pech IV, each of which might have a significant blank production element to it.

The Levallois indices for Muguruk are shown in Table 3.27. Based on the IL index (all Levallois/all flakes), the site has relatively few Levallois pieces. However, the ILty index is moderate and the Levallois core index high, in fact, higher than at the other sites examined. The percentage of single surface cores also is quite high, further indicating the presence of Levallois production at the site.

The blank to core ratio at Muguruk (Figure 3.93) is relatively low, resembling Combe Capelle Bas and layer 6A at Pech IV. However, there is an important caveat: only complete blanks were counted for this ratio, as I did not count the proximal fragments nor was this information published in the site report (McBrearty 1988). One way to address this problem is to compute the blank to core ratio as the sum of complete flakes and complete tools divided by cores (not including core fragments). These values tend to be very comparable to the values that include both proximal flake fragments and core fragments in the computation of the ratio, particularly at the lower values of the blank/core ratio. At Muguruk, the blank to core ratio then becomes 11.7, which is still on the low end as far as blank to core ratios go. In other words, the pattern at Muguruk does seem to match the pattern seen at sites with high blank production. This might be expected at a site with readily available raw material.

The flake to tool ratio at Muguruk is quite high (Figure 3.93), the highest for any of the sites examined. This pattern is different from the one observed at Combe Capelle Bas where tools were quite numerous. In other words, at Muguruk tool production does *not* seem to co-occur with blank manufacture, as observed at Combe Capelle Bas. This pattern is reinforced when excluding the tool fragments from the ratio to adjust for the absence of proximal flake fragments in the denominator. The resulting ratio becomes 40.7. Performing this same calculation for other layers examined here results in a consistent decrease in the flake to tool ratio for all sites. If this pattern is true for Muguruk as well, the ratio of 40.7 might be slightly lower than the true value.

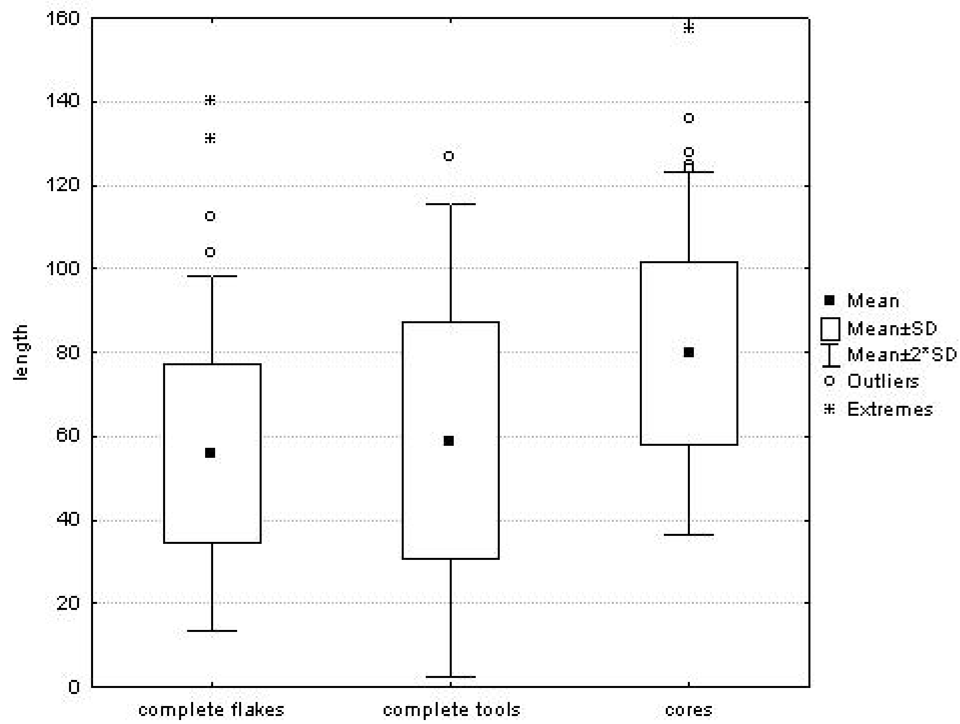

Figure 3.103: Box plots of the distribution of lengths of complete flakes (n=103), complete tools (n=19) and cores (n=68) in Layer 4 at Muguruk.

The distribution of the sizes of complete flakes, complete tools, and cores at Muguruk (Figure 3.103) shows a pattern much like the one at Combe Capelle Bas. Complete flakes are the smallest, cores the largest, and complete tools fall in between. However, the difference between complete flakes and complete tools is small and not statistically significant (p=0.58). At Combe Capelle Bas, tools were quite a bit larger than complete flakes — showing a clear selection of the larger flakes for further reduction; this is not the case at Muguruk. Since there is no evidence to suggest that complete tools were so heavily reduced that their size became comparable to flakes, it could be that there simply was no significant size selection operating in the manufacture of tools. Interestingly, the same pattern is observed at Contrebandiers Cave when we look at the coarse raw material, but not when we consider fine grained material.

Platform preparation in flakes and flake scars is very similar in the Layer 4 assemblage at Muguruk (Figure 3.104). The bulk of the flakes and flake scars show plain platforms. Faceted platforms are slightly more numerous in flakes than they are in flake scars, and cortical platforms are slightly more common in the flake scars than they are in flakes. This latter pattern is the opposite of the pattern seen in the other sites, perhaps because it is difficult to recognize cortex on phonolite. Recognizing cortex is easier when a larger surface of stone can be examined, which tends to be the case for flake scars, but not for the platforms of flakes themselves. Regardless of these small differences between platforms on flakes and flake scars, the pattern of platform type distribution is generally similar and shows that there is technological continuity between the two.

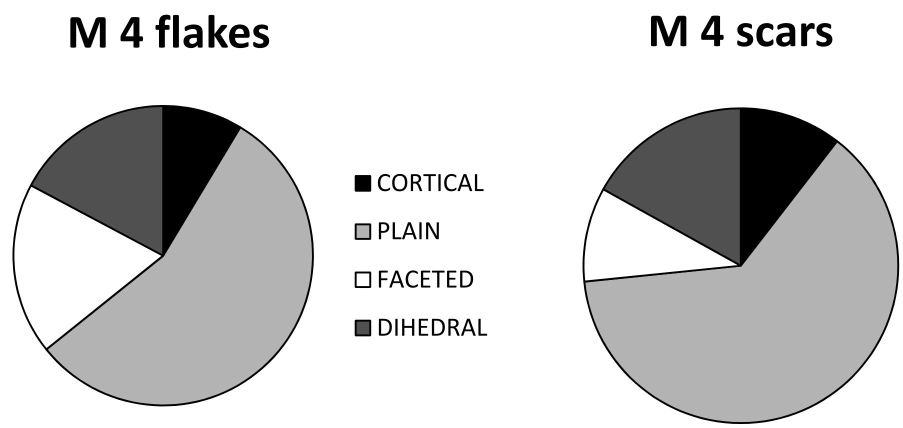

Figure 3.104: Frequency of platform types for flakes (n=151) and flake scars (n=124) in Layer 4 at Muguruk.

The overlap between flake scars on cores and flake scars on tools (Figure 3.105) is less pronounced at Muguruk than it was at other sites. Very few notches extend well into the sizes of flake scars on cores, and only overlap extensively for flakes between 1 and 2cm in length. This suggests that “tools” do not play as much a role of flake producers as they do in other sites.

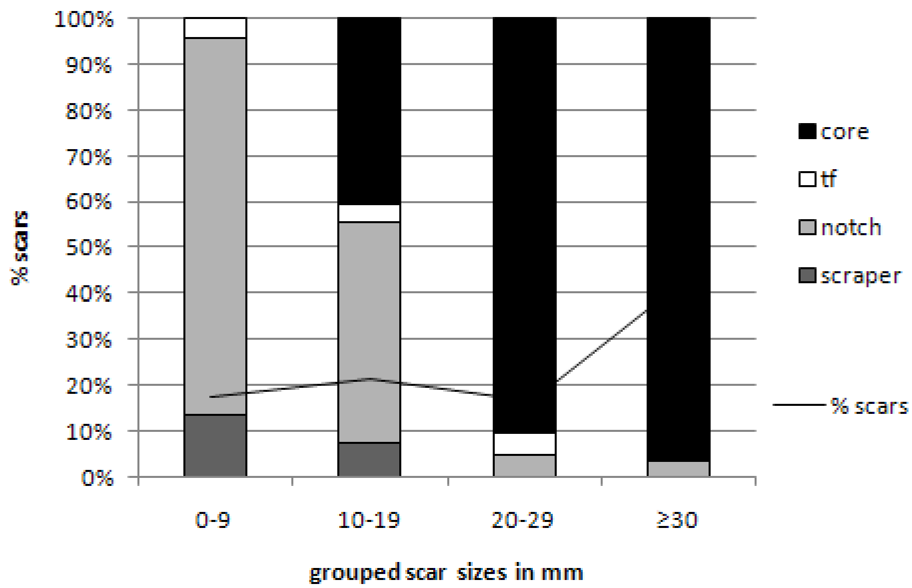

Figure 3.105: Distribution of flake scars on 4 categories of lithic artifacts by size in layer 4 at Muguruk.

Comparison of flake scars on tools and cores

The pattern based on the distribution of flake scars holds when we consider the length distributions of flake scars on cores, flake scars on tools, and complete flakes (Figure 3.106). While there is clear and extensive overlap between the distribution of complete flakes and flake scars on cores, the overlap with flake scars on tools is more limited than in other sites. Nonetheless, there is some overlap, and the overall pattern matches those from other assemblages: The sizes of complete flakes are largest, those of flake scars on cores slightly smaller, and finally the sizes of flake scars on tools the smallest. It is interesting to note also that the distribution itself is quite similar to those at Combe

Capelle Bas in the sense that the distribution of complete flakes and flake scars on cores does not show a very pronounced median, but appears to be rather flat. Most flake scars on tools are small. These patterns, together with the knowledge that the assemblage appears quite abraded and that notches are the dominant tool category, indicate a high proportion of the “tools” at Muguruk might, in fact, represent damaged pieces. This suspicion is further strengthened by the knowledge that there appears to be no size bias operating in the selection of blanks for tool manufacture[14].

Flake removals on tools in the Layer 4 assemblage at Muguruk are mostly notch removals, with very few core-like removals (Figure 3.107). Along with the small size of the notch removals, it seems likely that many tools do not function to produce useable blanks.

[14] Such bias is normally apparent in assemblages and reinforced by the patterns we have seen here at the different sites. Furthermore, archaeologists have shown that trampling and natural processes can lead to the manufacture of notches and denticulates (McBrearty 1998). Despite our best efforts to exclude artifacts from the notch and denticulate counts, when any type of irregular, steep, or bidirectional ‘retouch’ is observed on an artifact, it is quite likely that, depending on the context of the site itself, many natural notches and denticulates may be added to the tool counts. At sites where notches and denticulates are the most important tool type, this bias can be particularly damaging to the interpretation of the site.

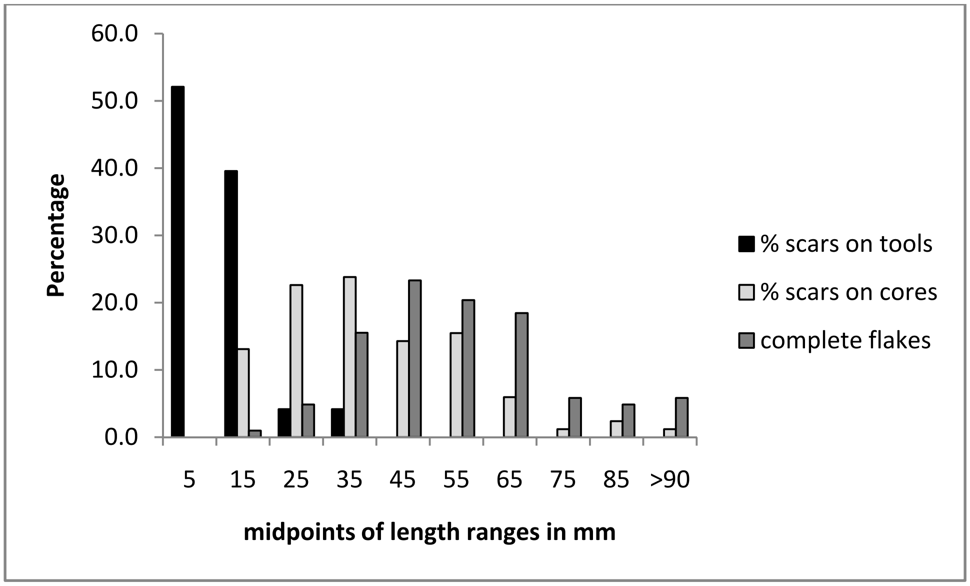

Figure 3.106: Distribution of artifact length by percentage scars on tools and cores as well as the distribution of complete flake sizes for Layer 4 at Muguruk. Note: removals on scrapers are excluded from this graph.

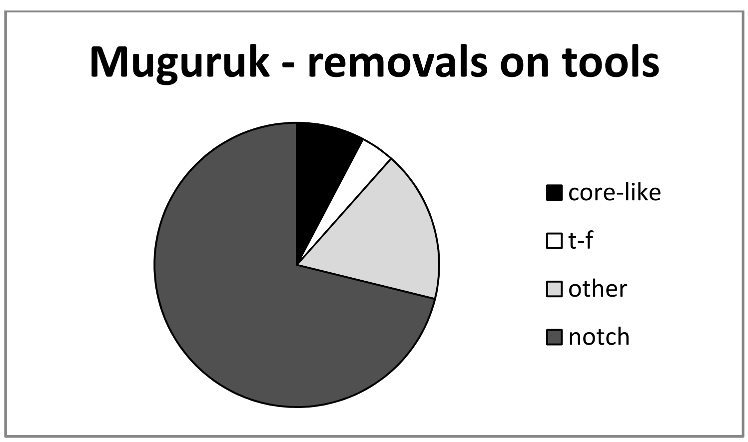

Figure 3.107: Frequency of flake scar removal types as they are found on tools (n=52) in Layer 4 at Muguruk.

Scars on tools are dominated by lateral removals, with about 20% distal removals and a very small percentage of proximal removals (Figure 3.108). This pattern by and large matches well with the pattern on scrapers, which are also dominated by lateral removals first and distal removals second. Scars on cores, on the other hand, as might be expected in an assemblage with predominantly single surface type core reductions, have a significant portion of proximal and lateral removals and very few distal removals.

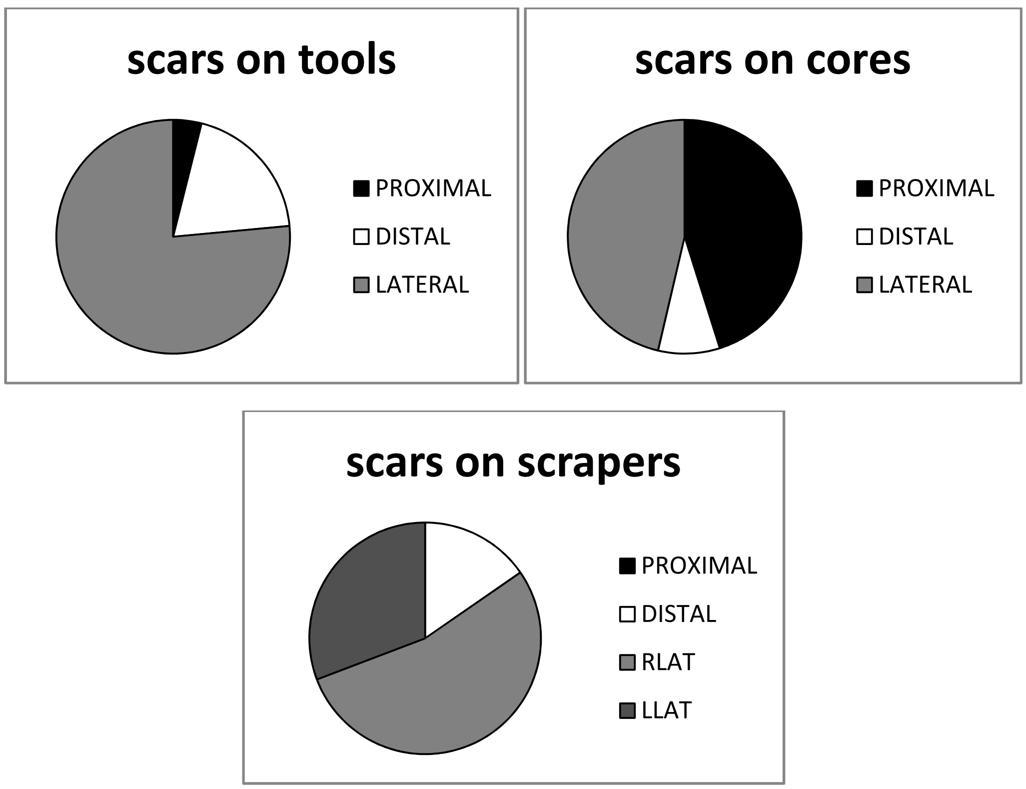

Figure 3.108: Frequency of the location of flake scars on tools (n=51), cores (n=82), and scrapers (n=13) at Muguruk.

In terms of the flake scar surface, the pattern in all three categories is quite similar (Figure 3.109). Scars on tools, cores, and scrapers have roughly 75% exterior removals, with a smaller portion of interior removals. Cores have the smallest component of interior removals, but somewhat more removals from the side of the core. Again, this pattern for cores fits well with the knowledge that the assemblage is primarily characterized by single surface reduction.

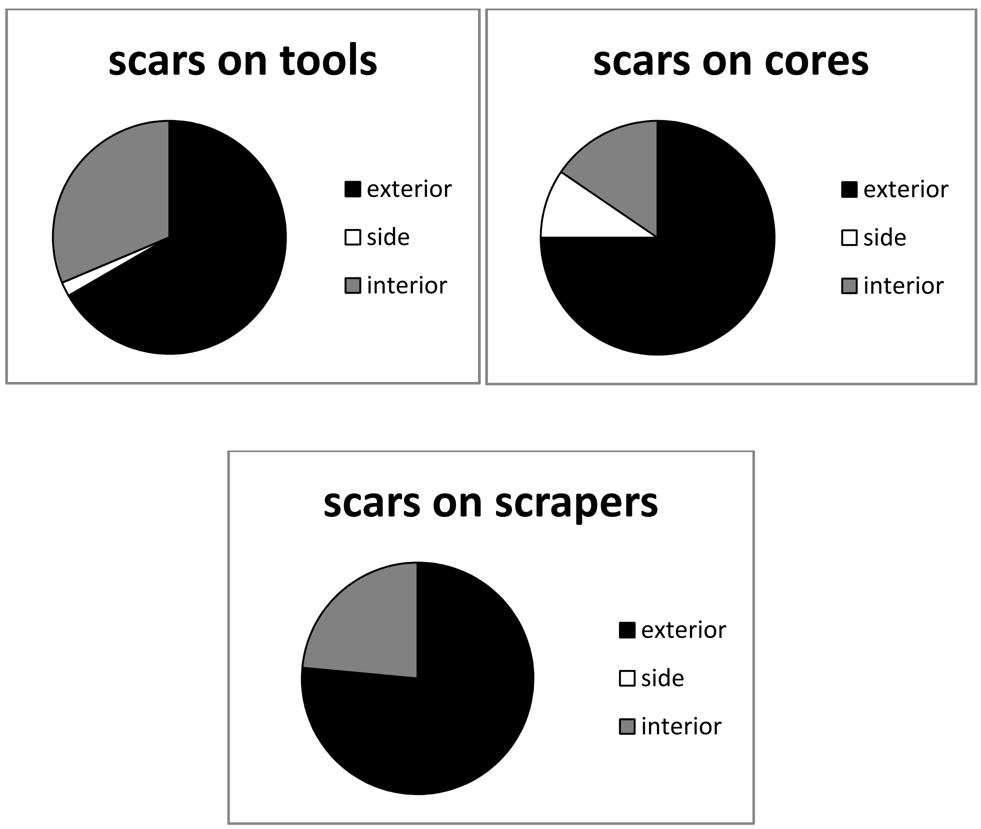

Figure 3.109: Frequency of the removal surfaces of flake scars on tools (n=51), cores (n=84), and scrapers (n=17) in Layer 4 at Muguruk.

The breakdown of platform types on tools provides yet another line of evidence to suggest that many of the tools might, in fact, be manufactured by natural causes rather than intentional human action (Figure 3.110). The majority of scars on tools show plain platforms with relatively minor components of prepared and cortical platforms. Scars on cores show a quite different pattern in which about equal portions of the flake scars show prepared and plain platforms. Complete flakes show more plain platforms than do the cores. It might be that proportionally more of the flakes with prepared platforms were transported from the site.

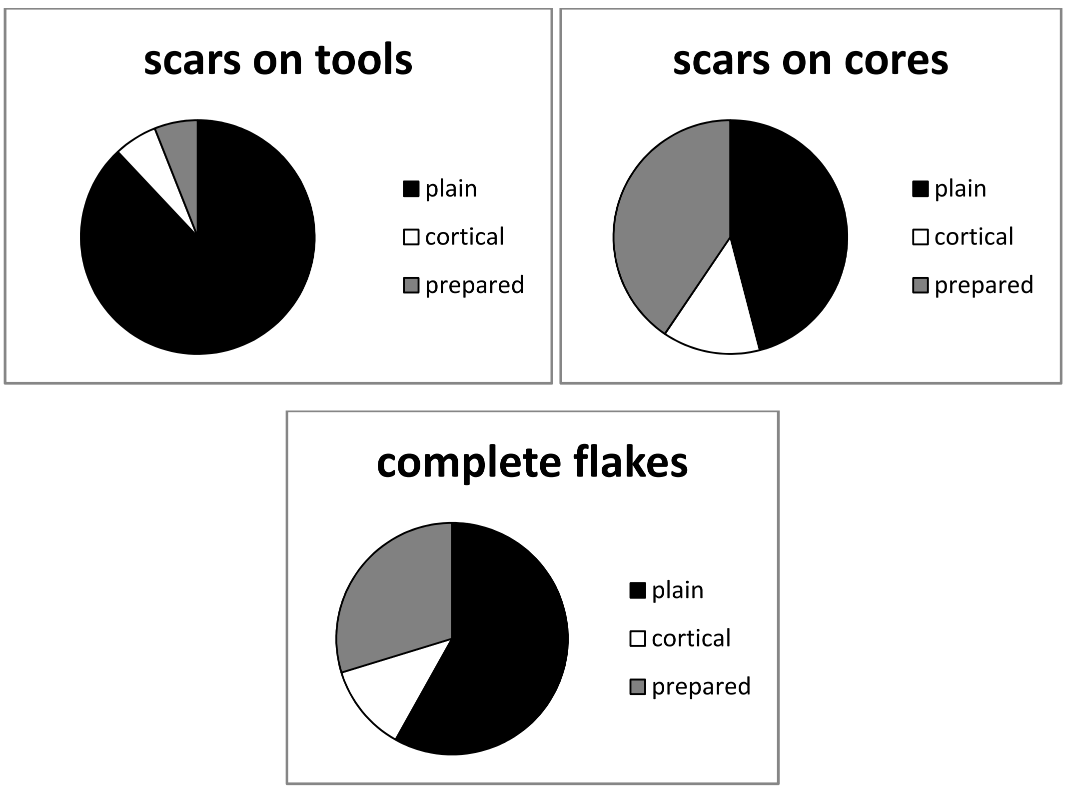

Figure 3.110: Frequency of the types of platforms for complete flakes (n=74) and for flake scars on tools (n=50) and cores (n=74) in Layer 4 at Muguruk.

Chapter 4 DISCUSSION

Four themes from the results warrant closer examination here. These are: (1) the relationship of blank to core and flake to tool indices and how informative they are; (2) the role of raw material as a predominant variable structuring lithic assemblages; (3) the comparison of assemblages from Europe and those from Africa; and (4) the implications of the similarity between flake scars on cores and those on tools. Each of these themes will be discussed in turn.

Indices of Reduction or Site Function?

Blank to core and flake to tool indices have been used to discern the intensity of lithic raw material utilization at Paleolithic sites. The work by Rolland and Dibble (Rolland 1981; Rolland and Dibble 1990; Dibble and Rolland 1992) has shown that the intensity of the use of raw material has profound effects in structuring lithic assemblages. This effect, they propose, can be measured by a number of indices, such as blank to core and flake to tool ratios, but also by indices that measure reduction within particular retouched tool types, such as the Scraper Reduction Index and the Notch Reduction Index. (See the Materials and Methods chapter for the definition of each of these indices.) As an assemblage is more reduced, the proportion of convergent, transverse, and dejete scrapers becomes larger compared to the single and double scrapers and therefore will increase the Scraper Reduction Index. The Notch Reduction Index measures a similar kind of intensity of raw material use by dividing the total number of heavily reduced notches (denticulates and Tayac points) by single notches (notches and end-notched pieces).

If, indeed, these various indices reflect the intensity of raw material use at sites, then we should expect a correlation between them. In particular, we would expect the two values to be inversely related to one another. As blank to core ratios increase (showing cores are more intensively reduced at a site), we would expect the flake to tool ratio to decrease (more flakes would be turned into tools). However, when we correlate the blank to core ratio and the flake to tool ratio of all eleven assemblages from the five sites, we do not see this expected inverse relationship (R^2=0.0002; df=1,9; p=0.96). Rather, the regression line is flat and shows there is no relationship between the two variables. Put differently, the ratios do not covary (see Figure 4.1 and Figure 4.2).

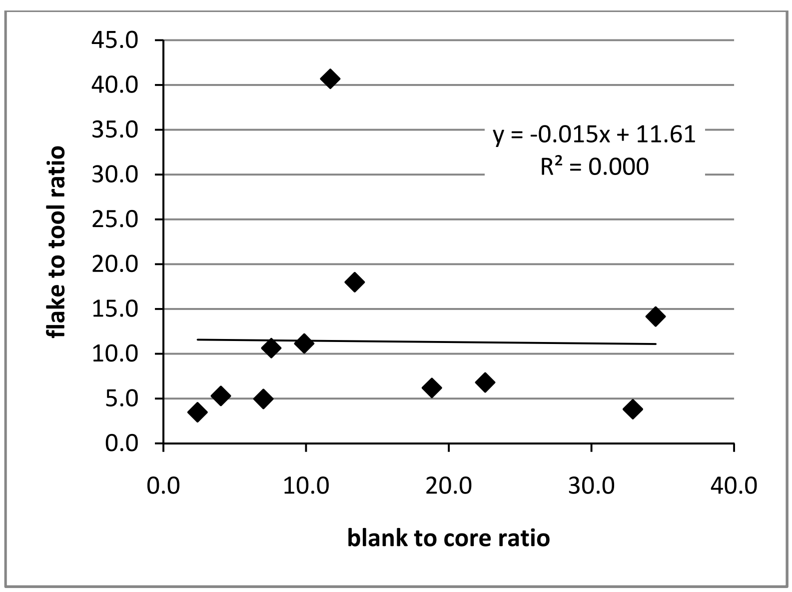

Figure 4.1: Regression of the blank to core and the flake to tool ratios

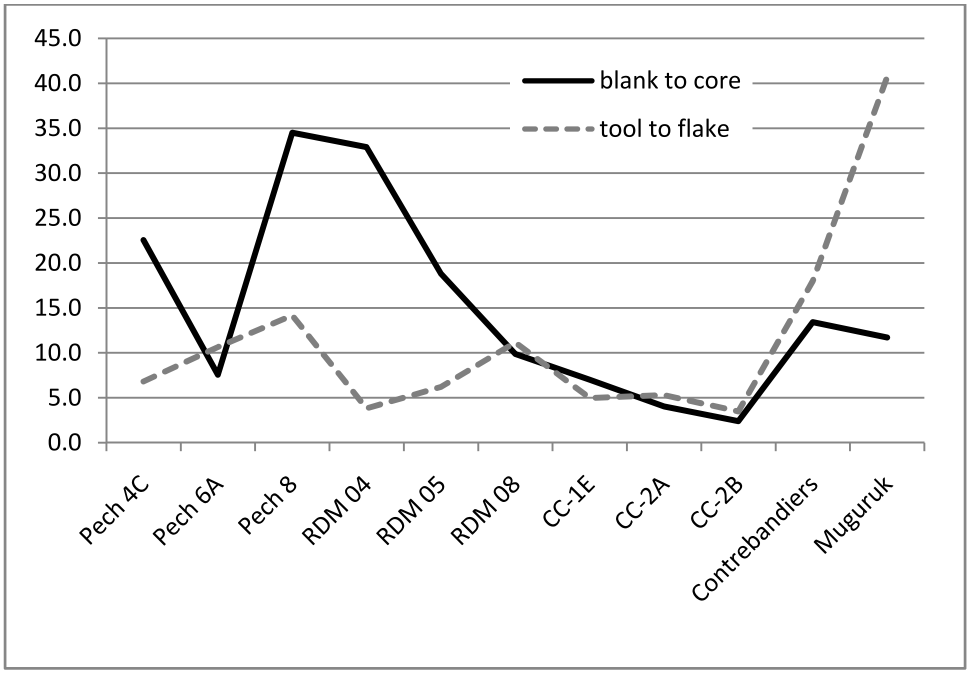

Figure 4.2: line graph of the blank to core and flake to tool ratios for all assemblages

A similar lack of relationship between the blank to core ratio and the Scraper Reduction Index exists for the sites examined (R^2=0.0002; df 1,9; p=0.97 Figure 4.3). Again, on purely theoretical grounds, a blank to core ratio increase would be expected to correlate with an increase in the intensity of scraper reduction. One relationship that does bear out in this study is the negative correlation between the blank to core ratio and artifact size. Particularly when we exclude the two African sites, the negative correlation between blank to core and artifact size is clear. In the case of complete tool sizes

(R^2=0.509; df 1,7; p=0.031, see Figure 4.4) and complete flake sizes (R^2=0.535; df 1,7; p=0.025), the correlation is significant, whereas it is not for cores (R^2=0.376; df 1,7; p=0.079). As the sizes of artifacts increase, the blank to core ratio decreases. This finding fits with the expectations that blank to core ratios reflect intensity of reduction. However, it also suggests that such an increase might be closely tied to the average size of nodules available in the area. When raw material is less ubiquitous, each piece of material is reduced more intensively (high blank to core ratios coincide with small average artifact sizes), whereas when raw material is readily available in large blocks, each core seems only minimally reduced (low blank to core ratios coincide with larger average artifact sizes).

However, as pointed out in the previous chapter, intensity of raw material use is not the only factor that can have an impact on the blank to core and flake to tool ratios. Import and/or export of material may also determine these ratios. In fact, this alternative view may help us to better understand particular values for the ratios at the different sites examined.

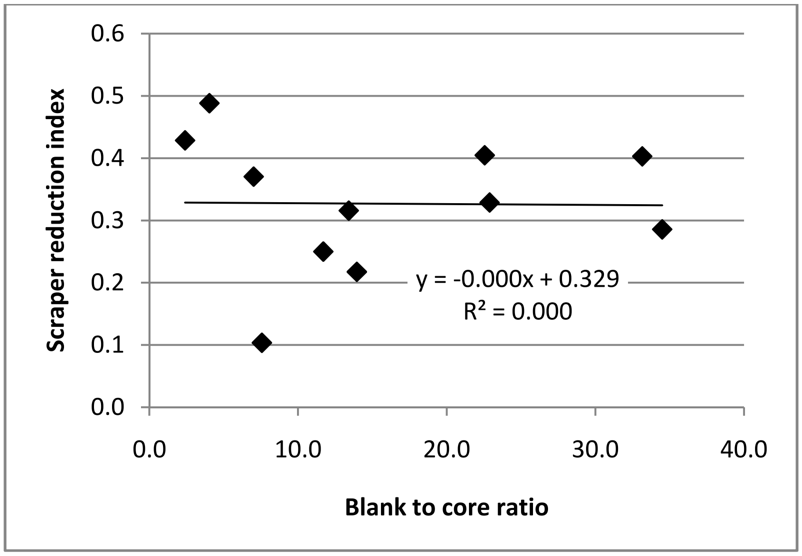

Figure 4.3: Regression between the blank to core ratio and the Scraper Reduction Index

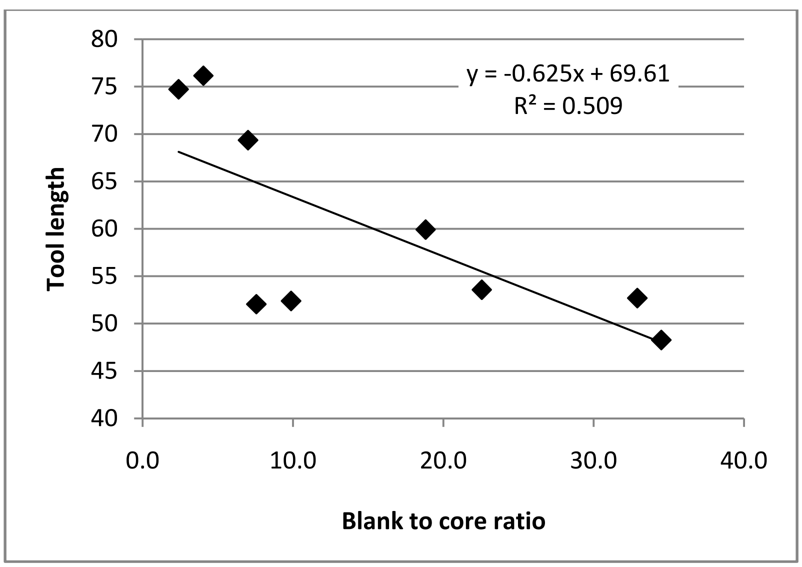

Figure 4.4: Regression between the blank to core ratio and complete tool length

This alternative interpretation echoes some of the views of Marks and colleagues on blank to core ratios (Marks 1988, 1989; Marks and Freidel 1977; Marks et al. 1991). In their studies, the sites in the Negev are interpreted in terms of the basic function each might fulfill in the broader settlement pattern. Three types of sites are proposed. These are workshops, habitation sites, and hunting and gathering stations[15]. Marks and colleagues show that as one moves farther from raw material sources, the average size of artifacts diminishes and blank to core ratios increase. Furthermore, at workshops, the blank to core ratios are low, as is the overall artifact density. Base camps, by contrast, are characterized by high artifact density, relatively rare cores, and smaller average core sizes. While Marks acknowledges that reduction intensity plays a role in influencing lithic distributions, he maintains that the primary reason for the observed differences lies in the movement of artifacts across the landscape.

Artifact transport between sites of different functions also is used to explain the patterns observed at the site of Starosel in the Crimea (Marks et al. 1996). This site is particularly relevant in this context as it is characterized by a very low core count and high blank and tool counts, mirroring the type of assemblage found in layer 4C at Pech IV and layers 04 and 05 at Roc de Marsal. The explanation for Starosel is that blanks

[15] Because tools are not nearly as important as a category in these open air sites compared to the cave sites further north in the Levant, researchers rely heavily on the sizes of raw material as well as the relationship between blanks and cores.

and/or tools are the primary target for transport, a hypothesis that might explain the patterns observed in these French sites.

Thus, transport may explain some of the patterns observed, in particular the blank to core ratios. Sites with a low blank to core ratio can be interpreted as blank production sites. These can exist both in contexts of high raw material availability such as the layers at Combe Capelle Bas, and in layers with less available raw material such as Pech de l'Azé IV. Layers with high blank to core ratios likely are predominantly specialized activity sites. The prime examples from this study are layer 4C from Pech de l'Azé IV and layer 04 from Roc de Marsal. In both these layers, the high blank to core ratio might be the result of the importation of blanks and/or tools into the site.

There are, however, some problems with relying uncritically on the transportation hypothesis. For example, layer 8 at Pech IV poses a problem as the high blank to core ratio suggests import of blanks and/or tools, while the high flake to tool ratio suggests that tool reduction at the site was not as important as in layers 4C at Pech and 04 at Roc de Marsal. While this discrepancy might suggest this site is a habitation site, the pattern remains unique and admittedly does not fit the proposed export/import-focused interpretation very well. Layer 08, also in Roc de Marsal, fits well with the pattern observed in layer 6A at Pech, having very similar blank to core and flake to tool ratios, whereas RDM layer 05 fits perhaps best with the specialized activity sites for layer 04 at the same site or layer 4C at Pech IV.

The blank to core ratio at Muguruk suggests a workshop assemblage more than a special activity or habitation site. However, the flake to tool ratio does not fit with what we would expect of a workshop. This discrepancy is probably due to the relative paucity of tools in African Middle Stone Age assemblages, and perhaps also to the pronounced differences in available raw material. Contrebandiers Cave also seems difficult to fit into the interpretation proposed.

To summarize, neither interpretation of the indices, or relationship between the indices, seems to apply to each case studied. Perhaps there is a problem with this conventional technique of relating blank to core and flake to tool ratios. Perhaps the flake to tool ratio itself confounds two different aspects of assemblages if a significant portion of the tools are blank producers rather than functional tools in their own right.

To explore these possibilities, I introduce two new ratios: The blank to scraper ratio and the blank to toolcore ratio. The blank to scraper ratio consists of dividing all blanks (proximal and complete retouched and unretouched flakes) by all scrapers (including retouched Levallois points, endscrapers, and limaces). The blank to toolcore ratio consists of the same numerator, but divides it by all tools except the scrapers specified above. The regression between the blank to scraper and the blank to toolcore ratios show no relationship between the two, as is the case with the blank to core and flake to tool ratios. However, when we regress the blank to scraper ratio with the Scraper Reduction Index, we get a significant inverse relationship between the two (R2=0.56; df

1,7; p=0.021; see Figure 4.5). In this regression, both Muguruk and Contrebandiers Cave were excluded simply because both these sites have extremely few scrapers and, as such, are irrelevant in this comparison[16]. If we further exclude layer 8 from Roc de Marsal, which seems to be an outlier for some unknown reason, then the correlation between the blank to scraper ratio and the Scraper Reduction Index becomes quite strong indeed (R^2=0.88; df 1,6; p=0.001,

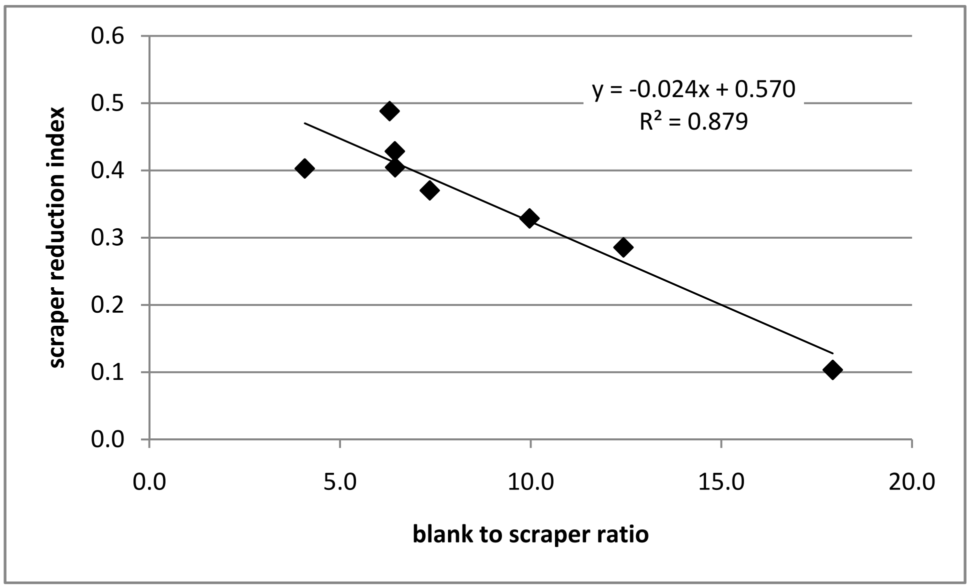

Figure 4.5Figure 4.5).

[16] The fact that there are few scrapers in the African sites is relevant for a different reason, however. It does seem to be a fundamental difference between the European sites and the African ones and there must be an underlying reason for this difference. Without going into the details, I suggest this difference has to do with the extensive hide preparation in the European context and its relative absence in the African context. I suspect this pattern might be effectively correlated with climatic differences.

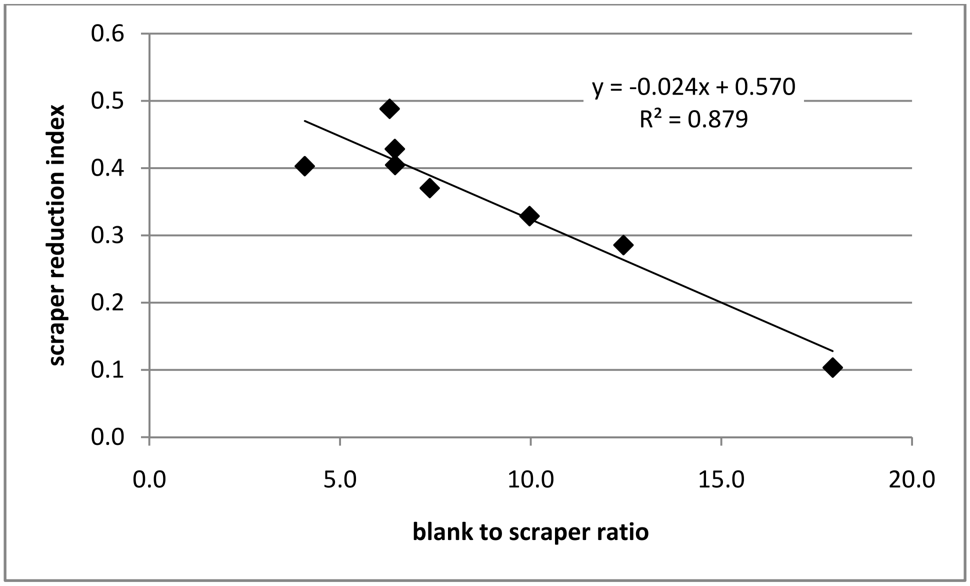

Figure 4.5: Regression between the blank to scraper ratio and the Scraper Reduction Index

What the strong correlation shows is that, as the relative importance of scrapers in an assemblage increases, there will be relatively more heavily reduced types of scrapers (double or transverse scraper types) in that assemblage. This trend fits well with the scraper reduction models of Dibble (1995a and references therein).

As mentioned, the blank to toolcore ratio does not correlate with the blank to scraper ratio or with the flake to tool ratio (not shown). This suggests that the behaviors that cause Neanderthals to manufacture scrapers are independent from those that lead them to manufacture other tools. As shown in the previous chapter, what does seem to account for the presence of other tools might be simply blank manufacture. If this is, indeed, the case, then we would expect the blank to core ratio to correlate with the blank to toolcore ratio as proposed here, since cores and tools are suggested to share essentially the same function. The regression shows that the two are, indeed, correlated (R^2=0.694; df 1,9; p=0.005, Figure 4.6 and Figure 4.7).

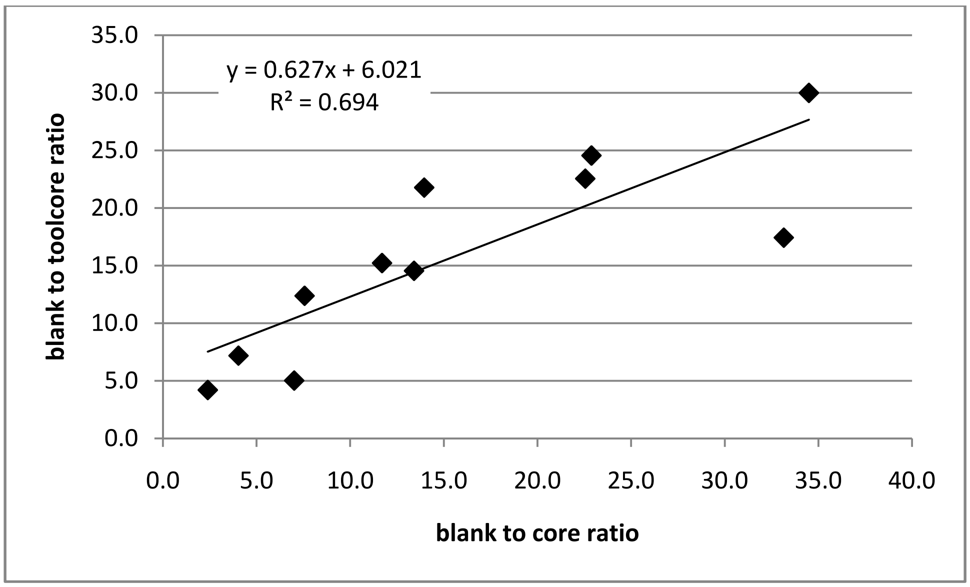

Figure 4.6: Regression between the blank to core and the blank to toolcore ratios

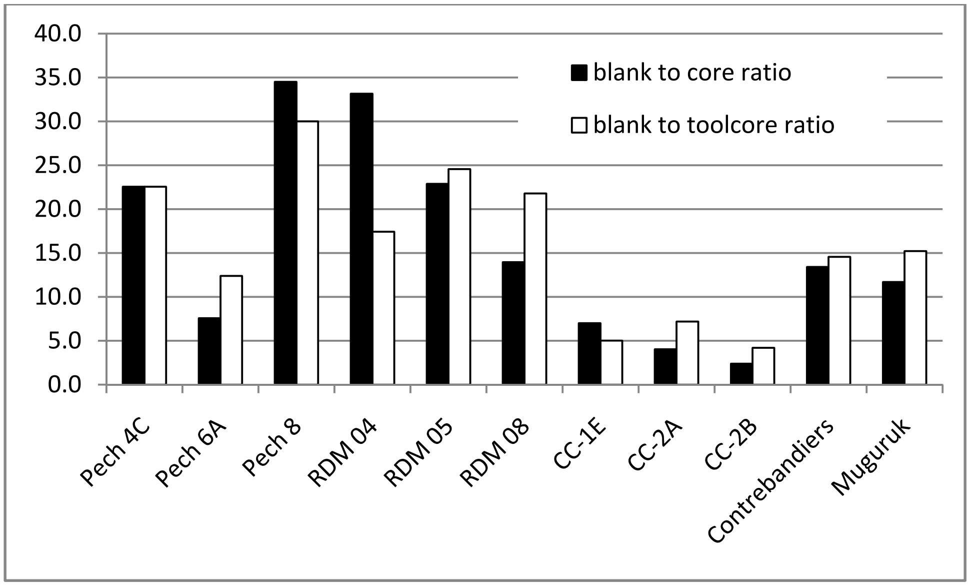

Figure 4.7: Bar charts showing the blank to core and blank to toolcore ratios for all assemblages

The implications of these findings are that, if we are interested in site function, we have to divide arguments into behaviors related to scraper manufacture, on the one hand, and those behaviors that are governing flake manufacture, on the other. Each of these are relevant to site function, but in their own way. When we revisit the arguments made above about the possible site functions for each of the layers, it becomes clear that the two new ratios proposed (blank to scraper and blank to toolcore) help in our interpretation. First, the suggestion that Combe Capelle Bas fits with the Quina technology is clearly shown by the blank to scraper ratio (Figure 4.8). In fact, layer 4C in Pech IV, layers 04 at Roc de Marsal, and the three layers at Combe Capelle Bas all have very comparable blank to scraper ratios. This pattern supports the argument of Dibble and Lenoir (1995) that Combe Capelle Bas is more than simply a raw material extraction site. Scrapers were used or at least discarded at an equal rate as at Pech IV and RDM. That they were not simply discarded at Combe Capelle Bas seems logical, as there is no reason to assume Neanderthals would carry these scrapers to the site if they knew that raw material was available at the site. Thus, while some scrapers may have been brought into the site, others were probably made and used on the spot.

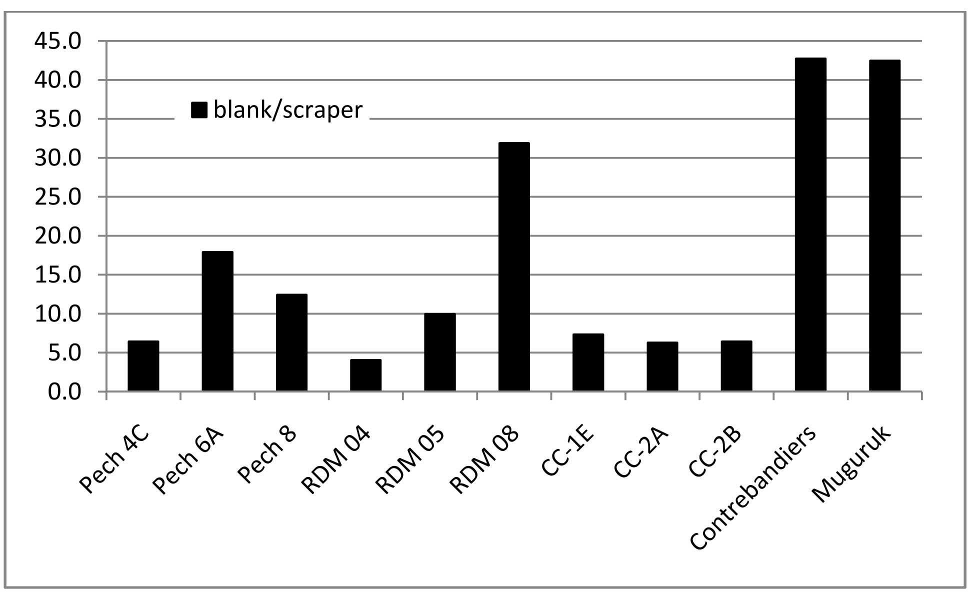

Figure 4.8: Bar chart of the blank to scraper ratios for all assemblages.

Second, when comparing the blank to core and the blank to toolcore ratios between Combe Capelle Bas layers and layer 4C at Pech IV / layer 04 at Roc de Marsal, it is clear that there is a distinct difference between these two sets of layers. Both blank to core and blank to toolcore ratios are high at layer 4C at Pech IV / layer 04 at RDM and low at the Combe Capelle sites. In addition to functioning as a scraper-using site, Combe Capelle Bas also functioned as a blank manufacturing site. In contrast, layer 4C at Pech and layer 04 at Roc de Marsal did not. The best way to interpret the differences between these sites is by invoking blank export from Combe Capelle and blank import at both Pech IV and Roc de Marsal[17].

Does Raw Material Structure Lithic Assemblages?

Archaeologists have argued that raw material is one of the most important, if not *the* most important variable, structuring lithic assemblages (Dibble and Rolland 1992; Rolland and Dibble 1990; Kuhn 1995). One step in evaluating this assertion is considering an exception. Layer 6A at Pech IV has been proposed by Dibble and McPherron (2006) to be such a case. They argue that raw material size and the degree

[17] Note that I am not arguing that the blanks exported from Combe Capelle Bas were actually imported directly into these other two sites. Barring refits, or perhaps demonstrable raw material ties between such sites, it is currently impossible to establish direct links between archaeological assemblages.

to which cores are reduced in layer 6A does not explain the peculiar abundance of techniques for the manufacture of small flakes found in the layer. They conclude that there is some special functional reason for the manufacture of these *small* flakes that overrides the role of raw material availability. They cite several lines of evidence in support of this view. First, the average sizes of flakes and tools are not smaller in this layer than in the others at Pech IV. Second, using blank to core and tool to flake ratios, there is no evidence to suggest that the intensity of the utilization of raw material was significantly higher in layer 6A. Third, many of the small Asinipodian cores “were made on very small knobs of flint struck from larger nodules” (Dibble and McPherron 2006: 781), showing they are not the end result of an extensive sequence of increased core reduction. Finally, Kombewa cores and truncated-faceted pieces retain the overall form of the original flake, indicating that the small flakes detached from them were the intended products.

Small flakes were, indeed, the intended products and more than likely were used, but there is no functionally relevant difference between *small* flakes and *larger* flakes. Layer 6A should be viewed as the continuation of the reduction process and not as some fundamentally different phenomenon aimed at producing a functionally specific and different class of usable flakes. There are a number of reasons for this view.

First, my results showed that flake scars of the small flakes produced in layer 6A – as in all layers studied – form a continuum when graphed in combination with the sizes of complete flakes. Flake scars on cores and on tools fit perfectly well in the tail end of the size distribution of complete flakes. This is the case, despite the fact that current studies artificially cut off that distribution at 2.5cm. Thus, I concur with Dibble and McPherron that we should lower our cutoff to allow the careful study of these smaller flakes themselves.

Second, in addition to the continuation between the distribution of complete flakes and flake scars on cores and tools, there is no evidence to suggest the presence of a bimodal pattern in the flake size distribution itself. Such a pattern would have strongly supported the notion that small flakes are functionally different from larger ones[18].

Third, as discussed above, there are good reasons to reject the utility of the tool to flake ratio and the blank to core ratio as indicating raw material utilization exclusively. Even relatively minor export or import of flakes or cores can have a drastic effect on these ratios. Furthermore, the tool to flake ratio, which combines scrapers and other tools, confounds two fundamentally different elements of lithic assemblage variability, and therefore its use should be discontinued. The blank to core ratio is very low, as low as at

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[18] However, the absence of this bimodality does not constitute proof as it has been well established through experimental work that flake sizes follow a fairly predictable distribution in which there are many small flakes and ever fewer flakes for increasingly larger size classes (Schick 1986, 1997). The trouble we face as archaeologists is to decide which of these flakes were desired and which constitute knapping waste. As far as I am concerned there is no way out of this problem, except to assume that all flakes manufactured were intentional on some level, albeit not functionally equivalent. The search for intended end products in the Middle Paleolithic and earlier is an intellectual dead end.

Combe Capelle Bas, and this fact strongly suggests that blank manufacture was a primary goal in layer 6A[19].

If blank manufacture was a goal in layer 6A, the question is, what was the available raw material from which to make these blanks? Dibble and McPherron (2006) mention very small knobs of flint; there are the cores at the site; and there are the retouched and unretouched flakes. The results of this study as well as the work by Dibble and McPherron show that all of these potential sources of raw material were used.

Unlike Combe Capelle Bas, Pech IV is not situated on a raw material source where large raw material nodules are readily available. In fact, the material that can be found in the area comes in rather small package sizes (Dibble and McPherron 2003). Therefore, Neanderthals had no choice but to further reduce the material present at the site and did so rather effectively using a variety of methods (Dibble and McPherron 2006, 2007; McPherron and Dibble 1999). The material that was initially favored was most likely the cores. Indeed, their small sizes suggest they were reduced quite extensively. The average sizes of cores in layer 6A are smaller than those from layers 4C and 8. Layer 6A is also the one layer in this study where the cores are reduced to the extent that there is no significant difference between the length of cores and complete flakes (consistently

[19] Notice that Dibble and McPherron interpreted the blank to core ratio not in function of blank manufacture, but rather in its standard use as an indicator of the intensity of raw material utilization. The low value of the ratio, again according to standard practice, is interpreted as evidence for a low intensity of reduction in 6A (Dibble and McPherron 2006).

the shortest artifact class). That the small difference that exists is not significant is surprising given the large sample sizes for both cores (n=115) and complete flakes (n=776). Even small knobs of flint were used to make flakes, just as other flakes were used as cores.

In this regard, layer 6A at Pech IV fits well with other sites where the available raw material was small in size and a need for flakes had to be met, such as in layer 08 at Roc de Marsal. According to the results from my study, layer 6A at Pech IV is not the exception that proves the rule, but rather an application of the rule itself. Raw material availability together with major site function (blank production or specialized activity site) are the predominant variables structuring lithic assemblage variability[20].

Comparison Between African and European Assemblages

One of the questions that archaeologists have yet to directly confront are explicit comparisons between assemblages from Europe, which are relatively well-studied, and those from Africa, where research is more sparse. Part of the problem is a framework within which similarities and differences can be integrated. There is a chasm between work being done in Africa and studies on European material. Approaches to lithic analysis are no exception. Vermeersch (2001), for example, attempted a comparison

[20] Other sites not examined here such as Warwasi and Bisitun also might fit as well (Dibble and Holdaway 1990, 1993; Dibble 1984b)

between his material from Egypt and the published data from the Near East. However, his comparison was marred with frustration as the classes into which assemblages are divided do not match one another. The result is not that the material is not comparable, but rather that paradigmatic differences prevent the comparison in the first place.

Paradigmatic differences are not only reflected in different classification of the material proper but also in the kinds of questions asked. As described in chapter 1, European research is still dominated by a desire to subdivide material into archaeological cultures. According to this view, one should not compare the Quina Mousterian with the Mousterian of Acheulian tradition because each of these is thought to represent a different unit, and comparing them would be like comparing apples and oranges. As “culture” becomes pinned to geography, comparison across geographic regions is precluded.

Rather than first categorizing the material into what are thought to be meaningful or “real” units, it may be possible to study fundamental features that exist across units. One example is Dibble’s (1991) comparison of assemblages from the Near East and Europe, which showed similarities between the Yabrudian and the Quina Mousterian, on the one hand, and the Zagros/Taurus and the Ferrassie Mousterian, on the other. Contrary to a more traditional approach (see, e.g., the study by Goren-Inbar et al. 2000 for an example), Dibble does not interpret these similarities in terms of possible affinities between the populations making these assemblages. Rather, he claims the similarities across lithic assemblages are due to raw material availability, blank morphology, and intensity of raw material utilization.

Comparing the assemblages studied here from France with those from Morocco and Kenya reveals some interesting similarities as well as some differences. First, the material from both Europe and Africa is governed by the same structuring mechanisms inherent in reduction techniques. For example, the distribution of flake scars on tools and cores and the distribution of complete flakes are very similar between all assemblages studied. The details of these patterns are, in large part, structured by the size and quality of the available raw material. In areas where raw material is abundant, the distribution of flake sizes tends to cover a broader range from very large to very small artifacts. However, areas with fewer raw material options tend to show more restricted flake size distribution with a strong median.

The average sizes of flakes also tend to clearly indicate the presence or absence of locally available raw material. As Marks and colleagues have argued (Marks et al. 1991 and references therein), the definition of “local” availability of raw material can be quite narrow. As soon as a trip of more than one kilometer is needed to obtain raw material nodules, there are noticeable effects in the sizes of cores and flakes at these sites (Munday 1976). This finding suggests that the traditional distinction between “locally available” (often interpreted as a 20km radius around a site) and “exotic” raw material might need to be adjusted to reflect the strong effect of even short distances on flake, core, and tool sizes.

The French sites of Roc de Marsal and Pech de l'Azé IV are good examples. Although Neanderthals would not have had to travel very far to find such sources, both of these sites are not located directly on a raw material source. The sizes of material at these sites differ dramatically from the lithic assemblages from Combe Capelle Bas or Muguruk, which sit directly on a source of large nodules of high quality raw material (Figure 4.9, Figure 4.10, and Figure 4.11). Contrebandiers Cave represents a slightly different case as the high *diversity* of raw material used at the site stands in stark contrast to all other assemblages studied here. Indeed, all other sites are dominated by one type of raw material (either chert at the French sites or phonolite at Muguruk). At Contrebandiers Cave, as shown in chapter 3, there is a clear preference for chert for the manufacture of blanks or tools. As a result, the sizes of complete tools are markedly smaller than they are at the French sites (see Figure 4.10).

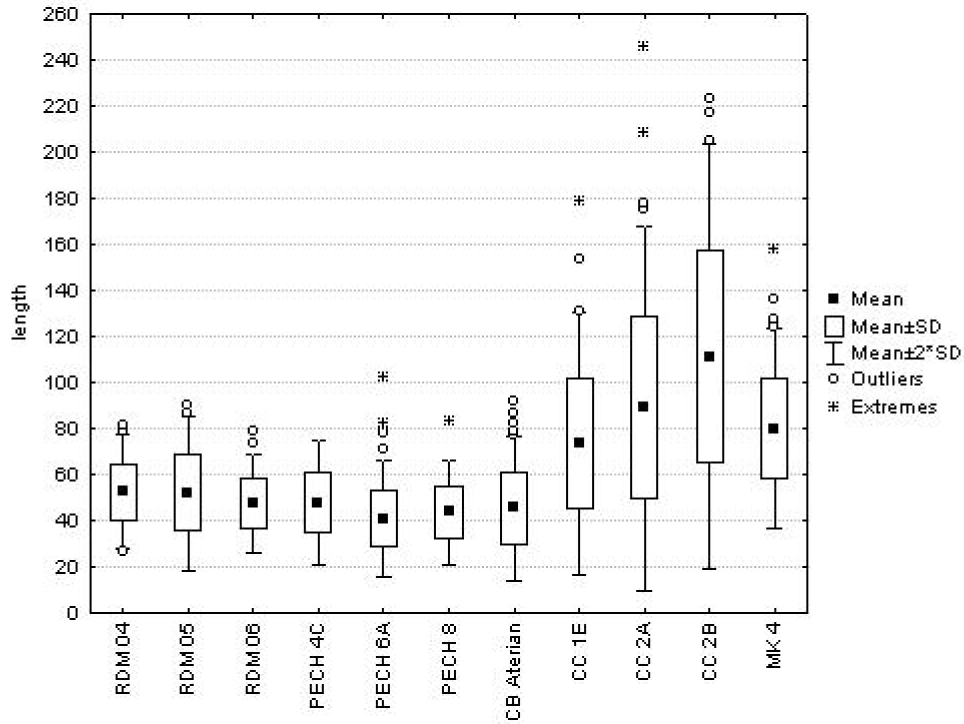

Figure 4.9: Box plots of the lengths of cores in all assemblages.

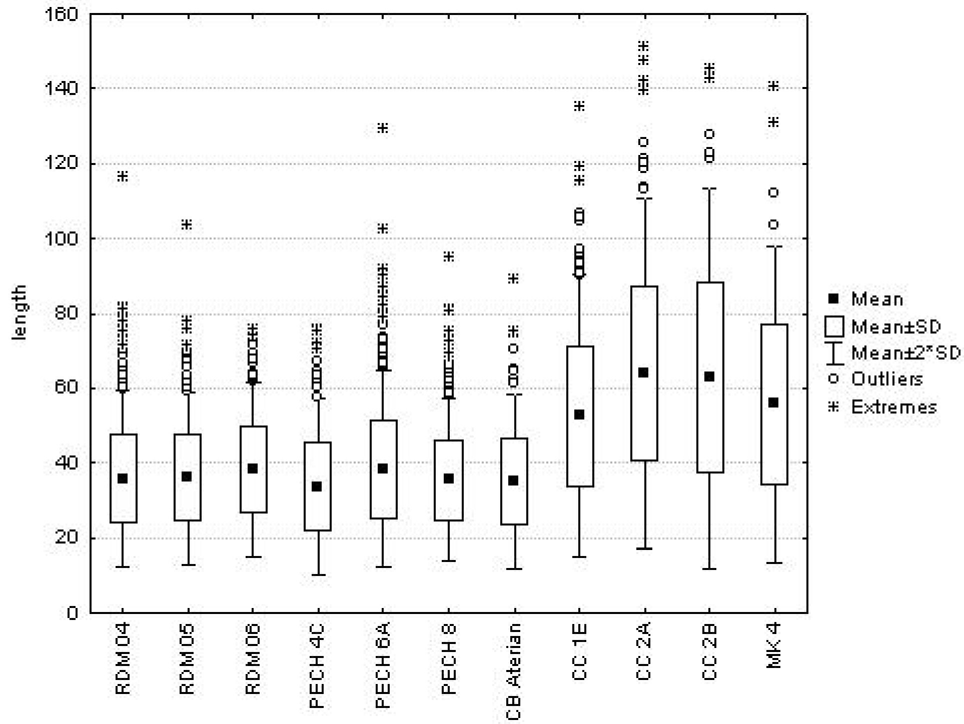

Figure 4.10: Box plots of the lengths of complete flakes in all assemblages

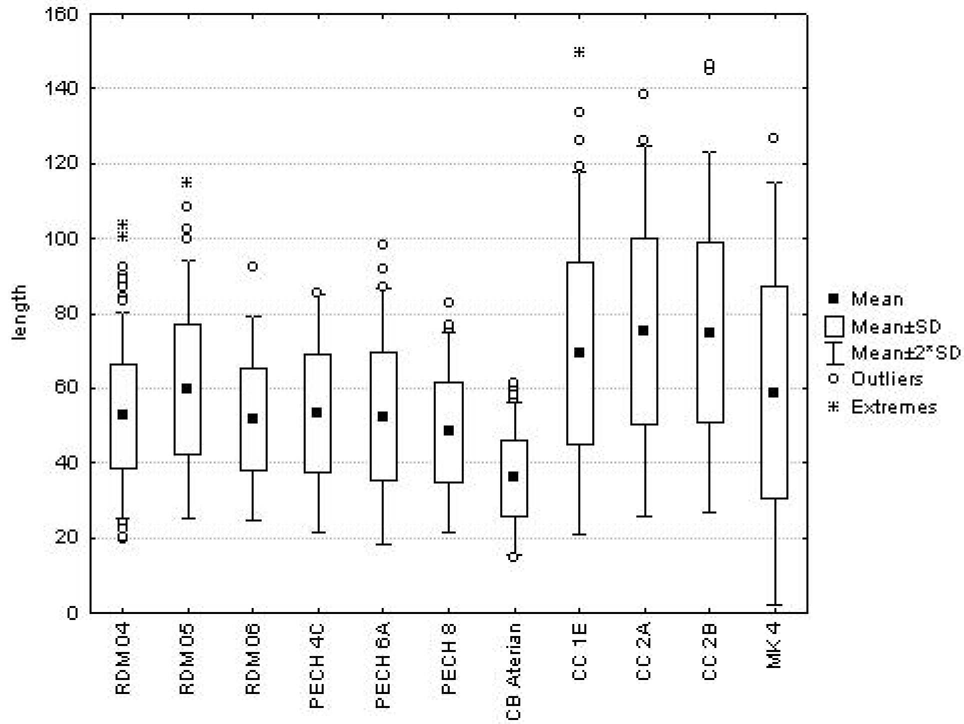

Figure 4.11: Box plots of the lengths of complete tools in all assemblages

Along with comparing flake scars across European and African sites, one can compare the blank to core ratio and the blank to toolcore ratios. Across all sites, the results of this comparison are strikingly consistent (Figure 4.6). This finding suggests that toolcores (tools other than scrapers) function in much the same way at African sites as they do in French sites. In other words, there appears to be no difference in the Middle Paleolithic between how different hominins employed raw material for the manufacture of flakes and the occasional tools.

There are, however, some differences between the French sites and the two African sites. The most prominent difference is the almost complete absence of scrapers in the African assemblages. This difference is not a new finding (see, e.g., McBrearty and Tryon 2006). The average blank to scraper ratio in the French assemblages is 11.4 whereas the average for Muguruk and Contrebandiers Cave is 42.6. Exactly how this difference should be interpreted is unclear. Scrapers may have been used primarily in an activity that was crucial to survival in the more northerly latitudes, such as the processing of animal hides. Thus, along with raw material availability and site function, climate can be investigated as a structuring variable of lithic assemblage variability.

A second rather distinct difference between the African sites and European sites examined here is the very high incidence of shatter in the two African assemblages. While future research may be able to determine if this difference is behaviorally meaningful or simply the result of differences in the fracturing qualities of the raw materials used in the two African sites, the point here is that the comparison of lithic assemblages between Africa and Europe is possible. In other words, lithic studies from one region do not require a framework that separate them from the study of lithic material in other areas[21].

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[21] I suspect the difference is behaviorally meaningful as some preliminary data from the site of Contrebandiers suggests that even in chert there is quite a high percentage of shatter in the assemblage which begs the question as to why that might be. One potential answer might lie in yet a different strategy for the manufacture of small flakes than the ones seen in the Asinipodian. There is some evidence for the use of a bipolar knapping technology at

Tools as Cores: Analytical Use of the Bordian Typology

This study set out to examine the presence and importance of small flakes in Middle Paleolithic assemblages as a means to examine broad lithic assemblage variability. While it is clear that small flakes do, indeed, form an important component of at least some assemblages, it has become equally clear that there is no particular reason to afford these small flakes a special status as a unique desired product. The Asinipodian industry at Pech IV is the logical extension of the reduction process in an environment where raw material was not readily available. To overcome the problem of raw material scarcity at layer 6A in Pech IV, Neanderthals used a number of strategies that they already employed at times in other more raw material rich contexts. These strategies include an increased reliance on truncated-faceted pieces, the manufacture of very small Levallois cores, the reliance on the Kombewa technique to remove flakes from the ventral surface of flakes, Clactonian notches, and others. Some of the technologies Neanderthals used to produce flakes rely on the reduction of other flakes. In doing so, they created what archaeologists have traditionally called 'tools'.

By analyzing some of the technological attributes of the tools and comparing them to similar attributes on cores, I showed that the two often are very similar to one another. However, there is one particular class of tools – scrapers – for which this similarity does

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Contrebandiers Cave. This technology, as evidenced by splintered pieces, becomes much more prevalent in the later Iberomaurusian at the site, but in the Aterian there are some splintered pieces as well. The presence of this technology has been shown at other African MSA sites as well (Villa et al. 2005).

not hold. The similarity between many of the tools and cores leads me to question the functional 'tool' status of many of the types in the Bordian typology. By separating scrapers from other tools in a blank to scraper and blank to toolcore (or non-scraper tool) ratio, I am able to demonstrate that these categories are, indeed, distinct (they do not correlate) and each was shown to correlate with other indices specific to its proposed function. More specifically, the blank to scraper ratio correlates with the Scraper Reduction Index, while the blank to other tool ratio correlates with the blank to core ratio.

These findings have significant implications for our study of lithic assemblage variability and the treatment of the Bordian typology in particular. To place these results in proper context, it is necessary to review concerns that have been previously raised with regard to the Bordian typology. Bisson (2000) points out two major issues, one practical and one theoretical. Practically, Bisson doubts interobserver consistency of typological assignments of Bordian types (Fish 1978, Dibble 1995c, Bisson 2000). For example, distinguishing between convergent scrapers and Mousterian points is notoriously difficult (see Fish 1978, 1979; Debénath and Dibble 1994). Other practical problems relate to the differences between typical and atypical types, and to some of the distinctions between particular scraper types (for example in his study of Biache St. Vaast, Dibble identifies 61 and Tuffreau 32 single convex scrapers [Dibble 1995c]).

Theoretically, Bisson takes issue with what determines morphological variability. According to Bordes himself, morphology was imposed on tools by their makers to fit some type of mental template of the desired tool. This is the industrial view of tool morphology (Barton 1991). Two alternative theories of morphological variability have been suggested, one being that reduction intensity determines scraper morphology (Dibble 1987, 1995a) and the other being that raw material morphology is the key determinant of tool morphology (Kuhn 1995, 1992; Bisson 2000). However, the Bordian typology was not devised to address issues of reduction intensity or raw material package morphology. If those are our analytical goals, then we should incorporate appropriate variables specifically designed with these analytical goals in mind.

In light of these practical and theoretical issues (directly or indirectly), the vast majority of contemporary paleoanthropologists do not limit their work to only recording Bordian types. While it is clear that Neanderthals did not design Bordian tools according to some rigid set of mental templates, the typology has not become useless.

The most important reason for maintaining the use of Bordian types is that it is the only language that is still more or less held in common between researchers. Bisson (2000) attempted to construct an alternative typology, but applications of his attribute-based alternative are, to date, quite rare. It also is important to place these debates surrounding typology into the proper context. It would be a serious mistake to believe that there is no longer any place for classification in Paleolithic research. Without classifications of some sort, research is impossible. There are two main purposes for classification: interpretion and communication (Whittaker et al. 1998). While the Bordian typology may have outlived its interpretive function, it is invaluable as an instrument of communication for Paleolithic researchers.

Nevertheless, the typology is in need of reinterpretation. Many such reinterpretations have already been suggested. For example, it is well-known that types 46-49 (artifacts with abrupt and alternating retouch) primarily reflect edge damage and not intentional retouch. The same argument has been made for notches and denticulates (McBrearty et al. 1998), and it is, indeed, possible that some notches and denticulates in lithic assemblages are the result of natural processes such as trampling.

Results from this research indicate that damage does not seem to be a clear factor structuring the blank to toolcore ratio. There is a slightly positive yet insignificant correlation (R^2=0.091; df 1,9; p=0.366, Figure 4.12) between the percentage of damaged pieces in an assemblage and the blank to toolcore ratio. This constrasts with the pattern expected – an inverse relationship – because, theoretically, one might expect more damaged pieces in assemblages with more toolcores, such as notches and denticulates.

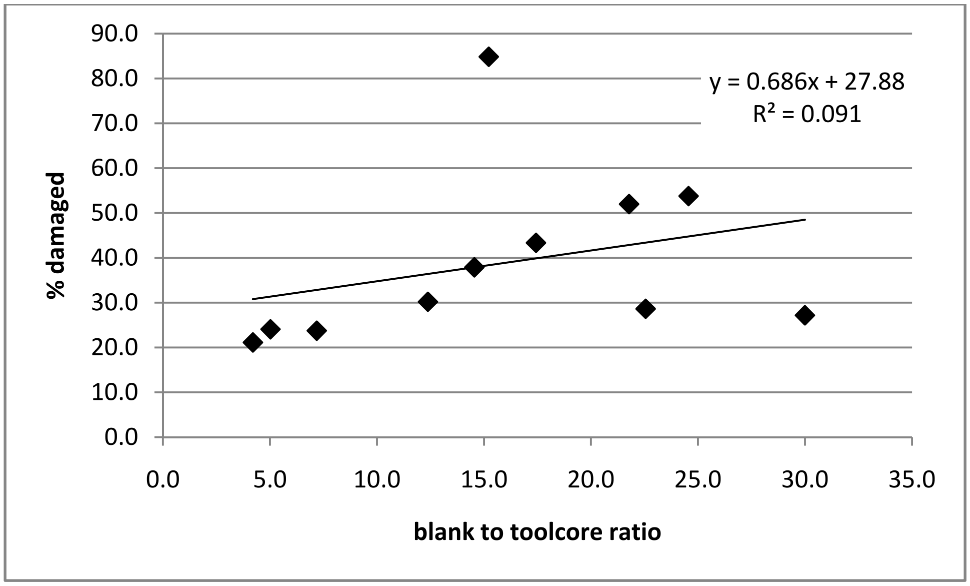

Figure 4.12: Regression between the blank to toolcore ratio and % damaged pieces

Another major reinterpretation of the Bordian typology resulted from Dibble's work on scraper morphology. Dibble (1995a) showed that, with increased utilization, scrapers can morph from one type of scraper into another. In other words, the types as Bordes defined them are not the result of a static mental template in the minds of the Neanderthals, but rather result from the fluid use of the raw materials available and the intensity of scraper resharpening.

Results from Chapter 3 point to an even more radical reinterpretation of Bordes' typology, namely, there are essentially only two classes of tools: scrapers and all other tools. Scrapers vary independently from the blank to core ratio, and must be tied to the regularity with which whatever activity or activities that require scrapers is carried out. All of the other tools, on the other hand, are shown to be largely tied to the production of flakes and, indeed, correlate strongly with the blank to core ratio. This does not mean that every single “tool” exists solely for the production of flakes (as a core in other words). Rather, flake production is frequent enough so that it structures the variability in this class of tools such that the blank to toolcore ratio mirrors the blank to core ratio. It should be clear that this finding does not exclude the possibility that other currently unknown factors play a demonstrable role in shaping the variability of toolcores vis à vis other artifacts in an assemblage.

This reinterpretation of a large portion of the tool classes in the Bordian typology as cores has significant implications for further research. For example, it implies that many of the standard indices employed by Bordes might need to be revisited. One of them is the distinction between essential and non-essential tools, which confounds what seem to be functional tools (scrapers) with what seem to be functionally predominantly cores (non-scrapers). Likewise, as suggested above, the current use of the tool to flake ratio (or the flake to tool ratio as I employed it here) should be abandoned and replaced with two separate ratios: the blank to scraper and the blank to toolcore ratios. The former tracks scraper reduction and provides additional evidence for the scraper reduction models (Dibble 1984a, 1987, 1995a). The blank to toolcore ratio, on the other hand, is an alternative to the blank to core ratio, which, as I argued earlier, does not track the intensity of raw material utilization very well. Instead it seems to be linked in large part with patterns of raw material transport and site function.

Chapter 5 Summary and Conclusions

What started out as a study of a particular set of artifacts – the production of small flakes as evidenced by truncated-faceted pieces, Kombewa cores, and small Levallois cores – turned into a critical examination of the methods and analytical units underlying the study of stone artifacts and a reinterpretation of lithic assemblage variability in the Middle Paleolithic. Following the current trend in North American Paleolithic research, I view stone tool types not as mental templates reflecting stylistic preferences of particular Neanderthal groups, but rather as fluid categories which can morph from one formal tool category into another during the reduction process. Theoretically, this dissertation builds on scholarship that views the composition of Middle Paleolithic lithic assemblages as structured by a number of fundamental variables, including the availability and package size of raw materials, the intensity of artifact utilization, site function, and the environmental conditions at the time assemblages were made, used, and subsequently abandoned. In addition the dissertation draws upon ethnographic evidence of stone artifact use. The literature shows that there is ample evidence that modern hunter-gatherer and other populations who employ lithic technologies made use of both formally retouched and unretouched tools. The broad goals of the dissertation were to study assemblages as a whole, both the retouched and unretouched components, and to suspend assumptions regarding which artifacts are end-products or desired over others; the difference cannot be discerned. Furthermore, the approach was to be applicable regardless of assemblage variability and geographical region.

The particular problem tackled here, small flake production, extends research conducted by Dibble and McPherron (2006, 2007). These authors have shown that small flake production is an as yet unrecognized component of Middle Paleolithic assemblages, and have argued that a number of techniques contribute to producing such small flakes in the Asinipodian layer at Pech IV. At least one of these techniques involves what had traditionally been considered a “tool,” truncated-faceted pieces, but the authors were able to show that these artifacts should be interpreted as cores (Dibble and McPherron 2007). They further suggested that other types in the Bordian typology might also need to be reinterpreted as cores. This dissertation set out specifically to examine these particular suggestions.

The study examined lithic assemblages from five sites: Three in France, Pech de l’Azé IV, Roc de Marsal, and Combe Capelle Bas, and two in Africa, Contrebandiers Cave and Muguruk. Each of these sites and the specific layers studied from them were discussed in chapter 2. Two of the sites are directly located on a raw material source (Combe Capelle Bas and Muguruk), whereas the other three are located in areas where good quality raw material is a little bit harder to come by. In the case of Contrebandiers Cave, good quality chert is probably farthest removed from the site itself, whereas in France good quality raw material, while not available at two of the sites themselves, can be found relatively close by. However, as discussed, even very small distances between a site and the source of raw material can have a significant impact on the assemblage composition.

The cores, tools, and a sample of the unretouched material from each of the sites were examined. In particular, the technological characteristics of flake scars on retouched tools and cores were recorded in detail. Other observations included edge damage, the measurement of the percentage of cortex on artifacts, the technology, the Bordian type number, and a number of metrical attributes such as length, width, thickness, and weight.

For each layer, the lithic assemblage was described, with particular attention paid to the role of tools and cores. Specifically, I compared flake scar attributes, such as scar location and scar surface, scar platform type, flake scar technology, and scar length and width. The examination of the data showed that the attributes of flake scars are comparable to similar attributes on complete flakes from the same site. However, on average, the flake scars were smaller than the actual sizes of complete flakes. This is not unexpected as complete flakes are the result of the entire reduction sequence, whereas flake scars represent the tail end of reduction. When the distribution of flakes is compared with those of flake scars on cores and tools, it is clear that the flake scars form a continuation of the complete flake distribution. Furthermore, the distribution of complete flakes and flake scars seems continuous and not bimodal as might be expected at those sites where there is strong evidence for small flake production, such as layer 6A at Pech IV. This observation suggests that small flake production is not fundamentally different from larger flake production, but rather part of the same desire to produce usable blanks.

In many instances, the direct comparison of flake scar attributes on cores and tools indicated strong similarities between flake scars on cores and those on tools. When compared to flake scars on scrapers, however, a distinct difference was noted. These data suggest that retouched tools other than scrapers (in the Bordian typology) are perhaps better viewed as cores rather than tools. This view is strongly supported by the statistically significant correlation between the blank to toolcore ratio and the blank to core ratio from each of the assemblages studied.

A second finding of this study is that blank to core and blank to toolcore ratios are not very good indicators of the intensity of raw material utilization at a site. The blank to core ratios are perhaps better indicators of site function. Sites where blank production seems to be an important site function tend to have low blank to core ratios, whereas sites where more specialized activities are taking place tend to have high blank to core ratios. At these latter sites, such as layer 4C at Pech IV and layers 04 and 05 at Roc de Marsal, the high blank to core value is not due to intensive raw material reduction, but instead may reflect the transport of flakes across the landscape. Whenever blank production was a major function of a site, the blank to core ratio tends to be low, as is the case in the three layers at Combe Capelle Bas, Muguruk, layer 08 at Roc de Marsal, and layer 6A at Pech IV. The low ratio seems to be due to the ubiquity of cores at these sites, and perhaps also the preferential transport of blanks from these sites.

This study further suggests that the tool to flake ratio (or flake to tool ratio as I used it) is not a good measure of either reduction intensity or functional tool use. I proposed two other ratios — blank to scraper and blank to toolcore — to replace it, and showed correlations for each of these ratios with other measures. The blank to toolcore ratio correlates with the blank to core ratio. The blank to scraper ratio correlates with the Scraper Reduction Index, and supports the already strong evidence for scraper reduction — when assemblages contain more scrapers, relatively more double, convergent, and transverse scrapers will be represented among the scrapers. Unfortunately, we are currently lacking an equally good measure of reduction intensity for the assemblage as a whole. This is because blank reduction and scraper reduction are not correlated, and so should be understood as structured by functionally separate phenomena.

A fourth contribution of the study is the result of the comparison of material from African Middle Stone Age sites with French Middle Paleolithic sites. This comparison shows that the fundamental factors structuring lithic assemblages in this time period are similar to one another. However, there also are some differences between the African assemblages and those from Europe. Specifically, the importance of scrapers is quite distinct. The European sites tend to have many more scrapers than the African ones, and this difference may be due to latitude dependent climatic factors. The African assemblages also are characterized by larger percentages of shatter.

Finally, the research has implications for our understanding of the Bordian typology and assemblage variability more generally. A reinterpretation of the Bordian typology is necessary. Some of the indices proposed by Bordes, in particular the distinction between 'essential' and 'real' types, should be discontinued. As is well known, some of the real types such as types 46-49 are predominantly the result of damage, and incorporating them in an index with items such as scrapers and notches seems inappropriate for answering any particular research question. Furthermore, essential types mix what seem to be two distinct sets: scrapers and all other tools.

In addition to implications for specific indices, this research also has implications for traditional divisions of assemblage variability into groups of industries. By using the blank to scraper index to examine the incidence of scrapers in assemblages, I was able to show that the assemblages from Combe Capelle Bas fit perfectly into the Quina Mousterian. While this resemblance had been shown technologically (Dibble and Lenoir 1995), it is now possible to demonstrate it based on the typology. However, rather than measure the relative importance of scrapers against other tools, I measured it against the totality of blanks at the site. This approach avoids paying undue attention to what is typically the largest class of other tools — notches and denticulates. This reinterpretation also has implications for our understanding of the Denticulate Mousterian as a separate facies. Rather than track a style of tool manufacture as Bordes suggested, or a functionally specific type of site, I am suggesting that this particular facies might be tracking sites where flake production is the major site goal.

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Index