The origin and development of the Pleistocene LSA in Northwest Africa: A case study from Grotte des Pigeons (Taforalt), Morocco

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Abstract

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This thesis examines variation within the microlith industries of the Later Stone Age (LSA) of Northwest Africa, around the time of the Last Glacial Maximum (LGM) until the onset of the Holocene, between ~25 - 11.5 ka. The traditionally held view is that whilst there is variation amongst the lithic assemblages, this can all be accommodated by a single definable industry, known as the Iberomaurusian. This thesis indicates an alternative scenario.

Based on the typo-technological analysis of 16,689 lithic artefacts recovered from recent excavations at the site of Grotte des Pigeons (Taforalt, Morocco) and the re-analysis of published data using the multivariate statistical approach of correspondence analysis (CA), this thesis shows that there was much greater variation than previously proposed within the Pleistocene LSA.

This thesis indicates that the LSA industries can be sub-divided into four chronologically distinct variants, an Initial LSA time-coincident with the first appearance of microlithic technology from ~25 ka and lasting up until Heinrich event 2, a succeeding Early LSA at ~22 ka that continued until Heinrich event 1, a Middle LSA marking a shift in technologies around this event at ~16 ka, and an Upper LSA occurring with the climatic amelioration of the Bølling-Allørod at ~14.5 ka.

The proposed chronological model provides a new framework for categorising variation within the LSA, which is a necessary pre-requisite for potential future research addressing wider anthropological and archaeological issues, such as reasons for shifts in subsistence and settlement.

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Table of Contents

Abstract ii

Acknowledgments iii

Table of Contents ix

List of Tables vii

List of Figures x

Chapter 1. Introduction 1
- **1.1. Rationale** 1
- **1.2. Objectives** 2
- **1.3. Thesis Structure** 3

Chapter 2. Background to the Study of the Pleistocene LSA of Northwest Africa 6
- **2.1. Nomenclature** 6
- **2.2. Radiocarbon Evidence of the Pleistocene LSA** 7
- **2.3. Origins of the Pleistocene LSA** 11
- **2.4. The Lithic Industries of the Pleistocene LSA of Northwest Africa** 13
  - 2.4.1. The Iberomaurusian 13
  - 2.4.2. Southern Tunisian bladelet industries 20
- **2.5. Human Remains & Symbolic Culture** 22
- **2.6. Subsistence Practices** 25
- **2.7. Geographical and Environmental Setting** 29

Chapter 3. Theoretical Considerations for the Study of Microliths 34
- **3.1. Definitions** 34
- **3.2. Uses** 35
- **3.3. Variation** 37
- **3.4. Methodologies** 43
  - 3.4.1. Typological Classification 43
  - 3.4.2. Sequential Approaches 47

Chapter 4. Grotte des Pigeons, Taforalt (Morocco): Background 50
- **4.1. Location** 50
- **4.2. History of Research** 52
- **4.3. The Role of Past Research** 57
- **4.4. Recent Excavations 2003-2010** 58
  - 4.4.1. Sector 3 60
  - 4.4.2. Sector 8 61
  - 4.4.3. Sector 9 68
  - 4.4.4. Sector 10 69

Chapter 5. Grotte des Pigeons, Taforalt (Morocco): Methodological Procedures 70
- **5.1. Laboratory Procedures** 70
- **5.2. Classification Methods** 71
  - 5.2.1. Cores 71
  - 5.2.2. Debitage 73
  - 5.2.3. Microburins & Related Products 74
  - 5.2.4. Retouched Tools 75
- **5.3. Attribute Analysis** 84

5.4. Statistical Analysis **85**

Chapter 6. Grotte des Pigeons, Taforalt (Morocco): Description of Lithic Assemblages **87**
6.1. Sector 3 ..... **87**
6.1.1. 0-28 cm 87
6.1.2. 28-44 cm 93
6.2. Sector 8 ..... **95**
6.2.1. L2-9 95
6.2.2. L10-14 106
6.2.3. L15-27 113
6.2.4. L28-29 123
6.2.5. Y1 132
6.2.6. Y2 sp1 142
6.2.7. Y2 sp2-5 148
6.2.8. Y3-4 154
6.3. Sector 9 ..... **159**
6.3.1. Layer 1 160
6.3.2. Layer 2 165
6.3.3. Layer 3 168
6.4. Sector 10 ..... **172**

Chapter 7. Grotte des Pigeons, Taforalt (Morocco): Statistical Analysis of Cultural Phases **189**
7.1. Overview of Cultural Phases **189**
7.2. Raw Material **192**
7.3. Cores **194**
7.4. Debitage **199**
7.4.1. Flakes 199
7.4.2. Blades 209
7.4.3. Core-trimming elements 218
7.5. Microburins & Related Products **220**
7.6. Retouched Tools **222**
7.6.1. Typological classification 223
7.6.2. Attribute analysis 229
7.7. Summary **239**

Chapter 8. Correspondence Analysis & Inter-site Assemblage Variation **241**
8.1. Method **241**
8.2. Data **243**
8.3. Brief Description of Sites **247**
8.3.1. Afalou Bou Rhummel 248
8.3.2. Columnata 250
8.3.3. El Haouita terrasse 251
8.3.4. El Onçor 251
8.3.5. Es Sayar 252
8.3.6. Ifri el Baroud 252
8.3.4. Rassel 253
8.3.5. Rolland 254
8.3.6. Tamar Hat 254
8.4. Results of CA **261**
8.5. Summary **270**

Chapter 9. Discussion **271**
9.1. A Revised Nomenclature **271**
9.2. Initial Maghreb LSA **273**
9.3. Early Maghreb LSA **274**
9.4. Middle Maghreb LSA **279**
9.5. Upper Maghreb LSA **283**
Chapter 10. Conclusions & Future Directions **290**
Bibliography **295**
Appendix I. Radiocarbon Determinations **315**
Appendix II. Classification Procedures **323**

List of Tables

Chapter 2. Background to the Study of the Pleistocene LSA of Northwest Africa

Table 2.1. Nomenclature for the Stone Age of Northwest Africa....6
Table 2.2. List summarising radiocarbon determinations published for the Pleistocene LSA 8

Chapter 4. Grotte des Pigeons, Taforalt (Morocco): Background

Table 4.1. Radiocarbon determinations from 1951-1955 excavations....55
Table 4.2. Radiocarbon determinations from 1969-1972 excavations....56
Table 4.3. Sector 3: Radiocarbon determinations associated with LSA 61
Table 4.4. Sector 8: Description of stratigraphic profile....64
Table 4.5. Sector 8: Radiocarbon determinations associated with the LSA 66
Table 4.6. Sector 9: Radiocarbon determinations associated with the LSA 70
Table 4.7. Sector 10: Radiocarbon determinations associated with the LSA 70

Chapter 6. Grotte des Pigeons, Taforalt (Morocco): Description of Lithic Assemblages

Table 6.1. Sector 3, 0-28 cm: Number of artefacts in each class by deposit 88
Table 6.2. Sector 3, 0-28 cm: Absolute and relative frequencies of tool types....91
Table 6.3. Sector 3, 28-44 cm: Number of artefacts in each class by group and deposit 93
Table 6.4. Sector 3, 28-44 cm: Absolute and relative frequencies of tool types....95
Table 6.5. Sector 8, L2-9: Number of artefacts in each class by deposit....96
Table 6.6. Sector 8, L2-9: Absolute and relative frequencies of tool types 102
Table 6.7. Sector 8, L10-14: Number of artefacts in each class by deposit....106
Table 6.8. Sector 8, L11-14: Absolute and relative frequencies of tool types 110
Table 6.9. Sector 8, L15-27: Number of artefacts in each class by deposit....113
Table 6.10. Sector 8, L15-27: Absolute and relative frequencies of tool types 118
Table 6.11. Sector 8, L28-29: Number of artefacts in each class by deposit....123
Table 6.12. Sector 8, L28-29: Absolute and relative frequencies of tool types 129
Table 6.13. Sector 8, Y1: Number of artefacts in each class by deposit....132
Table 6.14. Sector 8, Y1: Absolute and relative frequencies of tool types 137
Table 6.15. Sector 8, Y2 sp1: Number of artefacts in each class by deposit 142
Table 6.16. Sector 8, Y2 sp1: Absolute and relative frequencies of tool types 146
Table 6.17. Sector 8, Y2 sp2-5: Number of artefacts in each class by deposit....148
Table 6.18. Sector 8, Y2 sp2-5: Absolute and relative frequencies of tool types 152
Table 6.19. Sector 8, Y3-4: Number of artefacts in each class by deposit 154
Table 6.20. Sector 8, Y3-4: Absolute and relative frequencies of tool types....157
Table 6.21. Sector 9, Layer 1: Absolute and relative frequencies of artefacts....159
Table 6.22. Sector 9, Layer 1: Absolute and relative frequencies of tool types 163
Table 6.23. Sector 9, Layer 2: Absolute and relative frequencies of artefacts....165
Table 6.24. Sector 9, Layer 2: Absolute and relative frequencies of tool types 167
Table 6.25. Sector 9, Layer 3: Absolute and relative frequencies of artefacts....168
Table 6.26. Sector 9, Layer 3: Absolute and relative frequencies of tool types 170
Table 6.27. Sector 10: Number of artefacts in each class by excavation season 172
Table 6.28. Sector 10: Absolute and relative frequencies of tool types....180

Chapter 7. Statistical Analysis of Cultural Phases

Table 7.1. Absolute and relative frequencies of artefacts according to phase 191
Table 7.2. Absolute and relative frequencies of raw materials according to phase 194
Table 7.3. Absolute and relative frequencies of the colour of cores by phase....195

Table 7.4. Absolute and relative frequencies of cores according to phase 196
Table 7.5. Absolute and relative frequencies of scars on cores according to phase 197
Table 7.6. Absolute and relative frequencies of cortex on cores by phase 197
Table 7.8. Absolute and relative frequencies of abrasion on cores by phase.....198
Table 7.9. Dimensions on cores by phase 198
Table 7.10. Absolute and relative frequencies of raw materials on flakes by phase.....200
Table 7.11. Absolute and relative frequencies of colours on chert flakes by phase 201
Table 7.12. Absolute and relative frequencies of cortex on chert flakes by phase 202
Table 7.13. Absolute and relative frequencies of butt types on chert flakes by phase 203
Table 7.14. Absolute and relative frequencies of abrasion on chert flakes by phase.....204
Table 7.15. Absolute and relative frequencies of dorsal scar patterns on chert flakes by phase 204
Table 7.16. Absolute and relative frequencies of terminations on chert flakes by phase 205
Table 7.17. Dimensions on chert flakes 207
Table 7.18. Absolute and relative frequencies of the colour of blades by phase 210
Table 7.19. Absolute and relative frequencies of cortex on blades by phase 211
Table 7.20. Absolute and relative frequencies of butt types on blades by phase.....212
Table 7.21. Absolute and relative frequencies of abrasion on blades by phase 213
Table 7.22. Absolute and relative frequencies of dorsal scar patterns on blades by phase.....214
Table 7.23. Absolute and relative frequencies of terminations on blades by phase 215
Table 7.24. Dimensions on blades by phase 216
Table 7.25. Absolute and relative frequencies of retouched tool classes by phase.....222
Table 7.26. Absolute and relative frequencies of microliths by phase 224
Table 7.27. Absolute and relative frequencies of the colour of microliths by phase 230
Table 7.28. Absolute and relative frequencies of retouch lateralisation on microliths by phase 231
Table 7.29. Absolute and relative frequencies of retouch distribution on microliths by phase ..232
Table 7.30. Absolute and relative frequencies of retouch direction on microliths by phase 233
Table 7.31. Absolute and relative frequencies of points on microliths by phase.....234
Table 7.32. Absolute and relative frequencies of the position of single points on microliths by phase 235
Table 7.33. Absolute and relative frequencies of the retention of the butt on microliths by phase 235
Table 7.34. Absolute and relative frequencies of basal truncations on microliths by phase 236
Table 7.35. Dimensions on microliths by phase 237

Chapter 8. Correspondence Analysis & Inter-site Assemblage Variation

Table 8.1. Pleistocene LSA assemblages from the Maghreb in the study sample 245
Table 8.2. Frequency of microliths from assemblages in the study sample.....245
Table 8.3. Relative frequency of retouched tools from assemblages in the study sample.....246
Table 8.4. Published radiocarbon determinations from Afalou Bou Rhummel.....250
Table 8.5. Published radiocarbon determinations from Ifri el-Baroud 253
Table 8.6. Description of the stratigraphy from 1928-1930 excavations at Tamar Hat.....256
Table 8.7. Description of the stratigraphy from 1973 excavations at Tamar Hat 257
Table 8.8. Traditional C^{14} radiocarbon determinations from Tamar Hat.....260
Table 8.9. AMS radiocarbon determinations from Tamar Hat 260
Table 8.10 Inertia accounted for by the CA dimensions.....261
Table 8.11. Contribution of the columns (i.e. microlith types) to the definition of the dimensions relevant to interpretation.....262
Table 8.12. Pleistocene LSA assemblages arranged chronologically within identified CA groups 264

Table 8.13. Quality of display of row points (i.e. assemblages) on the planes defined by pairs of dimensions. 269

Chapter 9. Discussion

Table 9.1. Chronological framework of variation within the Maghreb LSA of NW Africa 273

Appendix I. Radiocarbon Determinations

Table I.1. Published radiocarbon determinations for the Pleistocene LSA of NW Africa 315

Appendix II. Classification Procedures

Table II.1. List of types for the LSA of NW Africa.....323

Table II.2. List of variables recorded on recorded tools at Grotte des Pigeons (Taforalt).....324

Table II.3. List of variables recorded on cores at Grotte des Pigeons (Taforalt) 325

Table II.4. List of variables recorded on debitage at Grotte des Pigeons (Taforalt).....326

List of Figures

Chapter 2. Background to the Study of the Pleistocene LSA of Northwest Africa

Figure 2.1. Map of sites with radiocarbon determinations published for the Pleistocene LSA. 9
Figure 2.2. Lithic artefacts from the Iberomaurusian 16
Figure 2.3. Core reduction strategies of the Iberomaurusian 20
Figure 2.4. Ceramic figurines from Afalou Bou Rhummel 25
Figure 2.5. Reconstruction of sea-surface temperatures for the last 50,000 years in core MD 95-2043 from the Alboran Sea, Mediterranean 30
Figure 2.6. Map showing coastal areas during the Last Glacial Maximum 31

Chapter 3. Theoretical Considerations for the Study of Microliths

Figure 3.1. Hafted composite tools set with microliths 36
Figure 3.2. Hypothesised manufacturing trajectory of microlith types 45

Chapter 4. Grotte des Pigeons, Taforalt (Morocco): Background

Figure 4.1. Site information 51
Figure 4.2. Plan of 1951-1955 excavations 55
Figure 4.3. Plan of 1969-1971 excavations 56
Figure 4.4. Plan of 2003-2010 excavations 60
Figure 4.5. Sector 3: Schematic representation of stratigraphic profile 61
Figure 4.6. Sector 8: Schematic representation of stratigraphic profile 65
Figure 4.7. AMS dates for Sectors 3, 8, 9, and 10 in relation to ice core data 67
Figure 4.8. Sector 9: Schematic representation of stratigraphic profile 68
Figure 4.9. Sector 10: Human burials 70

Chapter 5. Grotte des Pigeons, Taforalt (Morocco): Methodological Procedures

Figure 5.1. Lithic artefacts designated perforators by J. Tixier (1963) 77
Figure 5.2. Size distribution of unbroken microliths from Sectors 3, 8, 9, and 10 78
Figure 5.3. Lithic artefacts designated backed bladelets *sensu lato* and segments by J. Tixier (1963) 80
Figure 5.4. Lithic artefacts designated obtuse ended backed bladelets, scalene bladelets, and bladelets with Ouchtata retouch by J. Tixier (1963) 83

Chapter 6. Grotte des Pigeons, Taforalt (Morocco): Description of Lithic Assemblages

Figure 6.1. Sector 8, L2-9: Cores 98
Figure 6.2. Sector 8, L2-9: Retouched Tools 105
Figure 6.3. Sector 8, L10-14: Cores 107
Figure 6.3. Sector 8, L10-14: Retouched Tools 113
Figure 6.5. Sector 8, L15-27: Cores 115
Figure 6.6. Sector 8, L15-27: Retouched Tools - Part A 121
Figure 6.7. Sector 8, L15-27: Retouched Tools - Part B 123
Figure 6.8. Sector 8, L28-29: Cores 125
Figure 6.9. Sector 8, L28-29: Tested core with ochre on the surface 126
Figure 6.10. Sector 8, L28-29: Retouched Tools 132
Figure 6.11. Sector 8, Y1: Cores 134
Figure 6.12. Sector 8, Y1: Retouched Tools - Part A 141
Figure 6.13. Sector 8, Y1: Retouched Tools - Part B 141
Figure 6.14. Sector 8, Y2 sp1: Cores 143
Figure 6.15. Sector 8, Y2 sp1: Retouched Tools 147

Figure 6.16. Sector 8, Y2 sp2-5: Cores 149
Figure 6.17. Sector 8, Y2 sp2-5: Retouched tools 153
Figure 6.18. Sector 8, Y3-4: Cores 155
Figure 6.19. Sector 8, Y3-4: Retouched tools 159
Figure 6.20. Sector 9, Layer 1: Retouched tools 164
Figure 6.21. Sector 9, Layer 2: Retouched tools 168
Figure 6.22. Sector 9, Layer 3: Retouched tools 172
Figure 6.23. Sector 10: Cores 174
Figure 6.24. Sector 10: Splintered pieces 176
Figure 6.25. Sector 10: End-scrapers, Perforators, Backed Blades & Flakes 183
Figure 6.26. Sector 10: Microliths 186
Figure 6.27. Sector 10: Notches & Denticulates, Truncations, and Miscellaneous 187

Chapter 7. Grotte des Pigeons, Taforalt (Morocco): Statistical Analysis of Cultural Phases

Figure 7.1. Relative frequencies of diagnostic artefacts by phase 191
Figure 7.2. Relative frequencies of the raw materials on flakes by phase 200
Figure 7.3. Relative frequencies of colours on chert flakes by phase 201
Figure 7.4. Relative frequencies of cortex on chert flakes by phase 202
Figure 7.5. Relative frequencies of butt types chert flakes by phase 203
Figure 7.6. Relative frequencies of abrasion on chert flakes by phase 204
Figure 7.7. Relative frequencies of dorsal scar patterns on chert flakes by phase 205
Figure 7.8. Relative frequencies of terminations on chert flakes by phase 206
Figure 7.9. Boxplot showing length of chert flakes by phase 207
Figure 7.10. Boxplot showing width of chert flakes by phase 208
Figure 7.11. Boxplot showing thickness of chert flakes by phase 208
Figure 7.12. Relative frequencies of colour of blades by phase 210
Figure 7.13. Relative frequencies of cortex on blades by phase 211
Figure 7.14. Relative frequencies of butt types on blades by phase 212
Figure 7.15. Relative frequencies of abrasion on blades by phase 213
Figure 7.16. Relative frequencies of dorsal scar patterns on blades by phase 214
Figure 7.17. Relative frequencies of terminations on blades by phase 215
Figure 7.18. Boxplot showing length of blades by phase 216
Figure 7.19. Boxplot showing width of blades by phase 217
Figure 7.20. Boxplot showing thickness of blades by phase 217
Figure 7.21. Relative frequencies of colour of microliths by phase (excluding indeterminate) 221
Figure 7.22. Relative frequencies of retouch lateralisation on microliths by phase 222
Figure 7.23. Relative frequencies of retouch distribution on microliths by phase 223
Figure 7.24. Relative frequencies of retouch direction on microliths by phase 224
Figure 7.25. Relative frequencies of the position of single points on microliths by phase 225
Figure 7.26. Relative frequencies of the retention of the butt on microliths by phase 226
Figure 7.27. Boxplot showing length of microliths by phase 238
Figure 7.28. Boxplot showing width of microliths by phase 238
Figure 7.29. Boxplot showing thickness of microliths by phase 239

Chapter 8. Correspondence Analysis & Inter-site Assemblage Variation

Figure 8.1. Pleistocene LSA Sites with published retouched tool data 244
Figure 8.2. Plan of excavations at Tamar Hat 256
Figure 8.3. Section of the 1973 excavations at Tamar Hat showing radiocarbon determinations 258
Figure 8.4. Symmetric CA map of sample data showing microlith types on the plane defined by the first and second dimension. 263

Figure 8.5. Symmetric CA map of sample data showing assemblages on the plane defined by the first and second dimension. 266
Figure 8.6. Symmetric CA map of sample data showing microlith types on the plane defined by the first and third dimension. 268
Figure 8.7. Symmetric CA map of sample data showing assemblages on the plane defined by the first and third dimension. 270

Appendix II. Classification Procedures

Figure II.1. Schematic representation of type for the LSA of Northwest Africa 323

Chapter 1

Introduction

1.1 Rationale

The aim of this thesis is to provide a re-evaluation of variation in the Pleistocene Later Stone Age (LSA) industries of Northwest Africa. Such a study in this area is long overdue and is a necessary prerequisite for addressing wider anthropological and archaeological issues such as reasons for shifts in subsistence and settlement practice, and changes in material culture. Until now there has been little advance of our understanding of variation within the Pleistocene LSA, which has largely been considered synonymous with a single industry, known as the Iberomaurusian (N.Barton and Bouzouggar, 2013; Bouzouggar et al., 2008; Camps, 1974; Linstädter et al., 2012; Lubell, 2001; Lubell et al., 1984; Sari, 2014, 2012). In contrast, elsewhere in the Mediterranean Basin the archaeological records at the time have much richer detail and characteristically include a wider variety of industries that reflect considerable changes in human behaviours. For instance, in the Levant there are five widely recognised socio-cultural entities for the Late Pleistocene, with numerous chronological and geographical variants (Bar-Yosef and Belfer-Cohen, 2010; Boyd, 2010), and in Egypt the situation is much the same (Schild and Wendorf, 2010). One of the issues therefore is why should the Northwest African LSA differ so radically from these models?

In part the apparent lack of variability is due to the scarcity of modern research in the Northwest Africa. There are few assemblages with radiocarbon determinations and this has inhibited past efforts to reconstruct a history of the Pleistocene LSA of Northwest Africa (Balout, 1955; Camps, 1974; Lubell et al., 1984; Nehren, 1992; Vaufrey, 1955). Whilst new dating efforts have provided greater chronological resolution, this work is largely restricted to Morocco (N.Barton et al., 2013, 2007, 2005; Bouzouggar et al., 2008; Linstädter et al., 2012; Moser, 2003; Nami, 2007). In Algeria the on-going political situation means that little modern fieldwork has been undertaken, whilst new work is still in its early stages and not much has yet been published from Tunisia (pers. comm. N. Barton).

Furthermore, while some recent fieldwork has led to the publication of more radiocarbon determinations, relatively rudimentary excavation techniques still continue to dominate in the area. For instance, stratigraphic resolution is often limited due to the removal of sediment in arbitrary spits (Hachi, 2003; Moser, 2003; Nami, 2007). A different issue is that many of the other finer-grained studies with new AMS radiocarbon determinations have been undertaken to establish a better palaeoenvironmental understanding of the area and often lack substantial lithic collections needed to assess variation within the Pleistocene LSA (N.Barton et al., 2005). In addition, a number of other collections with new absolute ages have yet to be described in detail (N.Barton et al., 2013, 2007; Bouzouggar et al., 2008; Linstädter et al., 2012). There is critical need to describe these collections as they hold the key to better understanding changes in the chipped-stone assemblages in the pivotal era from the Late Glacial Maximum (LGM) to the onset of the Holocene between ~24 – 11.5 ka cal BP.

1.2 Objectives

The primary objective of this work is to examine variation within the Pleistocene LSA through the analysis of collections from new excavations at the site of Grotte des Pigeons (Taforalt), Morocco (N.Barton et al., 2013, 2007; Bouzouggar et al., 2008, 2007; Clark-Balzan et al., 2012; Clark-Balzan, 2013; Humphrey et al., 2014, 2012; Oh, 2011; Taylor, 2014; Taylor et al., 2011). Here, the archaeological sequence is one of the longest recorded in Northwest Africa and is also one of few sites to include a record for the Pleistocene LSA from its initial inception until the beginning of the Holocene. The sequence has been comprehensively dated with 52 AMS radiocarbon on single charcoals and cut-marked bones relating to the Pleistocene LSA. It is also unusual in that the key sequence was excavated using a single-context recording system. This provides an unprecedented opportunity to investigate and describe variation in the Pleistocene LSA of Northwest Africa. Importantly, it provides a new opportunity to describe variation not only amongst the retouched tools, but also in the knapping procedures that until now have been largely overlooked (although a notable exception is Sari, 2014, 2012).

A secondary objective is to use the results of this high-resolution analysis to better contextualise the findings of past studies and construct a more robust model of variation that will be more widely applicable to the whole of Northwest Africa. In the final stages of this thesis this objective is explored through the multivariate statistical approach of correspondence analysis (CA). This is used to analyse the type-count data in this study and available data from other published sites in order to help tease out temporal and non-temporal variation within the lithic industries. Importantly, one of the aims of this approach is to show the use of CA for making sense of type-count data, which considering the lack of other standardised forms of data collection and reporting often provides the only means for making broader comparisons between assemblages and looking at inter-site variation within the Pleistocene LSA.

1.3 Thesis structure

Chapter 1. Introduction

In this chapter a brief rationale is given as to the major reasons for undertaking the research in the thesis. This is followed by an outline of the objectives and a brief methodological description as to how this will be achieved. It ends with the thesis structure and brief overviews of the work covered in each chapter.

Chapter 2. Background to the Study of the Pleistocene LSA of Northwest Africa

The major focus of this chapter is on previous work relating to the field of research. It begins with a brief discussion of current terminology used to describe the major archaeological episodes. This is followed by an overview of the earliest evidence for the Pleistocene LSA, its supposed origins, and the associated lithic facies and variation. This is then followed by a brief overview of the current state of knowledge relating to other aspects of hunter-gatherer behaviour at this time, including reference to human remains, evidence of symbolic activity, and subsistence behaviour. The final section focuses on the geographical and environmental setting of the research. This gives a broader framework for discussing the results of the thesis.

Chapter 3. Theoretical Considerations in the Study of Variation within Microlith Assemblages

This chapter focuses on some of the wider issues relating to the study of microlith assemblages. It begins by outlining the definition of a microlith and how these artefacts might have been utilised. Then a discussion and critique is given on how past scholars have approached the description of microliths and microlithic assemblages. This is followed by a discussion on how variation has been understood and outlines the theoretical framework for understanding variation observed in this thesis.

Chapters 4-7. A Case Study from Grotte des Pigeons (Taforalt), Morocco

These chapters relate to the work undertaken at the site of Grotte des Pigeons (Taforalt), including the excavation and collection of data that I undertook myself. The first of the chapters gives an overview of research at the site, outlines the new fieldwork at the site, and discusses the stratigraphic information on the lithic collections studied in this thesis (Chapter 4). The second of these chapters outlines the methodological procedures for describing the chipped-stone assemblages from the site (Chapter 5). This is followed by the detailed description of the lithic artefacts according to the major stratigraphic units (Chapter 6). The last of these chapters suggests the grouping of the assemblages into a number of distinct facies using statistical analyses to highlight significant variation between the identified groups and characterising typo-technological variation within the assemblages at the site (Chapter 7).

Chapter 8. Correspondence Analysis and Inter-site Assemblage Variation

This chapter relates to inter-assemblage comparisons using correspondence analysis (CA). It begins with an overview of the CA approaches used to interrogate the data in the analysis. This is followed by a brief description of the sites from which the data were obtained. It provides an opportunity to highlight some of the difficulties with a number of the collections, such as issues with chrono-stratigraphic control. It also provides an opportunity to describe a new series of AMS radiocarbon determinations for the site of Tamar Hat (Algeria) obtained as part of a related initiative organised by myself in order to add greater chronological resolution to the CA. This is followed by the results of the CA.

Chapter 9. Discussion

This chapter discusses the results generated and their impact on understanding variation within the Pleistocene LSA. It suggests a new chronological model and evaluates some of the implications of this new understanding of variation for addressing questions related to the origins and development of the Pleistocene LSA.

Chapter 10. Conclusions and Future Directions

The final chapter draws together the main conclusions and suggested future directions for research.

Chapter 2

Background to the Study of the Pleistocene LSA of Northwest Africa

2.1. Nomenclature

The Northwest African archaeological record has a complex history of research. Even at a basic level a standardized terminology for describing the major temporal units is lacking (Table 2.1). There has been a tendency to adopt cultural divisions devised for use in western European, such as Epi-, Upper, Middle, and Lower Palaeolithic (de Mortillet, 1900; Sterjna, 1910). However, difficulties ensue with their adoption, as there are clear departures in the archaeological records of the two continents. For instance, there are striking differences in the development and end of the Middle Palaeolithic and contemporary cultures in North Africa (Garcea, 2010, p. 54). A separate scheme of Early, Middle, and Later Stone Ages, originally developed for the Southern African record (Goodwin and van Riet Lowe, 1929), has also been utilized more recently. This scheme avoids some of the aforementioned issues, although it may not reflect as well proposed similarities and hypothesized connections with the Mediterranean and the Near East during late Pleistocene and Holocene (see below). Neither scheme is completely satisfactory, as the use of either implies shared features with a particular geographic region, which may or may not exist.

Table. 2.1. Nomenclature for the Stone Age of Northwest Africa

<table>
<tr><th>MIS</th><th>Age (ka cal BP)</th><th>Geological Epoch</th><th>Balout; Camps; Lubell et al.</th><th>Stoetzal et al; Linstädter et al.</th><th>N.Barton et al.</th></tr>
<tr><td>1</td><td>11.5-6.0</td><td>Holocene</td><td rowspan="2">Epipalaeolithic</td><td>Epipalaeolithic</td><td rowspan="2">LSA</td></tr>
<tr><td>2</td><td>24-11.5</td><td rowspan="4">Pleistocene</td><td>Upper Palaeolithic</td></tr>
<tr><td>3</td><td>59-24</td><td rowspan="3">Middle Palaeolithic</td><td rowspan="3">Middle Palaeolithic</td><td rowspan="3">MSA</td></tr>
<tr><td>4</td><td>74-59</td></tr>
<tr><td>5</td><td>130-74</td></tr>
</table>

Here, the term Later Stone Age (LSA) is used as it avoids some of the major issues with the European nomenclature, which implies a linear progression from burin-and-blade to microlithic assemblages, which has not be demonstrated for Northwest Africa. The Pleistocene LSA is used here to refer to all Mode 4 (i.e. burin-and-blade) assemblages, if any, and Mode 5 (i.e. microlithic) assemblages prior to the onset of the Holocene. In addition, the term Holocene LSA is used to refer to

the industries in the following geological epoch, which is outside the scope of this thesis. This terminology also avoids a number of the issues with the region specific terminology, such as the term 'Iberomaurusian' (see below for discussion).

2.2. Radiocarbon Evidence of the Pleistocene LSA

Whilst in recent years there has been an increase in the number of dated sites there still remains a general lack of chronological data, which makes it difficult to discuss the nuances of the occupation history of the Pleistocene LSA in Northwest Africa. In particular, a major issue is that whilst new dating efforts have led to the proliferation in the number of radiocarbon determinations from sites in Morocco, new chronological work has yet to be undertaken in Algeria and Tunisia. Furthermore, the age of most sites is still given by a single sample, or at best a handful of samples, with limited details available on the method, material, and stratigraphic context; essential criteria for assessing the reliability of a date.

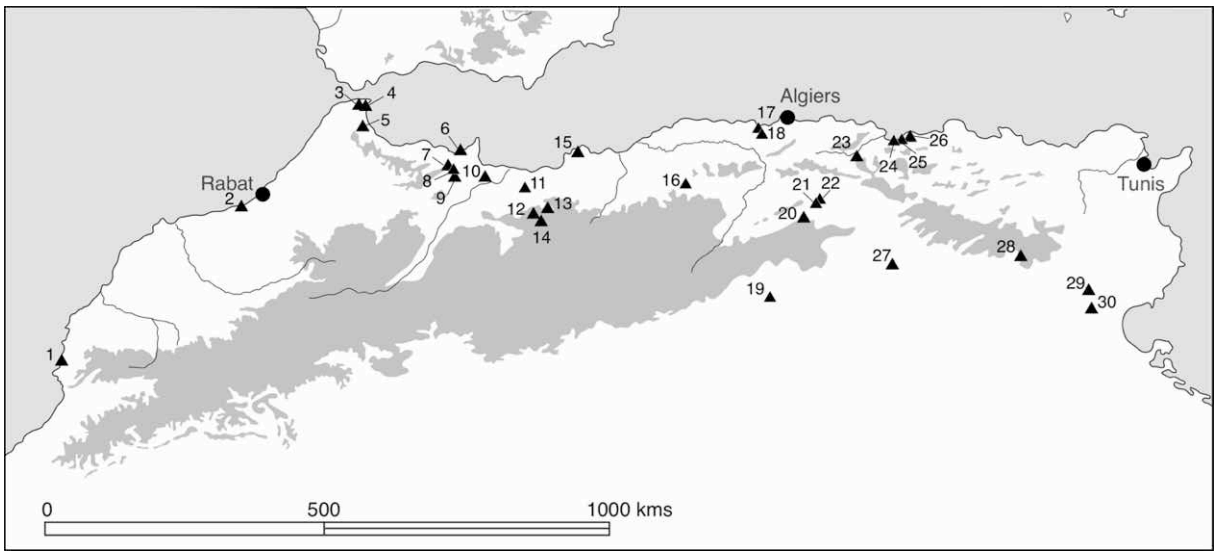
Issues surround samples produced using traditional C^{14} methods, as dating requires large samples, often out of necessity on bulked material, which results in inaccurate dates with an admixture of carbon from different sources, and dates obtained using this method ideally need re-evaluating (Ashmore, 1999). The use of certain materials is also problematic. Those on terrestrial mollusc shells can be anomalous due to the uptake of dead carbon from carbonate rocks during shell building (Goodfriend and Stipp, 1983), whilst marine shells can become contaminated with carbon dissolved in ocean waters (Bezerra et al., 2000). In contrast, whilst ostrich eggshell is not prone to contamination, initial carbonate fraction deficits in this material can result in ages that appear too old and the effects of this have only recently been studied in a systematic way (Vogel et al., 2001).

In addition, many of the assemblages with available radiocarbon determinations include only a small number of lithic artefacts or have not been adequately described, which limits their use for discussing variability within the LSA. A list summarising the calibrated radiocarbon determinations for the Pleistocene LSA is given in Table 2.2 with a full breakdown of dates including raw values given in Appendix I. All radiocarbon determinations were corrected using IntCal13 and Marine13 calibration curves (Reimer et al., 2013) with the OxCal 4.2 calibration software (Bronk-Ramsey,

2009). Radiocarbon determinations are given here are expressed as BP, whist calibrated ages are expressed as cal BP. The calibrated age ranges are given within two standard deviations unless otherwise stated. The location of each site is given in Figure 2.1.

Table 2.2. List summarising radiocarbon determinations published for the Pleistocene LSA

Site	No. of C^{14}dates	Approx. age (ka cal BP)	Description(s) of lithic assemblages
Morocco			
Chaâba Bayda	2	13.5-12.8	
Contrebandiers	4	18.1-13.1	Roche, 1963
Ghar Cahal	3	13.2-10.6	
Hassi Ouenzga	2	15.0-12.4	
Ifri Armas	2	13.7-13.4	
Ifri el Baroud	23	20.5-10.8	Nami, 2007
Ifri n'Ammar	19	17.1-11.3	Moser, 2003
Kehf el Hammar	6	26.4-15.9	
Pointe d'El Majni	2	31.7-16.2	
Rhafas	1	17.5-16.6	
Taforalt (1951-1955 excavations)	4	15.4-11.4	Roche, 1963
Taforalt (1969-1972 excavations)	11	27.2-15.3	
Taforalt (2003-2010 excavations)	52	22.1-12.6	This Volume
Taghit Haddouch	1	15.7-14.8	
Algeria			
Afalou Bou Rhummel	7	18.6-12.8	
Columnata	1	13.5-11.4	Brahimi, 1972; Sari, 2012; 2014
El Haouita	1	11.7-7.6	Estorges et al., 1969
El Hamel	1	11.2-10.6	Tixier, 1954
El Onçor	1	12.4-11.2	Heddouche, 1977
Es Sayar	1	16.5-15.0	Amara, 1977
Gueldaman 1	1	17.2-16.5	
M'Doukal	1	16.1-14.1	
Oued Guettara II	1	12.6-11.2	Camps, 1967
Rassel	1	17.6-17.2	Brahimi, 1970; Close, 1977; Sari, 2012; 2014
Rolland	1	16.9-15.2	Brahimi, 1970
Tamar Hat (1967 excavations)	2	16.1-11.1	Brahimi, 1969
Tamar Hat (1973 excavations)	5	25.9-18.7	Close, 1977; Close, 1980-1981; Sari, 2012; 2014
Taza I (1971 excavations)	3	15.8-12.7	
Taza I (1987-1990 excavations)	2	23.7-14.1	
Wadi Mezeraa	2	14.8-13.2	
Tunisia			
Bir Oum Ali	3	21.5-17.4	
El Oghrab	1	13.0-10.8	



1. Point d'El Majni, 2. Contrebandiers, 3. Kehf Taht el Ghar, 4. Ghar Cahal, 5. Kehf el Hammar, 6. Ifri Armas, 7. Taghit Haddouche, 8. Ifri el Baroud, 9. Hassi Ouenzga, 10. Ifri n'Ammar, 11. Taforalt, 12. Chaâba Bayda, 13. Oued Charef, 14. Rafas, 15. Oued Guettara II, 16. Columnata, 17. Rolland, 18. Rassel, 19. El Haouita terrasse, 20. El Hamel, 21. El Onçor, 22. Es Sayar, 23. Gueldaman, 24. Tamar Hat, 25. Afalou Bou Rhummel, 26. Taza, 27. M'Doukal, 28. Wadi Mezeraa, 29. El Oghrab, 30. Bir Oum Ali.

Fig. 2.1. Map of sites with radiocarbon determinations published for the Pleistocene LSA. (mountainous regions indicated by shading ~1000m above sea level)

In Morocco, the chronological record of the Pleistocene LSA is relatively well understood with 132 radiocarbon determinations having been published. The earliest known date is from Pointe d'El Majni at 31,355-30,956 cal BP (27,700±110 BP, Gif-3620)(Delibrias et al., 1976). However, this date is extremely questionable as it is on marine shell and discrepancies of ~10,000 radiocarbon years were found between paired samples of charcoal and marine shell by the same authors (Delibrias et al., 1982). A date has also been given for a single blade tool from the site of Kehf el Hammar of 26,427-25,902 cal BP (21,920±110 BP, OxA-11872)(N.Barton et al., 2005). However, the cultural association is not conclusive and additional fieldwork is needed to understand the exact stratigraphic context (Bouzouggar et al., 2006, p. 142).

Until recently the most widely accepted dates have been ages of 27,167-25,495 cal BP (21,900±400 BP, Gif-2587) and 26,135-24,388 cal BP (21,100±400 BP, Gif-2586) on bulked material from the site of Grotte des Pigeons (Taforalt) in Morocco (Delibrias and Roche, 1976; Roche, 1976). However, recent fieldwork at the site using AMS dating has shown that the timespan is limited to between 22,292-21,825 cal BP (18,185±75 BP, OxA-16240) and 12,713-12,568 cal BP (10,680±45, OxA-24111) (N.Barton et al., 2013, 2007; Bouzouggar et al., 2008). Based on the AMS radiocarbon

dating evidence the authors have suggested a relationship between Heinrich events (HE) and the occupational history of the site positing the abandonment and movement of populations into the coastal zone during HEs and re-occupation of the site following the return of more favourable interstadial conditions (N.Barton et al., 2013). Following HE 1 ~16.8 ka cal BP there is an increase in the available radiocarbon data and this coincides with a number of behaviour changes (N.Barton et al., 2013; Bouzouggar et al., 2008; Linstädter et al., 2012; Zielhofer et al., 2008; see discussion below). This general increase in the available radiometric data is interrupted with decline in the number of determinations towards the end of the Pleistocene during the Younger Dryas (YD) that might indicate a hiatus in the settlement of Northwest Africa after ~12.8 ka cal BP (Bouzouggar et al., 2008; Linstädter et al., 2012).

The Pleistocene LSA of Algeria is less well understood. There are only 31 published radiocarbon determinations from this area and due to the lack of documentation it is unclear whether any of the dates were produced using AMS methods and all seem likely to be on bulked material. None of the records are of sufficient resolution to discuss whether there were any hiatuses in occupation, but there are sporadic dates throughout Marine Isotope Stage (MIS) 2. For instance, there are seven ages on bulked material between 25,895-23,710 cal BP (20,600±500 BP, MC-822) and 13,031-11,105 cal BP (10,350±375 BP, Alg-5) from the site of Tamar Hat (Brahimi, 1969; Saxon et al., 1974). However, considering the discrepancies in ages between traditional radiocarbon dating and AMS techniques at related sites in Morocco there is a need to re-evaluate the age of LSA in Algeria. In an attempt to add greater chronological resolution a new series of AMS radiocarbon determinations were obtained for this thesis from Tamar Hat, which are discussed in Chapter 8.

Unfortunately, there are currently no well-published absolute dates for the Pleistocene LSA in Tunisia. However, there are some indications of human occupation during the timeframe recorded in Morocco and Algeria. For instance, there is a single date on ostrich eggshell from a midden at Bir Oum Ali of 17,842-17,178 cal BP (14,370±170 BP, Gif-5115)(Delibrias et al., 1986) and two further ostrich eggshell dates from elsewhere in the vicinity of 18,777-17,923 cal BP (15,117±199 BP, C-3568) and 21,945-20.325 cal BP (17,470±315 BP, C-3569)(Vernet and Aumassip, 1992); no details

have been given about the associated finds. There is also a single date on bulked terrestrial mollusc shell from El Oghrab of 12,988-10,813 cal BP (10,296±386 BP, Unknown), which was found in association with lithic artefacts more typical of the Holocene LSA and therefore this radiocarbon determination has been considered unreliable (Aouadi-Abdeljaouad and Belhouchet, 2008).

2.3. Origins of the Pleistocene LSA

Up until recently, there has been little progress in understanding the origins of the Pleistocene LSA in Northwest Africa. The debate has previously fluctuated between a number of competing theories based on proposed similarities in lithic assemblages and skeletal remains; it has been argued to have its origins in Europe, the Near East, elsewhere in Africa, or may have evolved *in situ* (Balout, 1955; Briggs, 1955; Camps, 1974a; Ferembach, 1985, 1976; Irish, 2000; Kozlowski, 2005; Vallois, 1969; Vaufrey, 1955). A major issue is that even at a basic level there is only a poor understanding of the timing of its appearance or the nature of the earliest assemblages. Nonetheless, with the recent advent of genetic studies the debate has been renewed.

A number of independent studies on mtDNA haplogroups M1 and U6 appear to indicate that modern human populations in North Africa originated from groups that migrated into this region from the Near East (Gonzalez et al., 2007; Maca-Meyer et al., 2003; Olivieri et al., 2006). However, the nature and timing of the back-migration is still a not fully understood (Pennarun et al., 2012). On the one hand, some studies propose an early dispersal of M1 and U6 lineages into North Africa at ~40-45 ka years ago (Olivieri et al., 2006), while others suggest multiple events with a major expansion of the U6 lineages in the Maghreb ~22 ka years ago (Maca-Meyer et al., 2003; Pereira et al., 2010). Both models can be shown to coincide with major technological shifts in the archaeological record. However, it still remains unclear whether the LSA was a truly indigenous development in the Maghreb, or whether it reflects a general spread of people and traditions from Libya and Egypt, with older roots in the Near East.

On archaeological grounds, there does not appear to be any antecedents of the LSA in Northwest Africa. The LSA is most often thought to be separated by a chronological gap and bear no resemblance to the preceding MSA industries (N.Barton et al., 2013; Close, 2002; Ferembach, 1985;

Linstädter et al., 2012; Moser, 2003; Roche, 1976). Furthermore, Mode 4 assemblages are essentially unknown, with perhaps the exception of a single blade tool from the site of Kehf el Hammar, which has a minimum age of 26,427-25,902 cal BP (21,920±110 BP, OxA-11872)(N.Barton et al., 2005). Instead, the archaeological record is marked by the sudden appearance of a fully developed Mode 5 LSA, characterised by the dominance of backed bladelets, at least ~22/21 cal ka BP (N.Barton et al., 2013) and possibly as early as ~26/25 ka cal BP (Delibrias and Roche, 1976; Roche, 1976; Saxon et al., 1974). The sudden appearance of the Mode 5 technology in the archaeological record has led to the assumption that the LSA has its origins outside of the Maghreb (Balout, 1955; Briggs, 1955; Camps, 1974a; Ferembach, 1985, 1976; Kozlowski, 2005; Linstädter et al., 2012; Vallois, 1969; Vaufrey, 1955). However, this does not account for the fact that the region also has some of the earliest dates for Mode 5 technology (N.Barton et al., 2013, 2007).

In contrast, Mode 4 LSA assemblages are comparatively well represented in Libya. It is observed at a handful of sites in the Jebel Gharbi from ~30 ka years ago, where it is succeeded by Mode 5 LSA assemblages at ~20/19 ka cal BP (Barich et al., 2006; Barich and Garcea, 2008; Garcea, 2010). However, the LSA is best understood at the site of Haua Fteah in Cyrenaica (Close, 1986; McBurney, 1967). Here, the local Mode 4 LSA, know as the Dabban industry, has been given as dating from ~44-40 ka cal BP, which is succeed by the Mode 5 assemblages, referred to as the 'Eastern Oranian', at ~17.1-16.2 ka cal BP (Barker, 2009; Barker et al., 2012, 2010; Douka et al., 2014). Nonetheless, the nature of the transition is poorly understood. A number of authors have considered the differences between the two industries to be so profound as to suggest a change in population (Close, 1986; McBurney, 1967, p. 327), whilst others have suggested the transition is less distinct with types characteristic of the 'Eastern Oranian' found in the final stages of the 'Dabban' (Barker et al., 2010, p. 74).

A different scenario is observed in Egypt. Here, Mode 4 assemblages are observed at a few sites along the Nile Valley. There is an early assemblage from the chert mine of Nazlet Khater 4, which has dates from ~40-35 ka cal BP (Vermeersch, 2002). However, there is some doubt as to whether these assemblages should be included within the LSA or are more consistent with the MSA as

the technology shows a clear basis in the Levallois technique (Leplongeon and Pleurdeau, 2011). The first definitive signs of Mode 4 technology occur with the Shuwikhatian industry, with thermoluminescence ages of ~25,000 years ago. These assemblages notably lack marginally retouched and backed bladelets (Paulissen et al., 1985; Vermeersch, 2000). The earliest evidence of Mode 5 LSA technology appears at three sites in the form of the Fakurian industry soon after ~24.5 ka cal BP and fully elaborated in the Kubbaniyan industry from ~23/22 ka cal BP (Schild and Wendorf, 2010).

2.4. The Lithic Industries of the Pleistocene LSA of Northwest Africa

2.4.1. The Iberomaurusian

The Iberomaurusian is generally thought to be the earliest evidence of LSA technology within Northwest Africa. However, there is some disagreement as to the longevity of the industry. A number of authors consider it to be restricted to the Late Pleistocene (Close and Wendorf, 1990; Linstädter et al., 2012), whilst others consider it to continue into the Holocene (Bouzouggar et al., 2010; Nehren, 1992). In any case, the industry is generally considered to span at least ~10,000 radiocarbon years.

Terminology

Pallary (1909) first coined the term "Ibéro-maurusien" in relation to collections from rockshelters along the river Mouillah. The name derives from the fusion of two words, 'Ibero' (meaning Spanish) and 'Maurusian' (referring to Mauritania tingitana, the name first given by the Romans to northern Morocco and western Algeria). It has long been considered inadequate as it implies links with southern Europe. Gobert and Vaufrey (1932, p. 490) favoured the renaming the industry 'Oranian' to reflect its local distribution. Whilst, Goetz (1941, p. 265) suggested 'Moullian' as an alternative after the site where it was first recognised. However, neither of these alternatives have gained wide acceptance with the Iberomaurusian remaining most common in the literature.

Definition

The Iberomaurusian was originally defined as:

> *...some hammerstones, cores, unmodified blades and blades with edge retouch, notched blades, a profusion of very small backed and pointed blades, some circular end-scrapers, some discs, ... [and] few polished bone awls and objects of adornment*

> *... What clearly distinguishes this industry is the smallness of the tools, especially the elongated convex backed blades, of which one finds thousands of examples. True geometric flints (in the form of trapezes) are excessively rare… (Pallary, 1909, pp. 45–6, own translation).*

In 1950s there was growing recognition of the diversity within the 'Iberomaurusian' (e.g. Antoine, 1955; Balout, 1955; Cadenat, 1948; Morel, 1953) and the inadequacies of such as broad a definition that could not discriminate between distinct assemblages (Balout, 1955; Castany and Gobert, 1954; Gobert, 1954). Gobert (1954, p. 443) recommended using the term "Ibéromaurusien *sensu stricto"* in order to refer to collections similar to the type-assemblage, and "Ibéromaurusien *sensu lato*" to describe collections that were similar in the proportions of backed bladelets, but different in other respects. Unfortunately, he was not very explicit in distinguishing between the Iberomaurusian *sensu stricto* and Iberomaurusian *sensu lato*, which might be best explained by the fact the purpose of the paper was to substantiate differences between the 'Iberomaurusian' and the LSA Holocene industries.

Nonetheless, Gobert (1954) introduced a number of *fossiles directeurs* to the definition of the Iberomaurusian. He suggested, based on observations of the material from the type sites along the Mouillah River in eastern Algeria, that backed bladelets retaining a microburin facet (so-called La Mouillah points) were important within the industry. He also noted, based on his own investigations in the vicinity of Ouchtata in Tunisia, that backed bladelets with naturally blunted ends, often with marginal retouch restricted to the proximal portion of the edge, were common.

In the following year, Balout (1955, p. 337) proposed a more radical approach, the abandonment of the term Iberomaurusian, and the use of the more general "*epipaléolithique*" to refer to the period post-Aterian and pre-Neolithic. Nonetheless, Tixier (1963, p. 95) noted a decade later that term Iberomaurusian, "…déplorable et deploré…", was still in use for a number of different facies with greater than 40% backed bladelets.

During the 1960s scholars began to define new facies (e.g. Columnatian, Elassolithic, Keremian, 'Southern Tunisian Bladelet industries') and reassign assemblages that had been labelled as 'Iberomaurusian', and in turn, this led to a more restricted use of the term. In addition, the establishment of an initial radiocarbon chronology for the stone-age industries of the Maghreb showed

that dates for the industry were internally consistent, that they were pre-Holocene and were temporally distinct from the other Epipalaeolithic/LSA industries (Camps, 1974b, 1968), giving a renewed sense of the Iberomaurusian as a valid chrono-stratigraphic marker.

Camps (1974a) followed these findings by making amendments to the definition. He added that backed bladelets are always above 40%, that the types are variable between assemblages, but that '*aiguillion droits*' forms, obtained by the modification of burin spalls are usually absent; burins are unsophisticated, usually on a break, and rare (highest frequencies at El Haouita 1.4%); end-scrapers are generally on short flakes, though are sometimes characteristically modified from small cores, and are always present (ranging from 0.3% to 9.5%); that geometric microliths are rare and when present are usually segments; that the microburin technique is always used and sometimes prolific (highest frequencies at El Hamel 29.5%); that *pièces esquillées* are sometimes frequent; and the cores are usually small with a single platform, whilst pyramidal cores are rare, and fluted '*cannelé*' cores are absent.

A decade later the definition remained unchanged. Close (1986, pp. 170–3) commented that whilst it might appear 'objective' the definition was only a summary of findings from a few sites by authors primarily attempting to substantiate their original intuitive distinctions. In part recognising this issue, most authors have returned to more general usages of the term Iberomaurusian. For instance, Nehren (1992) applied the term to assemblages that were not assigned to one of the other LSA facies (e.g. Typical Capsian; Upper Capsian; Columnatian, etc); this usage appears to be favoured by those espousing population continuity throughout the LSA, including into the Holocene (Bouzouggar et al., 2010). In contrast, others use the term to refer only to assemblages from the Late Pleistocene, although not necessarily with the implication of population discontinuity (Garcea, 2010; Linstädter et al., 2012; Sari, 2014). Nonetheless, a more specific definition is still implicit within the discussion of the Iberomaurusian (after Camps, 1974a)(Fig. 2.2).

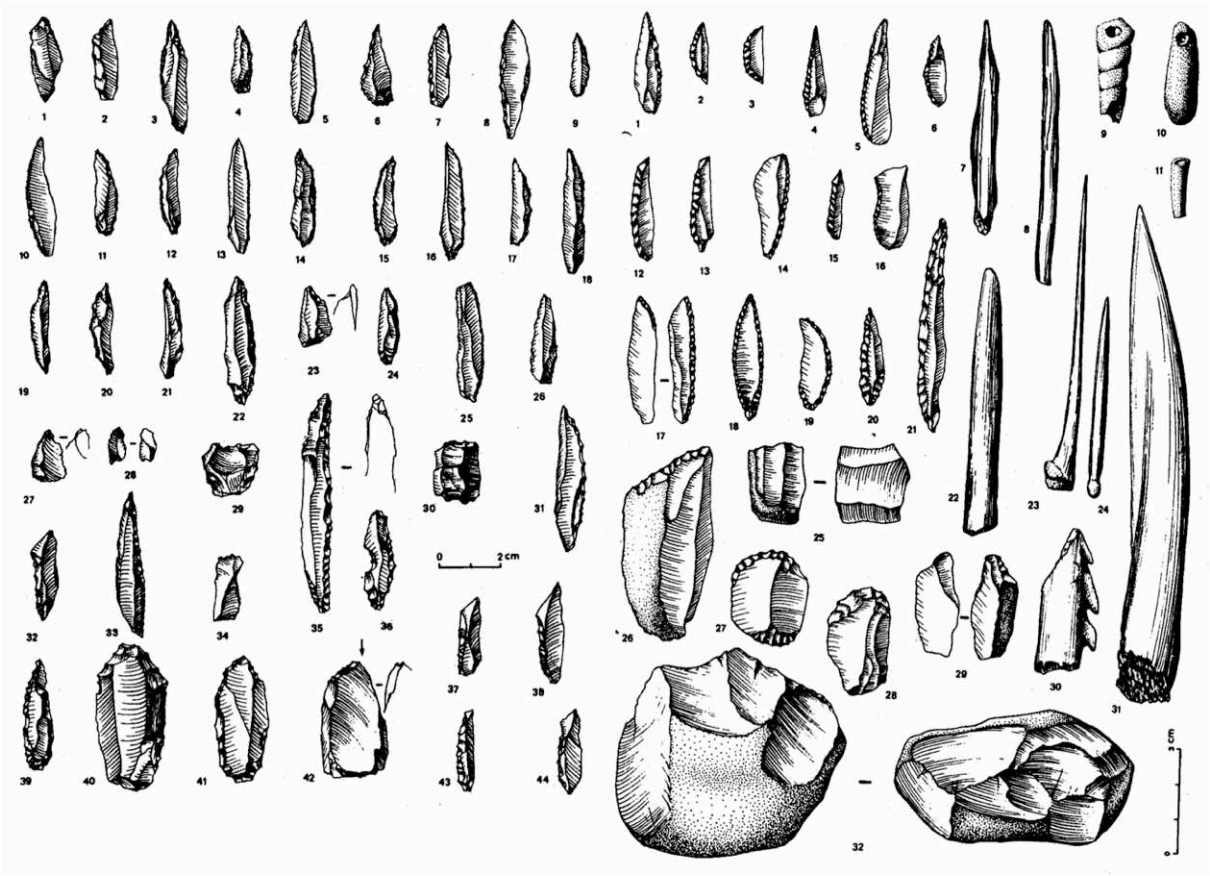


Fig. 2.2. Lithic artefacts from the Iberomaurusian (Camps, 1974a)

Variation

Detailed studies of variation within the industry have not been particularly forthcoming and are difficult to evaluate due to the differences in the usage of the term Iberomaurusian. Early attempts were based primarily on collections with little, if any stratigraphic control, and/or included assemblages that are now not thought to be consistent with the Iberomaurusian. In addition, this work was carried out using a number of poorly defined and regionally specific lithic typologies limiting the nature of comparisons between different authors' work (e.g. Antoine, 1955, 1937; Balout, 1955; Cadenat, 1948; Gobert and Vaufrey, 1932; Morel, 1953; Roche, 1963, 1953; Tixier, 1954; Vaufrey, 1955). As such, these accounts provide few insights into variability within the industry that have not subsequently been refined, but they were undoubtedly important in developing the definition of the Iberomaurusian. A number of summaries of this work have been given elsewhere (Camps, 1974a; Close, 1986; Phillips, 1975).

J. Tixier (1963) was pivotal to the first significant discussions of variation within Iberomaurusian and continues to form the basis of modern discussions of variation within the industry to this day. In his tome entitled *Typologie de L'Épipaléolithique du Maghreb* he described in detail 112 types from 11 classes of tools that could be observed in the LSA archaeological record (see Appendix II). It was the first explicit and clear outline of a lithic typology for the area. Whilst not intended to serve as a standardised typology it was quickly adopted and continues to serve as the *lingua franca* for Northwest Africa. This led to greater comparability between studies and has aided discussions of variation since the 1960s.

G. Camps (1974a, pp. 67–80) made an attempt in light of the introduction of radiocarbon dating that occurred during the 1950/60s to reorganise the available published data according to this new *lingua franca* and gave a new interpretation of variation within the Iberomaurusian. His study included published data on 37 assemblages from 22 sites, which he divided into three variants. A phase *ancienne* given as dating to between ~18.8 - 13.8 ka cal BP[1], characterised by high proportions of backed bladelets, although fewer than observed in the later phases; numerous microburins; small quantities of endscrapers and notched pieces; with other classes, specifically geometric microliths and burins, rare or absent. A phase *classique* from ~13.8 – 11.5 ka cal BP, distinguished by an excess of backed bladelets and rarity of all other tool classes. Finally a phase *évoluée*, at 11.5 - 9.5 ka cal BP, noted for the lowest numbers of backed bladelets; high proportions of notched and denticulated pieces; and increased numbers of endscrapers, burins, microburins, and geometric microliths. Camps (1974a) assumed the sub-divisions were chronological variants in terms of a cultural-evolutionary scheme.

The utility of his model for describing variation was called into question soon after. Research published later in the year showed that the Iberomaurusian had a much longer timeframe than suggested by Camps (1974a). Saxon et al. (1974) published a series of five radiocarbon determinations assigned to the industry at Tamar Hat (Algeria) between 25,895-23,710 cal BP (20,600±500 BP, MC-

[1] Camps (1974) originally gave dates in uncalibrated years BC, but are converted here to calibrated years BP

822) and 20,337-18,689 cal BP (16,100±360,MC-817). An earlier age also seemed to be confirmed by new excavations at the site of Grotte des Pigeons (Taforalt, Morocco), which gave a new series of radiocarbon dates ranging between 27,167-25,495 cal BP (21,900±400 BP, Gif-2587) to 16,186-15,826 cal BP (13,140±150 BP, Gif-2267)(Delibrias and Roche, 1976; Roche, 1976). However, it should be noted that the only artefacts to have been described from the site come from earlier excavations with ages between 15,359-13,140 cal BP (12,070±400 BP, Sa-14) and 13,162-11,197 cal BP (10,500±400 BP, Sa-15)(Roche, 1963). This thesis will be the first time that variation within the earliest LSA assemblages at the site has been discussed.

In addition to the evident chronological issues with the model of variation suggested by Camps (1974a) there is also a question to be raised about the utility of divisions based on differences in the relative proportions of major tool classes (e.g. end-scrapers, burins, composite tools, backed bladelets, etc), which may have little to do with socio-cultural variation and more to do with other factors (e.g. site function, excavation methods). Close (1978, 1977) sought to re-visit the issue of variation within the Pleistocene LSA industries of North Africa, including the Iberomaurusian, through identifying *stylistic* attributes on microliths that had no functional or adaptive underpinning (see Chapter 3 for discussion of *style*). Based on her work she suggested that differences between assemblages were accommodated within a single, diachronic, social group, introducing the idea that the Iberomaurusian was homogeneous and represented the long-term maintenance of social traditions throughout the terminal Pleistocene. Close (2002, p. 38) later re-iterated this position stating that "…backed bladelets are so consistent within each context – the word *monotonous* is often appropriate – that one might ask whether any factors other than social negotiation were important". The idea that differences within and between lithic assemblages can be thought of as variation within a single social group has endured (e.g. N.Barton and Bouzouggar, 2013; Lubell, 2001; Lubell et al., 1984; Sari, 2014, 2012).

Overall, there have been few other wide-ranging studies of variability within the Iberomaurusian. A brief note should be made of the much overlooked doctoral thesis of A. Gragueb (1983). His work focused on the re-analysis of Iberomaurusian and other LSA collections from

Tunisia. Gragueb (1983, pp. 85–6) took little time to discuss his data and came only to one brief conclusion about variation within the Iberomaurusian; that it might be divided into two facies, one characterised by backed bladelets *sensu stricto* and another with the dominance of bladelets with marginal (so-called Ouchtata) retouch. Nonetheless, the huge catalogue of data he collected remains of critical value as these assemblages have not been studied in detail since and there have been few new sites recorded for the Iberomaurusian from Tunisia.

L. Sari (2014, 2012) has most recently added much greater resolution to our understanding of variation within the Iberomaurusian focusing on the *chaîne opératoire* of these assemblages. Based on a re-analysis of museum collections she suggested that different technological behaviours were utilised by populations living along the coast and those living in the hinterland. In broad terms she observed an integrated *chaîne opératoire* geared towards the manufacture of narrower and thinner blade blanks at coastal sites (Fig. 2.3a), and, in contrast, she identified two distinct non-integrated schemes, one focusing on the manufacture of wider and thicker blade blanks, and another on the manufacture of flake blanks, at inland sites (Fig. 2.3b). Sari (2014, 2012) suggests that the differences between assemblages reflect adaptation of the same populations to different ecological niches. However, this hypothesis fails to recognise that based on the current dating evidence there is a minimum gap of ~3,400 radiocarbon years between the ages of coastal and inland assemblages in her study, which might indicate that there is a chronological basis for variation. Unfortunately, none of the collections in her study are well-dated, which makes it difficult to assess the explanatory strength of competing hypotheses accounting for variation.

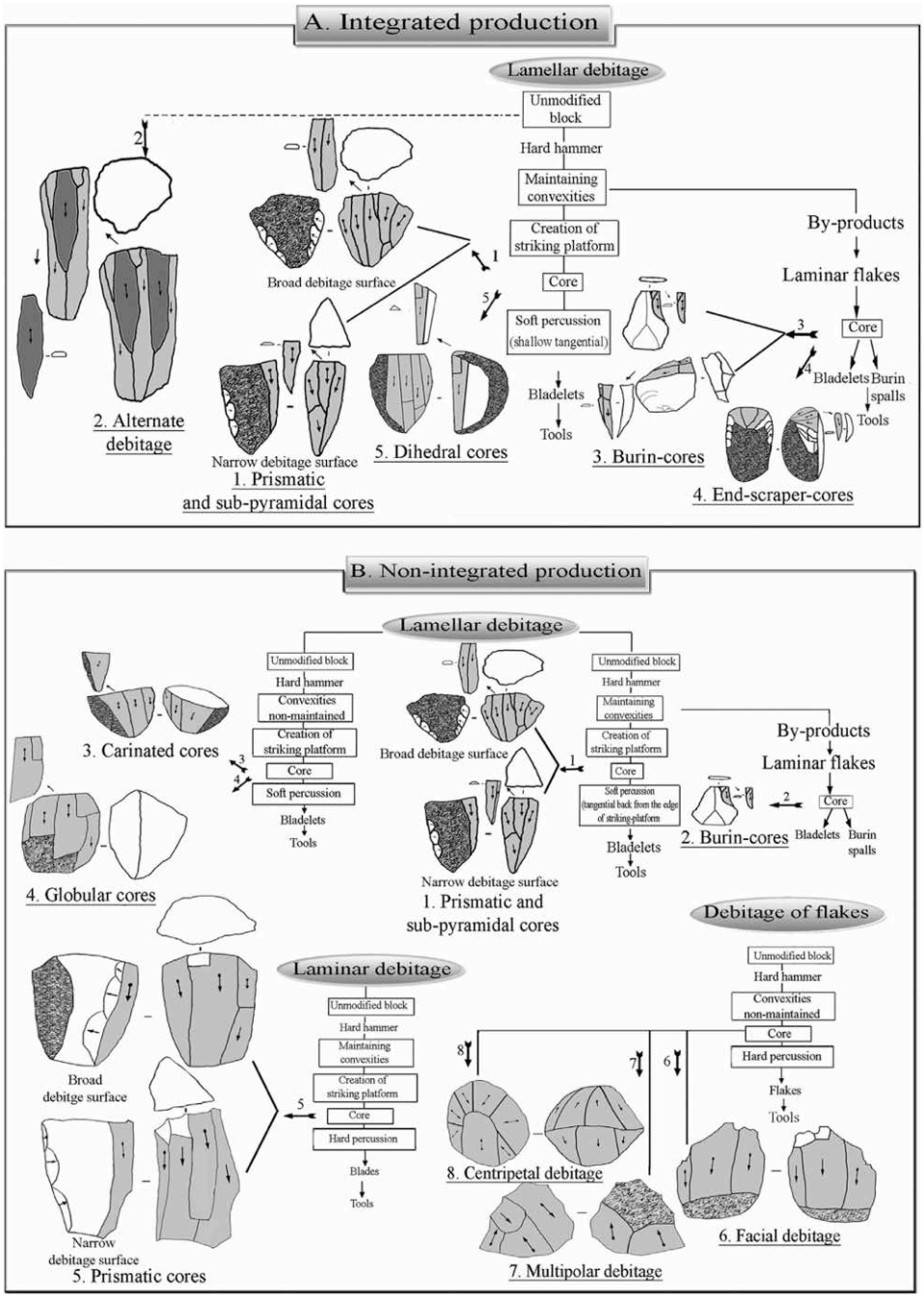


Fig. 2.3. Core reduction strategies of the Iberomaurusian (Sari, 2014)

2.4.2. Southern Tunisia bladelet industries

The 'Southern Tunisia bladelet industries' have received little attention. There are few absolute radiometric ages for the assemblages. The four available radiocarbon determinations range between ~10.3 and 9.5 ka cal BP at Oued Akarit (Lubell et al., 1984, p. 154). However, on stratigraphic grounds most of the 'Southern Tunisia bladelet industries' are thought to date to the Late Pleistocene (Castany and Gobert, 1954, 1954; Gobert, 1962; Gragueb, 1983).

Definition

Lubell et al. (1984) first introduced the term “Southern Tunisian bladelet industry” to the English literature, which gives the impression of well-understood and distinct facies. In reality, the 'Southern Tunisian bladelet industry” is an umbrella term used to refer to a heterogeneous collection of assemblages, which for various reasons were considered distinct from the Iberomaurusian by Gobert (1962, 1954). These include, Aïn el-Atrouss, the Horizon Collignon at Sidi Mansour, Lala, Mareth, Menchia, and Oued Akarit (Stations A, B, and C). The list of sites has been added in subsequent years (Camps, 1974a; Gragueb, 1983). Nonetheless, these assemblages for many authors are still thought to represent variation within the Iberomaurusian (N.Barton et al., 2013; Close, 1986; Close and Wendorf, 1990).

Variation

The most recent and extensive discussion of variation within the ‘Southern Tunisian bladelet industries’ is given by A. Gragueb (1983). Based on this work he suggested division of the assemblages into three groups. Group 1, represented by the Horizon Collignon (at Sidi Mansour), and given as dating to before ~20 ka BP, characterised by high frequencies of backed bladelets (>80%), the strong presence of Ouchtata bladelets, obtuse ended bladelets, and scalene bladelets, the predominance of retouch at the right edge (>70%), and low proportions of crossed retouch (<25%). Group 2, represented by Menchia, Aïn el Atrous, Mareth, Aïn Zigzou, Buttes d’Guettar, given as dating to before ~10 ka BP, characterised by high frequencies of backed bladelets (70-90%), that are predominately pointed straight-backed bladelets and convex-backed bladelets, with backing more often at the left lateral (55-70%), and formed by crossed retouch (~55% of cases). Group 3, as represented along the Oued Akarit (Station A, B, C), and given dating to the Holocene, characterised by relatively few backed bladelets (<40%), most often pointed straight-backed bladelets or convex-backed bladelets, the presence of geometric microliths (>15%), and the presence of microburins (>20%).

Gragueb's (1983) work has received little attention, which is almost certainly a reflection of the fact that it remains unpublished, rather than being a reflection of any lack of quality. There has been little, if any, more recent research on the collections of the 'Southern Tunisian bladelet industry'.

2.5. Human Remains & Symbolic Culture

The Pleistocene LSA of Northwest Africa is often associated with evidence of human burials including some of the earliest cemeteries, such as Afalou Bou Rhummel in Algeria (Arambourg et al., 1934; Hachi, 2006, 2003, 1996; Hachi et al., 2002) and Grotte des Pigeons (Taforalt) in Morocco (Ferembach et al., 1962; Humphrey et al., 2014, 2012; Roche, 1963). The human remains associated with these cemeteries are usually referred to as Mechta-Afalou, Mechta el-Arbi, and/or Mechtoïd type, which to some extent resemble modern European Cro-magnon, although are considered more robust or to differ in additional ways (Briggs, 1955; Elder, 2010; Ferembach, 1985; Ferembach et al., 1962; Harvati and Hublin, 2012; Irish, 2000; Turbón et al., 1997; Vallois, 1969).

The best-known cemetery is from excavations at the Grotte des Pigeons (Taforalt) in Morocco. Here, an especially large and remarkable assemblage of skeletal remains has been uncovered that might include as many as 86 adults and adolescents (Ferembach et al., 1962), although Mariotti et al. (2009) suggested that the number of burials is overestimated counting only 40 individuals. A single radiocarbon determination on bulked material of 14,639-13,257 cal BP (11,900±240 BP, L-399E) has been given for the *nécropolis* (Roche, 1959), although few details are available relating to the archaeological context of this material. Recent excavations at the site have uncovered a series of human skeletal remains from at least 13 individuals, which have seven AMS radiocarbon determinations on human bone between 15,086-14,189 cal BP (12,470±100 BP, OxA-16663) and 14,431-13,993 cal BP (12,255±50 BP, OxA-23779)(Humphrey et al., 2014, 2012).

Elsewhere in Morocco, there is also a small number of burials from the site of Ifri n'Ammar, which have ages for *sépultures* IV through I of 14,935-13,836 cal BP (12,290±133 BP, Erl-4401), 13,956-13,462 cal BP (11,853±105 BP, Erl-4400), 13,134-12,690 cal BP (11,009±144 BP, Erl-4399), and 13,525-13,140 cal BP (11,526±110 BP, Erl-4398), respectively (Mikdad et al., 2002; Moser, 2003). In addition, the remains of a partially articulated skeleton have been uncovered at the site of Ifri

el-Baroud, which based on the stratigraphic position is between 14,315-13,830 cal BP (12,198±65 BP, Bln-4753) and 11,223-10,785 cal BP (9677±60 BP, Bln-4755)(Ben Ncer, 2004; Nami, 2007). Furthermore, fragmentary remains of at least four individuals have been found in disturbed archaeological horizons at the site of Kehf el Hammar (N.Barton et al., 2005).

In Algeria, the most well known burials are from excavations undertaken in the early 20th century at the site of Afalou Bou Rhummel (Arambourg et al., 1934). Recent excavations at the site have shown a series of burials from Layer IV with available radiocarbon dates for this archaeological horizon of 16,894-14,409 cal BP (13,120±370 BP, Alger-0008), 15,268-13,788 cal BP (12,400±230 BP, Ly-3228), and 14,477-13,461 cal BP (12,020±170, Gif-6532) (Hachi, 2003, 1996; Hachi et al., 2002). In addition, the remains of a single individual were recovered from Layer X, with a *terminus ante quem* given of 18,568-17,715 cal BP (14,910±180 cal BP, Gif-9637)(Hachi, 2006).

A human skull has been found at the base of a midden horizon with rather dubious radiocarbon determinations of 23,717-16,390 cal BP (16,100±1,400 BP, Gif-6800) and 17,101-16,281 cal BP (13,800±130 BP, Gif-6799) at Taza I (Medig et al., 2005, 1996; Meier et al., 2003). Furthermore, skeletal remains are available from a number of other undated assemblages thought to relate to the Pleistocene LSA (Cadenat, 1960, 1948; Marchand, 1936). The available radiocarbon determinations taken directly from human bone appear to indicate the establishment of a burial tradition from at least ~14.6 ka cal BP, although there are some indications of intentional burial before this time that remain poorly dated.

A number of authors have described several practices surrounding the burial of the dead, including the dismemberment and removal of the flesh on cadavers, the colourisation of the bones using pigments, and also the potential execution and cannibalisation of individuals (Belcastro et al., 2010; Mariotti et al., 2009). However, whilst these behaviours might be evidenced, it is not possible to identify a set of characteristic habitual cultural traditions, with much variability between the individual burials (Humphrey et al., 2012).

The remains give other insights into the behaviour of the populations of the Pleistocene LSA. A striking feature is the clear evidence for the deliberate extraction of teeth, most often both of the upper central incisors, during the lifetime of the individual. A number of competing theories have been put forward for this custom including group identification, beautification, and rites of passage, related to puberty, marriage, or mourning (Humphrey and Bocaege, 2008). Irrespective of the explanation, which is likely to remain obscured with ancient populations, tooth evulsion would have been visually distinctive, leading to the suggestion of strong group identification (Close, 1986). In addition, unintentional dental modification including wear, chipping, notches, and grooves, resulting from the use of the teeth in day-to-day tasks indicate differences in task specialisations between male and females, although the exact nature of these is not fully understood (Bonfiglioli et al., 2004). The human skeletal remains also give evidence of the sort of foods that these hunter-gatherer populations consumed (see below).

In addition to the treatment of the dead one of the most distinctive aspects of the emotive culture is clear evidence of the manufacture of clay figures that were intentionally heated at temperatures of 500°-800°C at the site of Afalou Bou Rhummel (eastern Algeria)(Fig. 2.4). These figures were fashioned into a number of anthropomorphic and zoomorphoric figures from at least Layer VII, which has a single radiocarbon determination on bulked charcoal of 18,568-17,715 cal BP (14,910±180 BP, Gif-9637)(Hachi, 2006, 2003, 1996; Hachi et al., 2002). There is also a small fragment of a baked clay object thought to have been accidently fired and resemble the horncorn of a Barbary sheep (*Ammostragus lervia*) at the nearby cave of Tamar Hat. It originates from towards the bottom of the sequence in Layer 60 that on stratigraphic grounds dates to between 25,895-23,710 cal BP (20,600±500 BP, MC-822) and 25,194-22,723 cal BP (19,800±500 BP, MC-820)(Saxon et al., 1974).

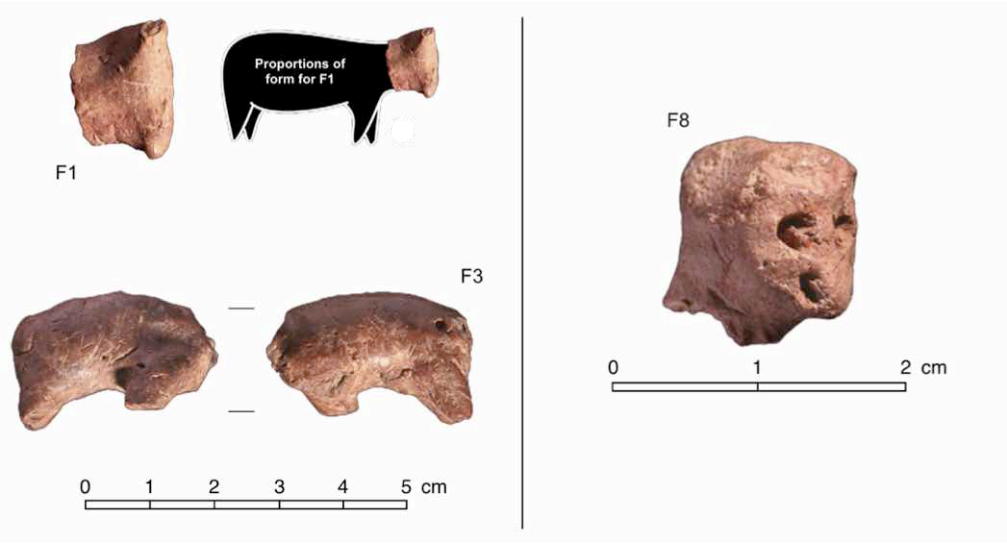


Fig. 2.4. Ceramic figurines from Afalou Bou Rhummel (Hachi, 2003)

There is strong evidence of the use of marine shells for decoration at a number of sites along the coast (Brahimi, 1970, 1969; Saxon et al., 1974) and further inland (Brahimi, 1972; Moser, 2003; Nami, 2007; Roche, 1963) and evidence for the exploitation and use of marine shells for personal ornamentation extends back to ~82,000 years ago in Northwest Africa (Bouzouggar et al., 2007). The behaviour is observed from the onset of the LSA with evidence coming from the base of the sequence at Tamar Hat (Algeria) (Saxon et al., 1974). Interestingly, whilst ostrich shell has been found at a number of sites there is little evidence to support the manufacture of beads in this material (N.Barton and Bouzouggar, 2013). Roche (1963) recovered a number of marine shells, some ostrich eggshell shell beads, but also perforated stone pendants from sediments giving calibrated radiocarbon determinations of 15,359-13,140 cal BP (12,070±400 BP, Sa-14), 13,474-11,406 cal BP (10,800±400 BP, Sa-13), and 13,162-11,197 cal BP (10,500±400 BP, Sa-15) at Grotte des Pigeons (Taforalt). Collina-Girard et al. (1997) noted similar stone pendants from undated assemblages at Aïn Aghbal (Morocco) and at La Mouillah (Algeria).

2.6. Subsistence Practices

The economy of hunter-gatherer populations of the Pleistocene LSA is not well understood due to the lack of detailed studies with sufficient chronostratigraphic resolution to identify shifts in subsistence. Nonetheless, a few tentative observations have been made.

The majority of sites show Barbary sheep (*Ammostragus lervia*) as the most prolific aspect of the large vertebrate fauna and it is generally considered to be the primary food source during the Pleistocene LSA (Balout, 1955; N.Barton and Bouzouggar, 2013; Camps, 1974a; Lubell, 2001). There is some evidence for a change in the exploitation of this species at Tamar Hat (Algeria)(Saxon et al., 1974). Here, the data suggests that the occupants shifted from the indiscriminate killing of individuals to a focus on younger animals. This change is time coincident with a shift in the nature of the sediments between Units V and IV, which have ages of 25,194-22,723 cal BP (19,800±500, MC-820) and 23,914-21,538 cal BP (18,750±500 BP, MC-818), respectively. The high proportions of Barbary sheep amongst the ungulate fauna and changing age profile led to speculation of herd management and domestication (ibid). However, the connection between species frequency and domestication is tenuous and most often the dominance of this single species is considered to reflect the selective hunting of a principal game species (Lubell et al., 1984). None of the other sites of this era have been published with a similar level of detail. Nevertheless, most sites with faunal lists tend to include a range of other prey species, such as, gazelle (*Gazella* sp.), hartebeest (*Alcelaphus* sp.), wild boar (*Sus scrofa*), wild cattle (*Bos* sp.), and wild ass (*Equus* sp.)(Brahimi, 1970; Medig et al., 1996; Merzoug, 2008; Michel et al., 2009; Roche, 1963; Saxon et al., 1974).

The majority of species lists are restricted to the large fauna. However, these lists sometimes include smaller species. It is certainly reasonable to assume that microfauna might have been incorporated into the diet, although cut-marked bones have yet to be found and the few microfaunal remains could represent natural accumulations. In should be noted that the crested porcupine (*Hystrix cristata*), known for borrowing and accumulating bones, is recorded at a number of sites (Bouzouggar et al., 2008; Mikdad et al., 2002; Moser, 2003; Nespoulet et al., 2008).

One of the most enigmatic aspects of the archaeological record is the occurrence of large-scale middens, containing vast numbers of edible terrestrial land molluscs remains, and appearing to mark a significant change in subsistence activities. These are often referred to as *escargotières*, but are also known as *rammadiya* (Balout, 1955; Lubell, 2001) from the arabic '*ramad*' meaning ash, and referring

to the large amounts of ash often found in the deposits. The term *cendrières* has also been used to highlight the occurrence of ash and burning (Gobert, 1937; Morel, 1974).

In Morocco, at a number of inland sites the occurrence of so-called *escargotières* is apparently synchronous. Preliminary work at the site of Taforalt showed an inception date of the *escargotière* in what is described as the Grey Series at around 15,052-14,314 cal BP (12,495±50 BP, OxA-13478) (Bouzouggar et al., 2008) and Bayesian modelling of additional dates now shows the transition to have occurred in the range of 15.2-14.8 ka cal BP (N.Barton et al., 2013). A remarkably similar age is given for the base of the *escargotière* at Ifri el-Baroud at 15,178-14,472 cal BP (12,574±65 BP, Bln-4748)(Nami, 2007), although a couple of slightly earlier ages have also been given in association with the *escargotière* of 15,225-14,711 cal BP (12,626±59, Bln-4746) and 15,738-15,204 cal BP (12,932±78, Bln-4873)(ibid). The published evidence from Ifri n'Ammar appears to corroborate these findings with a similar sediment transition recorded in *enlévement* (spit) 18, which gives calibrated radiocarbon determinations of 14,977-14,090 cal BP (12,834±100 BP, Erl-4407), 15,311-14,516 cal BP (12,640±90 BP, UtC-6178), and 14,966-14,175 cal BP (12,430±70 BP, UtC-6176) (Mikdad and Eiwanger, 2000; Moser, 2003). In contrast, at the site of Kehf el Hammar that is situated relatively close to the modern coastline, terrestrial mollusc shell becomes more common from Layer 6, which is dated earlier at 17,238-16,730 cal BP (14,005±55, OxA-11928)(N.Barton et al., 2005).

The timing is less well understood further east due to the lack of modern fieldwork and radiocarbon studies. In Algeria, Saxon et al. (1974) recorded a surge in the number of terrestrial molluscs and occurrence of edible marine mollusc remains in the upper half of the sequence at the coastal site of Tamar Hat (Units IV-I), associated with changes in the exploitation of the Barbary sheep (*Ammotragus lervia*). Isotopic studies of the mollusc remains indicated a seasonal winter inhabitation of the site (ibid). Earlier excavations in the midden horizons at the site gave ages of 16,140-13,441 cal BP (12,250±480, Alg-4) and 13,031-11,105 cal BP (10,350±375 BP, Alg-5)(Brahimi, 1969), although these are now considered contentious (Close, 1980; Saxon et al., 1974).

Hachi (2006, 2003, 1996; Hachi et al., 2002) recorded the occurrence of numerous molluscs remains at the nearby site of Afalou Bou Rhummel from Layer IV, which has given a series of dates

on bulked charcoals with large error margins; 16,894-14,409 cal BP (13,120±370 BP, Alger-0008), 15,268-13,788 cal BP (12,400±230 BP, Ly-3228), and 14,477-13,461 cal BP (12,020±170 BP, Gif-6532), These radiocarbon determinations are broadly time coincident with the appearance of *escargotières* at the interior sites in eastern Morocco. A number of other assemblages in the region also show evidence of the use of terrestrial and marine molluscs, such as Rassel (14,270±50 BP, Alg-3), Rolland (13,330±280 BP, Alg-47)(Brahimi, 1970), and Taza I (11,340±220 BP, Gif-2110; 12,075±250 BP, Alg-52; 12,700±220 BP, Gif-2111; 13,800±130 BP, Gif-6799; 16,100±1400 BP, Gif-6800)(Brahimi, 1976; Medig et al., 2005, 1996; Meier et al., 2003), although none of these are well-dated.

The scant subsistence evidence shows that other marine resources were consumed. Saxon et al. (1974) recovered evidence that hunter-gatherers were catching fish, such as sea bass (Serranidae), in the Units IV-I at Tamar Hat (Algeria). As noted above, these archaeological horizons are associated with shifts in the hunting practices of the principle game species the Barbary sheep (*Ammotragus lervia*) and the accumulation of terrestrial and marine mollusc remains, from at least 25,194-22,723 cal BP (19,800±500 BP, MC-820). The co-occurrence of marine resources seems to corroborate the suggestion that coastal inundation was a causal factor in the observed subsistence shift (Saxon et al. 1974, p. 70). Fish bones have also been recovered at a number of other sites, including from Morocco (N.Barton et al., 2005; Nespoulet et al., 2008).

There are few sites where botanical remains have been recorded. The available data indicate that charcoals, seeds, and nuts, from oak (*Quercus* sp.) and pine (*Pinus* sp.), are well represented. Research shows that these foodstuffs were collected systematically for storage and formed an integral aspect of the diet from ~15.0 ka cal BP at Grotte des Pigeons (Taforalt) (Humphrey et al., 2014). The botanical evidence is currently under study from the earlier archaeological horizons at the site (*pers. comm.* J. Morales). The remains of other edible plants including blackberry (*Rubus* sp.) elderberry (*Sambucus* sp.), juniper (*Juniperus* sp.), olive (*Olea* sp.) pistachio (*Pistacia* sp.), wild pulses (Leguinosae, *Lathryus* sp. *Vicia* sp.), and wild oats (*Avena* sp.) have also been recorded (N.Barton et al., 2005; Brahimi, 1970; Humphrey et al., 2014; Saxon et al., 1974).

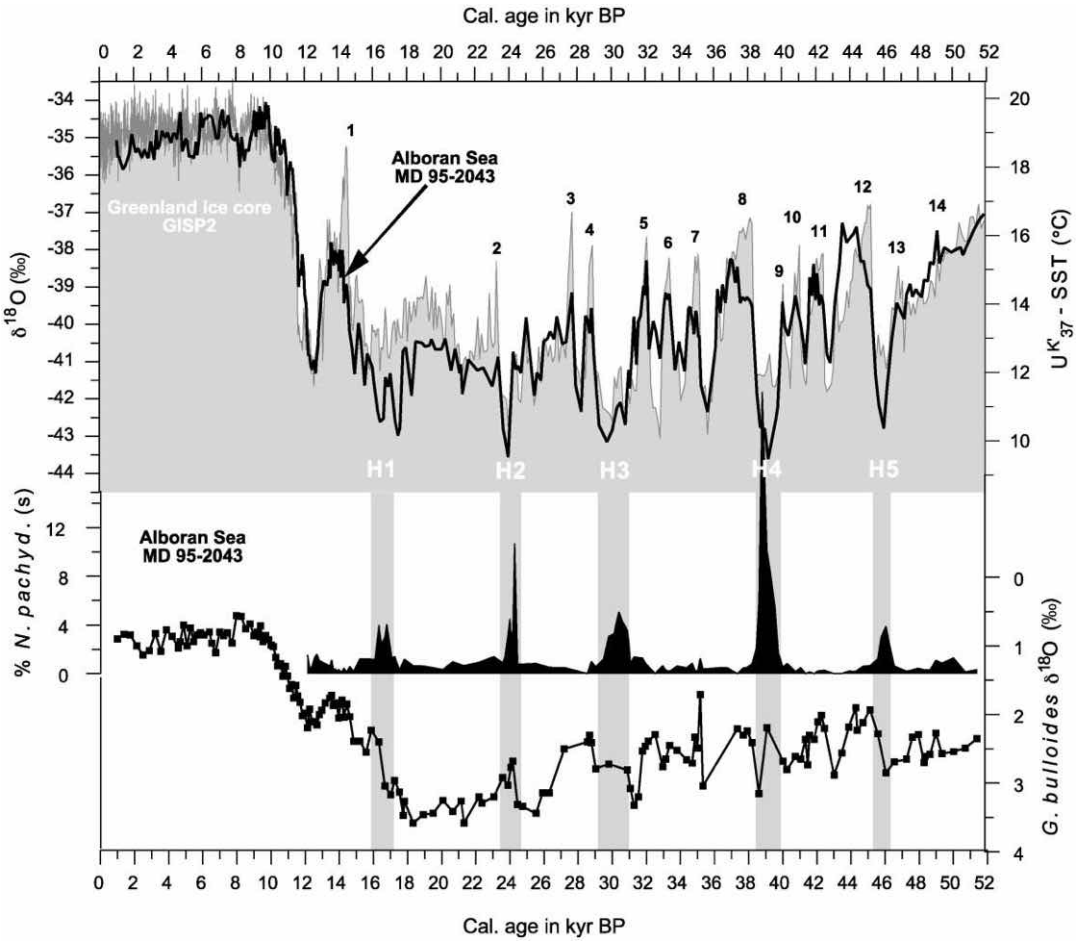
2.7. Geographical and Environmental Setting

The focus of this study is Northwest Africa (Morocco, Algeria, Tunisia), in particular the area known as the Maghreb, located between approximately 27ºN at the Atlantic Coast of Morocco and 34ºN at the Gulf of Gabès in Tunisia (Lubell et al., 1984). Today the climate is characterised by warm temperate conditions with dry summers in the higher latitudes along the Mediterranean Coast, and arid steppe and semi-desert conditions in the lower latitudes towards the hinterland (Rubel and Kottek, 2010).

There are no recent published syntheses of climatic and environmental conditions during Marine Isotope Stage (MIS) 2 between ~24 – 11.5 ka cal BP. This reflects the general paucity of available data for the area. For instance, of the few available lacustrine and fluvial records most are poorly dated (Ben Tiba and Reille, 1982; Lamb et al., 1989), restricted to the end of MIS 2 (Lamb and van der Kaars, 1995; Salamani, 1993; Zielhofer et al., 2009, 2008), and/or have poor resolution (Cheddadi et al., 2009; Rhoujjati et al., 2010). Furthermore, there have been only a few modern well-described phytolith, charcoal, botanical, molluscan, microfauna, and faunal records from archaeological sites (Humphrey et al., 2014; Jones, 2013; Taylor et al., 2011; Ward, 2007). Fortunately, data derived from marine cores from the western Mediterranean, and off the Atlantic coast of Morocco, are quite abundant and have been extensively discussed giving a broad understanding of the climate on the continent at the time (Brun, 1992; Cacho et al., 2002, 2001, 1999; Combourieu Nebout et al., 2009, 1999; de Menocal et al., 2000; Marret and Turon, 1994; Martrat et al., 2004; Moreno et al., 2005).

MIS 2 is a period of massive climatic shifts with abrupt fluctuations in sea-surface temperatures (SSTs), far more frequent than any other time during the last 250,000 years (Martrat et al., 2004). The Mediterranean basin, due to its semi-enclosed nature, was particularly sensitive to global climatic oscillations. The Atlantic meridonal overturning circulation (AMOC) had a significant effect on the periodicity of cold-warm cycles (Moreno et al., 2005), and in combination with long-scale changes in the tilt of the earth's axis (de Menocal et al., 2000), played a dominant role in the climate history of Northwest Africa.

Marine core records (in particular MD 95-2043) indicate that in the Alboran Sea SSTs were at their coldest at any point during the last 30,000 years, at around ~24 ka cal BP with values having plummeted by at least 4˚C (Cacho et al., 2002, 2001, 1999; Pérez-Folgado et al., 2003)(Fig 2.5). In the Atlantic waters off the coast of Morocco, low sea-surface temperatures are also recorded at this time (Penaud et al., 2010). This cold period, associated with Heinrich event 2 (H2) (an interval in which massive icebergs broke away from the north Atlantic ice shelf), caused a rapid drop in global SSTs, with conditions on the continent becoming significantly more arid and dry than those seen today.



Upper panel: reconstruction of surface Alboran Sea temperatures for the last 50,000 years in core MD 95-2043 (solid line) plotted over an atmospheric temperature record from Greenland ice core GISP2 (Grootes et al., 1993). Numbers over the curves correspond to the Dansgaard-Oeschger Interstadials (Dansgaard et al., 1993). Labels below the SST curve correspond to the position of the Heinrich events 1 to 5 described in the North Atlantic Ocean. These events are also indicated in the lower panels by vertical bars (Bond et al., 1993). Middle panel: percentages of the polar planktonic foraminifer *N. pachyderma* (s). Lower panel: oxygen isotopic concentration of the planktonic foraminifer *G. bulloides* (reversal Y axis)

Fig. 2.5. Reconstruction of sea-surface temperatures (SST) for the last 50,000 years in core MD 95-2043 from the Alboran Sea, Mediterranean (Cacho et al., 2002).

It is thought that the LSA emerged following H2 during the latter stages of the Last Glacial Maximum (LGM)(see above for discussion). This would have been an era when conditions were relatively stable, but nonetheless much cooler, typically by ~7˚C, and drier than today (Jolly et al., 1998). During the LGM water stored in the ice-sheets meant sea-levels were considerably lower leading to significant shifts in the coastal geography (Shackleton et al., 1984)(Fig. 2.6). The subsequent melting of these ice-sheets led to massive coastal inundation, especially in eastern Tunisia, which has quite reasonably been suggested, accounts for the general lack of sites in this area (Lubell, 2001; Lubell et al., 1984).

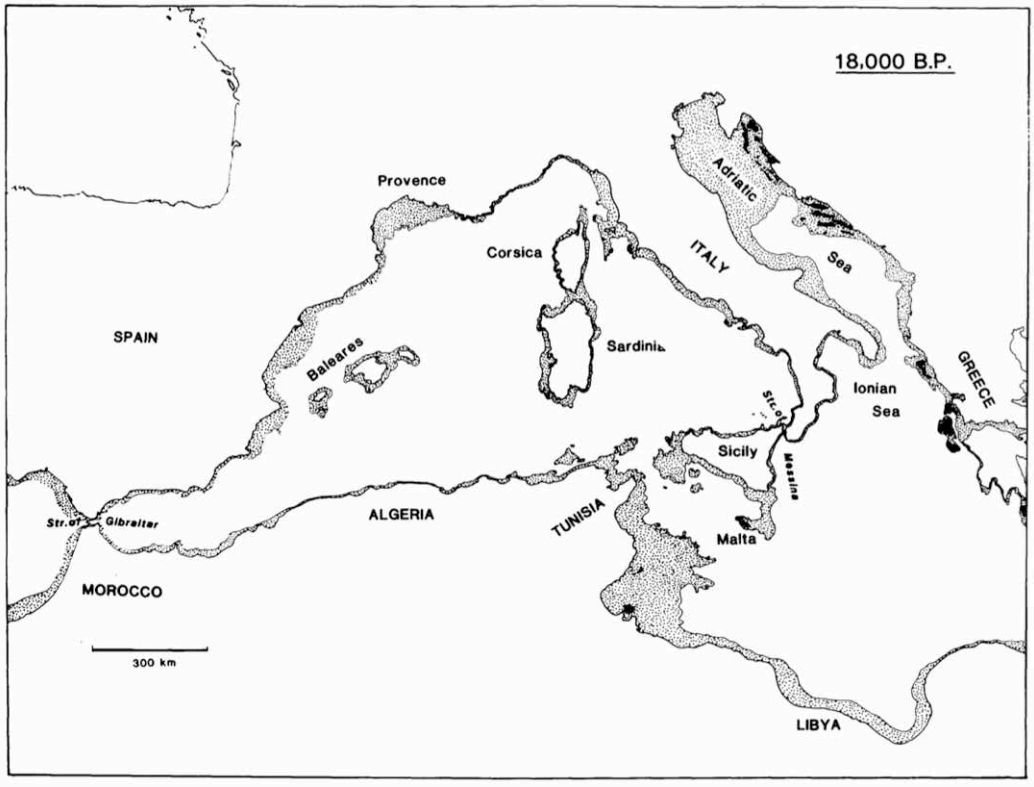


Fig. 2.6. Map showing coastal areas during the Last Glacial Maximum (Shackleton et al., 1984).

During the LGM the forest belt would have persisted only at higher elevations in the Atlas Mountains, but moisture was increasingly available towards the end of this period, as demonstrated by the presence of coniferous trees such as *Pinus* and *Cedrus* (Cheddadi et al., 2009). Steppe-like grasslands dominated by plants such, as *Artemisia*, Chenopods and *Poaceae* would have extended across broad areas of the Maghreb, including the Mediterranean coast (COHMAP Members, 1988; Combourieu Nebout et al., 1999; Hooghiemstra et al., 1992; Marret and Turon, 1994), and semi-desert

scrub would have encroached into what are now the most northerly margins of the Sahara (Jolly et al., 1998). The surface waters of the Alboran Sea would have been enriched with nutrients, due to a reduction in the gradient of SSTs in the Gibraltar Strait (Pérez-Folgado et al., 2003). This may have made the coastline a particularly attractive option for hunter-gatherer communities due to increased marine biomass (N.Barton et al., 2005).

From ~16.8 ka cal BP, a sudden drop in sea-surface temperatures is registered in the Mediterranean basin (Cacho et al., 2002, 2001, 1999; Pérez-Folgado et al., 2003). Convergent with Heinrich event 1 (H1), the magnitude and severity of SST change was less marked (~2˚C) than was recorded during the onset of H2. The boundary between the European and African water masses (the Azores Front) penetrated eastward into the Gulf of Cadiz during this period bringing with it a strong thermal gradient (Rogerson et al., 2004), which is consistent with major differences in Iberian planktonic communities and Moroccan ones (Penaud et al., 2010). Relative proportions of the small placoliths to *F. profunda* (N Ratio) indicate that at this time the productivity of the upper surface waters of the Alboran Sea were reduced (Colmenero-Hidalgo et al., 2004), which may have had an impact on marine resource availability in the area. Aridity continued on the continent, with herbaceous plants and shrubs (*Artemisia sp.*) becoming more abundant and deciduous forest elements (*Quercus sp.*) going into decline (Combourieu Nebout et al., 1999). A southward shift of the Inter-tropical Convergence Zone (ITCZ), in part contributed to the reduced humidity, and in tropical Africa, led to intense aridity, so much so, that Lake Victoria dried out (Stager et al., 2011).

De-glacial SST warming started immediately after H1 in the Gulf of Cadiz with a rapid warming pulse (4˚C per ~225 years). However neither in the Alboran Sea (4˚C per ~2000 years) nor in the Tyrrhenian Sea (4˚C per ~3000 years) did this happen so abruptly, with the maximum Bølling-Allerød (B-A) SSTs only reached after ~14.5 ka cal BP (Cacho et al., 2002, 2001). At around this time, changes in the Earth's orbit would have led to greater seasonality in the Northern Hemisphere, and reduced the role of sea ice on the climate (COHMAP Members, 1988). These factors led to a more positive precipitation-evaporation balance and resulted in wetter and warmer climatic conditions. This is observable in alluvial archives from Oued Medjerda, the main perennial watercourse in northern

Tunisia and adjacent eastern Algeria, where the deposition of clay- and silt-rich fine sediments records wetter conditions (Zielhofer et al., 2008). Aridity also appears reduced at the edges of the Sahara, with ground water influxes in the Sebkha Mellala (southern Algerian) palaeolake sequence at 16.4, 15-14.8, and 14 ka cal BP (Gasse, 2002). This is consistent with evidence for increased freshwater runoff into the Atlantic at this time, as indicated by proportions of *L. macaerophorum* in dinoflafellate cyst assemblages (Marret and Turon, 1994). The fossil pollen records indicate that on the continent the grass-steppe retreated, deciduous forest elements and scrubs (*Pistacia, Olea*) prospered, and verdant areas consisting of sedges (*Cyperaceae*) and quillworts (*Isoëtes sp.*) flourished (Combourieu Nebout et al., 1999; Hooghiemstra et al., 1992; Marret and Turon, 1994).

Following these moister conditions, SSTs in the Alboran Sea returned rapidly (within 50-80 years) to cold glacial values at ~12.8 ka cal BP, with temperatures diminishing by ~4˚C (Cacho et al., 2002, 2001, 1999; Pérez-Folgado et al., 2003), with a similar pattern recorded along the northwest coast of Moroccan (Penaud et al., 2010). The Azores Front re-established the position it had held during the H1 (Rogerson et al., 2004). Arid conditions returned, recorded as the precipitation of gypsum and dolomite at Sebkha Mellala (Gasse, 2002, 2000) and as a sharp rise in wind blown sediments entering the Atlantic Ocean from the Sahara (de Menocal et al., 2000). Deposition rates shifted dramatically in the major Maghreb watercourses feeding the Mediterranean, with coarse sediments and gravels accumulating rapidly in the Oued Medjerda profiles (Zielhofer et al., 2008). Artemisia-rich semi-desert re-established itself, and *Quercus* forests again retreated (Combourieu Nebout et al., 1999; Marret and Turon, 1994). This period, correlated with the Younger Dryas (YD), was relatively brief lasting for only ~800 years, before a return to warmer and more humid conditions with the onset of the Holocene as indicated in palynological (Combourieu Nebout et al., 1999; Hooghiemstra et al., 1992; Marret and Turon, 1994)(Combourieu Nebout et al., 1999; Hooghiemstra et al., 1992; Marret and Turon, 1994), geomorphological (Gasse, 2002; Gasse and Van Campo, 1994), and SST records (Cacho et al., 2002, 2001, 1999; Pérez-Folgado et al., 2003).

Chapter 3.

Theoretical Considerations for the Study of Microliths

3.1. Definitions

> …backed retouched flakes which have steep, often bipolar or anvil-rested retouch opposite/adjacent to sharp margins (Hiscock et al., 2011, p. 654).
>
> …a retouched stone artifact too small to have been used in the hand and inferred to be part of a composite edge or tool. No absolute size threshold is implied… (Kuhn, 2002, p. 84).
>
> …any small (2-3cm long, but often shorter) stone artifact deliberately retouched by means of vertical ("backing") or glancing ("normal") percussion or pressure work… (Straus, 2002, p. 70).
>
> …very small artefacts, usually shorter than 3 cm and geometric in shape… (Burdukiewicz, 2005, p. 338).

The above quotes are only a few of the definitions that have been given for a *microlith*. They illustrate just a fraction of the variability in how the term has been used. Most commonly there is no explicit definition given. In Northwest Africa, the term is often used in relation to small retouched artefacts with a geometric outline (Camps, 1974; Tixier, 1963), but it has also been used simply to qualify the size of a piece (Balout, 1955; Barbin, 1912, 1910; Bouzouggar et al., 2008).

Torrence (2002) highlights that on a global scale only two factors appear to be consistent amongst the application of the term *microlith*; 1) their small size, but this is not necessarily quantified, and 2) the assumption that they form part of composite tools. In addition, in the majority of cases intentional retouch appears to be important. This is most likely due to history of research with variations in morphology caused by retouch being the primary basis for typological classifications (Bar-Yosef, 1970; Goring-Morris, 1987; Tixier, 1963). However, it is important to note that the use of small unretouched blanks has been recorded in a number of archaeological contexts, such as in the Robberg of southern Africa (Mitchell, 2002, 1995).

3.2. Uses

It is generally assumed because of their small size that microliths were used as part of composite tools. Direct evidence of the use of microliths as inserts and tips in hafts is found in the archaeological record and ethnographic literature from at least the end of the LGM through until the 19th century (J. D. Clark, 1975; Davidson, 1934; Goodwin, 1945; Larsson and Sjöström, 2011; Sinitsin and Praslov, 1997). However, diagnostic projectile damage has been observed on microliths from archaeological contexts using macro- and micro-fracture analysis (Villa et al., 2010; Yaroshevich et al., 2010) and it is argued that the earliest fully established microlith tradition dates from ~71,000 years at Pinnacle Point (South Africa)(Brown et al., 2013).

In addition to the use of microliths in hunting technologies, a wide range of hafting possibilities exist and hafted microliths may have been utilised for tasks including "…plant-gathering, harvesting, slicing, grating, plant-fibre processing for lines, snares, nets and traps, shell openers, bow-drill points and awls…[and]…fish hooks…" (Clarke, 1976, p. 452)(Fig. 3.1). Certainly, the use of microliths in plant-processing activities appears well ascertained, with composite tools resembling harvesting knives and sickles having been discovered in a number of archaeological contexts (G. A. Clark, 1975; Garrod, 1932; Gurina, 1956; Solecki, 1963) and silica-rich residues having been identified on microliths (Semenov, 1964).

Unfortunately, whilst the archaeological record provides evidence of possible uses it is unlikely that the full range of diversity is represented. Bone, antler, wood, sinews, plant fibres, resins, and other materials utilised in hafting are unlikely to survive in most archaeological contexts, obscuring our understanding o the ways that microliths were incorporated into hafts and used. Nonetheless, the current evidence indicates that microliths played a number of different subsistence roles. In fact, it is this versatility, the ability to be incorporated into a variety of different tool forms, which probably made microliths an attractive technological choice across so many temporal and geographical contexts (Neeley, 2002).

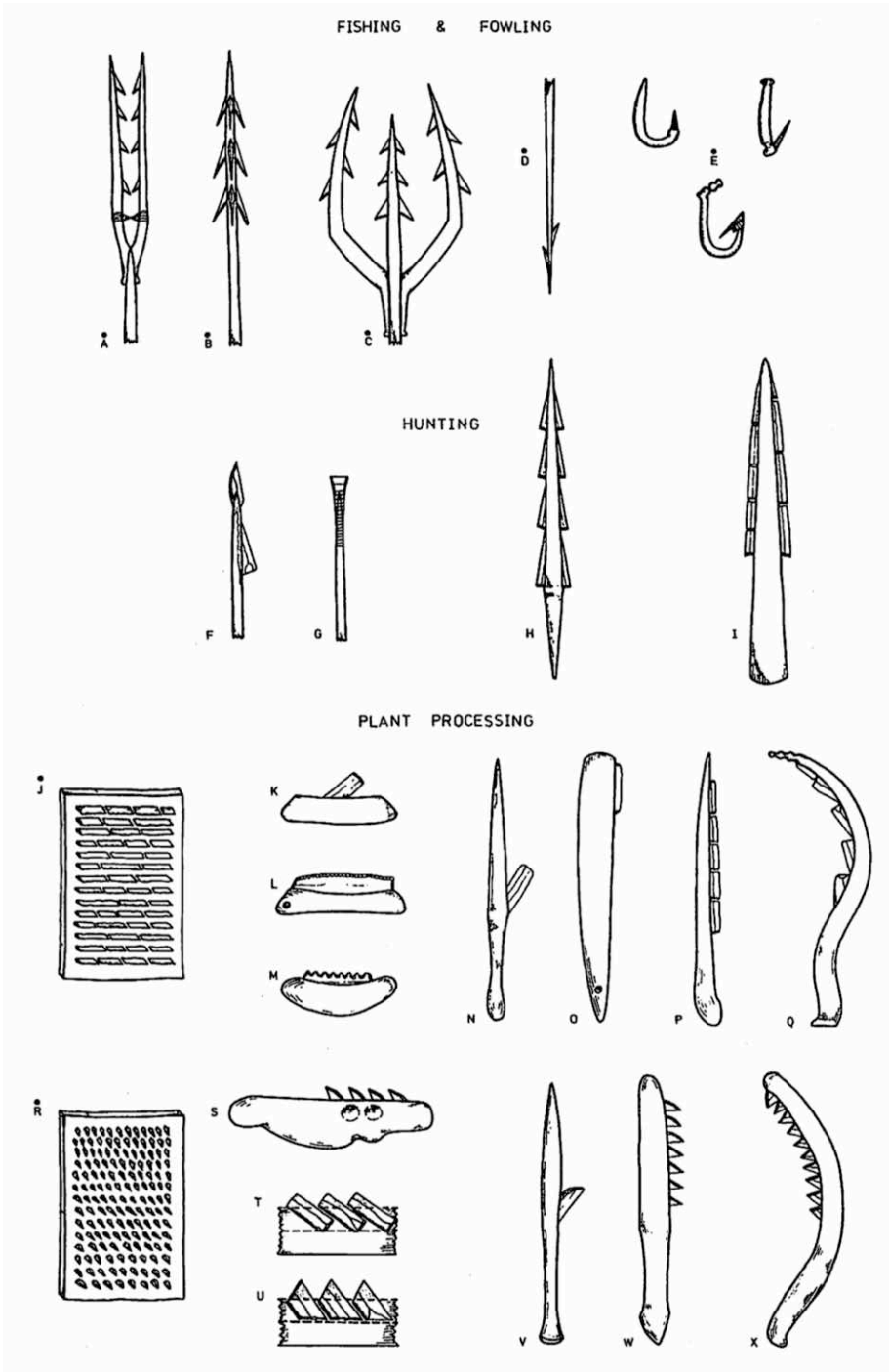


Figure 3.1. Hafted composite tools set with microliths (Clarke, 1976)

There is little direct evidence for the use of microliths in Northwest Africa. A complete sickle haft retaining three microlithic backed inserts has been uncovered from a Holocene LSA context at the site of Columnata (Cadenat, 1960; Tixier, 1960). No other hafted examples have so far been identified. The potential uses of microlithic tools are poorly documented in the Pleistocene LSA. A basic study of backed bladelets from Tamar Hat (Algeria) has indicated the presence of impact and edge damage consistent with their use as tips of projectile points (Merzoug, 2008; Sari, 2014). This appears to fit well with preliminary use-wear work conducted on a handful of specimens by K. Kyung-Jin, which has shown wear related to contact with soft animal tissues (reported by Sari, 2012). However, there are currently insufficient data available to isolate the functional role(s) that microliths played at this time. There is a clear need for comprehensive microwear, residue, and experimental studies, into the uses of microliths during the Pleistocene LSA of Northwest Africa.

3.3. Variation

In the early years of archaeology scholars sought primarily to identify a limited number of characteristic artefacts that served as index fossils (so-called *fossiles directeurs*) for particular epochs (de Mortillet, 1900, 1883). Few explanations were put forward concerning the sources of variability, with the focus being on the description of humans in deep time and their presumed unilinear evolutionary development (Trigger, 2006). In subsequent years, under the culture-history paradigm, variability in these *types* came to be predominately described in terms of *style* and associated by scholars with different ethnic groups. However, archaeologists rarely clarified what was meant by the term style (Dunnell, 1978).

This has largely continued to be the basis for discussing variability within Pleistocene LSA of Northwest Africa. It is not necessarily the case that other factors have not been considered significant, but style continues to be emphasised. For instance, although Lubell et al. (1984) moved away from the idea that "pots equal people", or stone in their case, and discussed the role of geography and environment, they still emphasised style as a primary factor driving artefact diversity. Whilst most recently authors have stressed alternative *functional* reasons for variation (Sari, 2014, 2012), there still has been little overt discussion of the causes of variation within lithic assemblages in the area (with the exception of the work of A. Close).

In general, there are broadly thought to be two potential sources of stylistic variation. The first of these consists of *active* style (Sackett, 1986a). This concept of style has been developed to a large extent by Wiessner (1997, 1985, 1983). Building on ideas outlined by Wobst (1977) she suggests that style functions as a means of information exchange with individuals establishing, maintaining, and reproducing stylistic choices as a form of social communication. For instance, amongst the !Kung San, projectile points carry information about group affiliation and boundaries (Wiessner, 1997, 1983).

In a few circumstances lithic artefacts appear to have played an important 'active' stylistic role, as is likely the case with the so-called 'eccentric' pressure-flaked artefacts of Mesoamerica (Benin and Pasztory, 1993; Schele and Milla, 1986). However, it seems unlikely that all flaked stone artefacts were imbued with the same social significance. In general, microliths are small and have a short use-life, meaning a person has little time, and must be extremely close, to identify features that might carry social information (C.Barton, 1997). However, the hafting arrangement, or haft itself, may have communicated social information. For instance, decorated sickle hafts with zoomorphic carvings have been recorded in the Natufian (Bar-Yosef, 1998). However, whilst we may be able to identify potential carriers of *active* style, it is unrealistic to expect to understand variation from an *emic* perspective, that is, in terms understood by its original creators.

The second form of style might best be referred to as *passive*. This at its base level is simply the premise that variability resides in material culture that was not deliberately introduced by the artisan during its creation and reflects a particular way of doing things. Sackett (1986a, 1986b, 1982, 1977) discussed style as an inherent property of all material culture that resides in the range of equally efficient means or *isochrestic* (literally "equivalent of use") alternatives for achieving a single goal. This might be described simply as the idea that two functionally identical artefacts can be made using a variety of different methods and have distinct forms. He suggested that material culture is socially bounded and largely dictated by the artisan's technical knowledge, which has been acquired from other members of the same social group. Thus, by extension, artefact form reflects not only function, but also social group affiliation or *ethnicity*.

Sackett's (1986a, 1986b, 1982, 1977) *isochrestic* variation is an important concept as it recognises that culturally prescribed methods of doing are not necessarily distinct or extraneous from

function, yet endorses an etic perspective of variation within the archaeological record, in contrast to the view espoused by the *chaîne opératoire* (see below). This is necessary as there are no artisans remaining to ask about the importance of variability from their own perspective in the study of prehistory (Clark and Lindly, 1991).

A criticism that might be made of Sackett's *isochrestism* is that it fails to recognise the cultural evolutionary ramifications of the use of one technological option over another, which is a criticism that has also been made of the *chaîne opératoire* (Tostevin, 2011, p. 355). However, this is not necessarily the case. Whilst a technological solution may prove advantageous in terms of its extractive abilities, there are costs associated with the transfer of technological knowledge between individuals and populations. These costs may outweigh the benefits that come with adopting a technology (Richerson and Boyd, 2005). Thus, the possibility persists that *isochrestic* variation is not restricted to allopatric, geographically isolated, populations.

Unfortunately, Sackett's (1986a, 1986b, 1982, 1977) discussion on *isochrestic* variability does not provide a very satisfactory method for its investigation This is unsurprising given that his work is primarily theoretical rather than methodological. What is of importance is his suggestion of the need for a dualistic approach to empirical data, with the recognition of, and willingness to juggle with the simultaneous roles that formal variation can play in both stylistic and functional realms. This may be more fruitful than adopting either, a strict *normative* (culture-historical) approach that has tended to presume variation is ethnically significant, or a stringent *systemic* (processual) paradigm, that appears "bound to commit the same error in reverse" (Sackett, 1986b, p. 633).

In contrast, Dunnell (1978) advances the notion that style and function are a fundamental dichotomy. He suggests that style is under little selective pressure as it is adaptively neutral and is therefore equivalent to stochastic variation. It is nevertheless in some ways similar to Sackett's (1986a, 1986b, 1982, 1977) *isochrestic* style in that it is passive; being passed on through social interaction (C.Barton, 1997, p. 142).

Close (1989, 1978, 1977) attempted to apply this concept to the study of microlithic assemblages from North Africa, including some of the Iberomaurusian assemblages from the

Maghreb. She sought to identify stylistic attributes on microliths by showing that they had no functional or adaptive underpinning, excluding characteristics *a priori* in advance of study. She identified the side (sinister, dexter), type (Ouchtata, obverse, inverse, *sur enclume*), and end (distal, proximal) of retouch as stylistically determined attributes having attempted to exclude alternative functional explanations.

In contrast to the established trend, interpretations that stress non-stylistic factors in shaping microlith variability have appeared sporadically over the last 20 years. This has followed in the wake of research on the study of technological organisation and sequential approaches to lithic artefacts (Bamforth and Bleed, 1997; Binford, 1979, 1973; Bleed, 1986; Nelson, 1991). In particular, *design* is one mechanism by which groups implement technological strategies to deal with social and economic concerns within the bounds of the environmental conditions of a given situation (Nelson, 1991). In this respect *design* is considered in relationship to function rather than as an artistic principle.

Binford (1979, 1973) introduced two design principles to the discussion of tool variability, *curation* and *expediency*. He refers to curated tools as having been produced in advance to meet the requirements of an anticipated task and involving high-levels of transport, reuse, repair, and recycling. In contrast, an expedient tool is one manufactured according to an immediate need that is usually discarded directly after use. Binford and Binford (1966) also distinguished between *extractive* tasks focused on the procurement of subsistence items or raw materials (e.g. hunting, fishing) and *maintenance* tasks related to the processing of already procured resources (e.g. hide-working, tool-production).

Bleed (1986) introduced the terms *reliability* and *maintainability* from the field of engineering to help better describe curated tools. To summarise, a reliable tool is designed to perform consistently and predictably. They will often have multiple components or backup options to ensure the tool functions successfully. These tools are often intricately designed. For example, the foreshafts of Inuit seal hunting harpoons were especially strengthened, with complex bindings and the use of multiple materials (Boas, 1964, p. 63). What distinguishes maintainable tools is that they are easily repaired. This may be done during the course of an activity with no clear separation between maintenance and

use phases. For instance, amongst the Sanuma (Yanomano) arrows consist of a simple shaft with interchangeable heads that can be slotted into place or manufactured on the spot (Taylor, 1974, pp. 21–1).

Bamforth and Bleed (1997) highlight that these technological considerations have different attendant costs in terms of the time and energy needed for procurement and production. Specifically, they link technological strategies to risk. In brief, they consider two components of risk; *failure probabilities* and *failure costs*. The former is the likelihood that an individual will not succeed in completing a task and the latter is the magnitude of harm resulting from failure. They show that technology helps to negate the cost of failure by ensuring that it is able to fulfil the required task. The selection of a particular technological strategy reflects the most optimal or efficient choice in balancing the technological costs with the cost of failure.

It is most often argued that the curation of tools and use of more efficient technological strategies is more commonplace in more sedentary groups with low residential mobility, whilst expedient tool use and less efficient strategies are the focus of highly mobile groups (Andrefsky, 1994; Bamforth and Bleed, 1997; Binford, 1979, 1973; Bleed, 1986; Nelson, 1991). However, Bousman (2005) has shown that this pattern is oversimplified and does not adequately explain the behavioural data from the ethnographic record (Gould, 1980; Lee, 1979; Osgood, 1940). Instead, Bousman (2005) showed that the principles of tool curation and expediency are used to manage different aspects of the technological requirements in both hunter-gatherer groups employing high and low residential mobility. In the case of the LSA of Southern Africa, he suggested that highly mobile groups favour the repair of extractive tools, but an expedient strategy for maintenance tools. Whilst more sedentary groups favour reliable extractive tools that are replaced rather than repaired, but invest more time in the repair of maintenance tools.

The role of efficiency is much discussed as a reason for the adoption of microlithic technologies (Ambrose, 2002; Belfer-Cohen and Goring-Morris, 2002; Bleed, 2002; Goebel, 2002; Hiscock et al., 2011; Neeley, 2002; Straus, 2002; Yesner and Pearson, 2002). Microliths are considered to be transportable, multifunctional, interchangeable, economical, and easy to manufacture.

However, few attempts have been made to link the differences in microlith form to different design considerations. Some important exceptions are discussed below.

Neeley and C.Barton (1994) have suggested that variation in microlith assemblages in the Levantine Epipalaeolithic represents the selection of the most effective strategies for dealing with different mobility and raw material constraints. Instead of representing different stylistic groups they suggested that the principal difference between the Mushabian and the Geometric Kebaran was linked to raw material availability. The authors argued that the latter techno-complex represents assemblages with scarce raw materials and therefore smaller microlith forms were selected and microburins modified into geometrics rather than discarded (Fig. 3.2)(contra Fellner, 1995; Goring-Morris, 1996; Henry, 1996; Kaufman, 1995; Phillips, 1996).

Yaroshevich et al. (2010) have suggested that the various microlith types are associated with different projectile hafting configurations that provide the optimal technological solution in a given situation. For instance, they suggest that the adoption of lunates in the Natufian reflects the demand for a simple and more efficient technology, requiring less time investment in preparation and retooling in order to sustain larger and more sedentary communities.

Design considerations probably also played a role during Holocene LSA in Northwest Africa. Here the proliferation of geometric microlith forms has been tied with the development of the pressure-flaking technique. It has been very reasonably proposed that this method of blank production is extremely efficient and allowed the hunter-gatherers to become less dependent on fixed raw material sources and extend their range in face of changing environmental conditions ~ 8.2 ka cal BP (Jackes and Lubell, 2008; Rahmani, 2004; Rahmani and Lubell, 2012).

There appears to be an inherent assumption in the work of some scholars that functional explanations hold more weight than stylistic ones. In fact some *hyper-functionalists* doubt the ability to identify any form of stylistic traditions in stone-tool industries due to the coarseness of the archaeological record during this period (C.Barton, 1997; Clark, 1989; Clark and Lindly, 1991). Conversely, the same could be said of understanding any aspect of the archaeological record. How can we recognise an element of material culture as adaptive or efficient if our knowledge of the ecological

setting is poor? In my view, the main problem with such approaches is that in their eagerness to move away from stylistic explanations of artefact variation they make preordained functional interpretations of variability. In other words, there is a need to demonstrate through palaeoenvironmental and radiometric evidence the co-occurrence of changes in material culture with climatic shifts and/or particular ecological zones, rather then assuming any such relationship. Likewise, there is a need to show that stylistic variability transcends such boundaries.

Those denying a relationship between socially learned behaviour and utilitarian behaviours seem to base this on the idea that the production of lithic technology was simple and straightforward. For instance, G. Clark (1996, p. 139) suggests that "there are only a few ways to back a bladelet, all of them immediately apparent to even an exceptionally stupid rock-knocker" and C. Barton (1997, p. 145) has suggested that this can be extended to all lithic technologies. I find these generalisations rather simplistic: they make unwarranted assumptions about the skill, or lack there of, involved in making stone-tools, do not adequately account for the costs involved in learning, and encourage unsatisfactory explanations for variation that is clearly visible in many lithic industries.

This section highlights some of my own biases and, to be explicit, it is my view that whilst individuals will choose the best solution to mitigate subsistence risk, the viable set of options is constrained by social learning. These socially mediated 'choices' can be considered stylistic in that they reflect a manner or a way of doing. Whilst research into variability in microlithic assemblages falls broadly into two theoretical camps: one that emphasizes the role of social factors in shaping the material record and the other that places importance of the economic benefits of different technological strategies – I believe there is a need to accept the dual nature of variability.

3.4. Methodologies

3.4.1. Typological Classification

Up until recently, most studies of variability within the microlithic industries of Northwest Africa have been dominated by the typological approach. This involves the classification of microliths and other artefact forms into distinct categories based on similar characteristics. It is not in itself emic in outlook, as it is primarily concerned with permitting the description and quantification of variability in

time and space. However, in its early culture-historical use few attempts were made to understand the relationship between form and type, and instead, 'types' were associated with, and thought of as expressions of inherited cultural behaviours, that is to say ethnicity. Thus, whilst the theoretical basis for typological classification is empirically grounded, an inherent notion of types as emic units prevailed, which could not be explicitly tested (Dunnell, 1986, 1971).

Initial reaction against typological approaches was largely a response against the assumed stylistic, and by extension ethnic, importance of variability, rather then a criticism of reality of the type units themselves. In actuality typologies often incorporate more than just formal variability. Neeley & C. Barton (1994) have suggested in relation to the microlithic assemblages of the Levantine Epipalaeolithic that backed bladelet and geometric microlith types represented stages within the continuum of manufacture, rather than ideal static types (Fig. 3.2). For instance, *La Mouillah points*, defined by the retention of a microburin facet at one end, were argued to represent an intermediate stage in the process of making certain backed bladelet forms, which were probably only rarely used in their own right. However, presumably stone-tool manufacturers had at least some ideal types in mind, especially considering the need for reproducibility and standardisation in order to mount microliths within the haft.

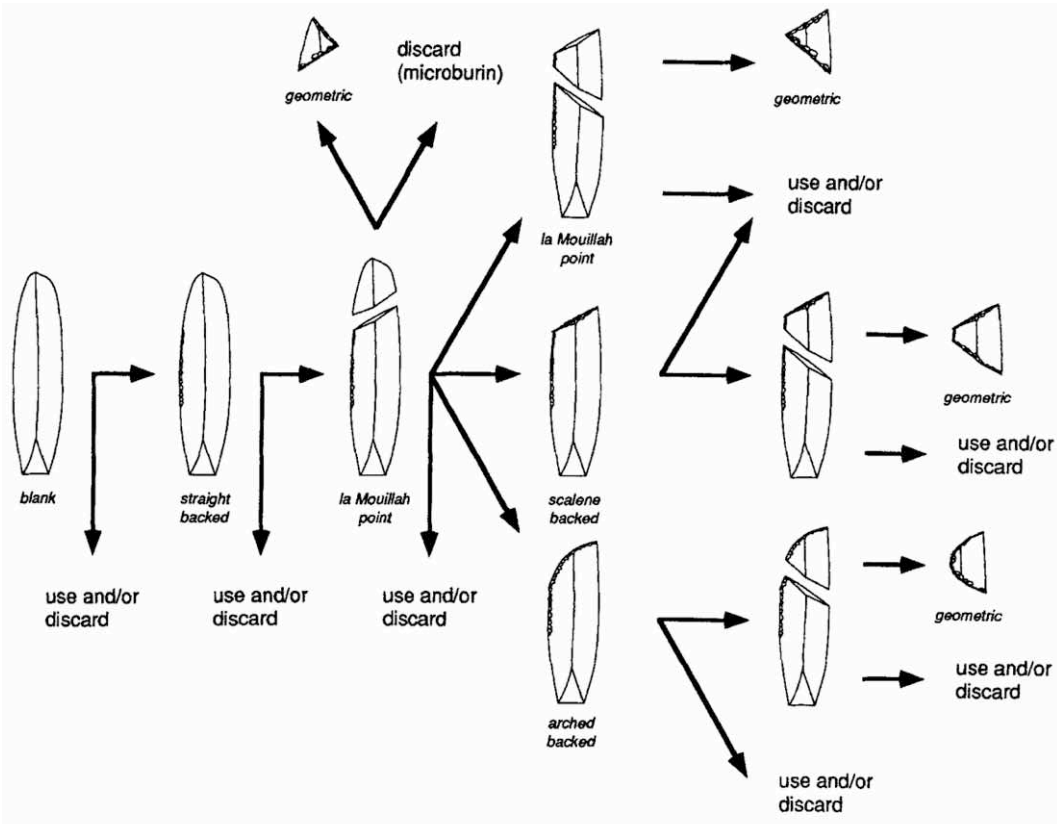


Figure 3.2. Hypothesised manufacturing trajectory of microlith types (Neeley and C. Barton, 1994)

Despite the lack of interpretative strength typological classification still plays a major role in the study of lithic assemblages. Nonetheless, problems persist in attempting to understand variability through typological data, as in some cases predefined and finite type-lists do not appear to account for the range of variation observed in an assemblage. In North Africa, a number of scholars have attempted to deal with this issue by defining additional types or sub-types (Close, 1977; Lubell, 1974; Phillips, 1973) within traditional tyologies (Tixier, 1963). However, this is problematic as it makes it more difficult to compare assemblages. This is due to the fact that earlier works may have simply subsumed variability into pre-existing categories, rather than defining new types. Thus, it is not possible to distinguish between genuinely distinct artefact assemblages and those that have been investigated via an alternative method.

In addition, classification consistency appears to be an issue with some typologies, with error occurring as a result of ambiguous definitions and the systematic bias of investigators to classify artefacts as particular types (Whittaker et al., 1998). The question of classification consistency has not been directly tested in relation to the microlith typologies in use in the Maghreb. However, vague

definitions that might lead to inconsistencies between analysts are apparent. For instance, Close (1977, pp. 37–41) defined seven sub-types within Tixier's (1963, pp. 113–5) *scalene bladelet*, including one form she described as "… a bladelet with straight backing on one edge which forms a point at one end, and the other end is contiguous with a truncation with which it forms a clearly marked, more or less obtuse angle. This may in effect, be an elongated scalene triangle…" (Close, 1977, p. 40). There appears to be no fixed attributes whatsoever in distinguishing this sub-type from Tixier's (1963, p. 134) *elongated scalene triangle* other then a feeling that the former "…are *usually* larger and more irregular…"[own emphasis](Close, 1977, p. 40).

Despite these difficulties, the majority of research into microlith assemblages has sought to understand variability through existing typologies and therefore we are left with a dilemma. Whilst there are inherent problems with research due to the issues with existing typologies, these data form the basis of our current understanding, and thus it is not possible to abandon this form of classification in its entirety. In the study of the Pleistocene LSA of Northwest Africa, the exclusion of typological data would be particularly problematic, as nearly all distinctions between assemblages are based on traditional typologies. Type counts provide the dominant form of numerical data, which is essential if one is to compare assemblages with any attempt at scientific rigour.

Furthermore, some of these distinctions are meaningful and have utility. For instance, traditional typologies have been used to group assemblages into 'cultures', which have subsequently been shown using radiocarbon dates to be restricted to specific timeframes, as is the case for the distinction between Iberomaurusian and later industries (see Chapter 2). Thus, whilst there are problems in constructing histories using artefact variability (e.g. homoplasy – the appearance of a trait in two or more populations that has similar form or function, but does not share a common origin), typologies can nonetheless provide an alternative method of time-classification to radiocarbon dating and other absolute chronological methods. This is especially useful in areas where there are very few determinations, with most sites lacking absolute dates, such as with the study of Pleistocene LSA in Northwest Africa. Typology can therefore provide an effective means, albeit with limitations, for describing differences and similarities between assemblages.

Importantly, typology provides an indispensible *lingua franca* for the description of artefacts, helping to aid communication between researchers (Close, 1986, pp. 169–70). Whilst there is the potential issue of classification inconsistency, research indicates that broad typologies can be applied in a consistent manner (Whittaker et al., 1998). It may be possible to reduce error in existing microlith typologies by subsuming types that are repeatedly the subject of contention between researchers and by looking for attributes that *must* exist in defining types, rather than those that 'might', 'often', 'usually' or 'sometimes' exist. This may be achieved through the comparison of definitions in order to highlight the important attributes to be considered in assigning an artefact to a particular type (Dunnell, 1971, p. 139).

3.4.2 Sequential Approaches

There has been a broad shift in lithic studies within recent years towards sequential approaches to the study of assemblages, although this approach has only recently used in relation to the Pleistocene LSA of Northwest Africa (Sari, 2014, 2012). In common with all sequential approaches is the attempt to arrange the products and by-products of the stone-tool manufacture into a temporal framework, that is to time order the steps used to produce an artefact, rather than focusing solely on what is assumed to be the final tool form, as is espoused by a traditional typological approach (Bleed, 2001). Two major approaches have been adopted in the west: the French *chaîne opératoire* and the American reduction sequence. Shott (2003) has suggested that the two approaches are essentially the same thing, capable of addressing the same questions. However, there are fundamental differences between the *chaîne opératoire* and the American reduction sequence.

The concept of the *chaîne opératoire* has its origins in ethnography and the idea that techniques enacted by the artisan are a reflection of the social traditions (Leroi-Gourhan, 1993, 1945, 1943; Mauss, 1935). The broader ethnographic background of the *chaîne opératoire* means that the concept has been adopted for understanding a wide range of technologies (e.g. Lemonnier, 1992, 1989, 1980; Pétrequin and Pétrequin, 1994). In contrast, the reduction sequence is firmly based in the American archaeological tradition (Holmes, 1894) and as such, is restricted to chipped-stone technology.

The *chaîne opératoire* is conceived by its proponents as providing its own questions (high-level theory) and analytical method for addressing these questions (Audouze, 1999). In lithic studies, the objective of the *chaîne opératoire* is the identification of variability in chipped-stone assemblages that reflects the technical knowledge (*savoir faire*), and ultimately the cognitive decisions of knappers (Soressi and Geneste, 2011). In this respect there are similarities with Sackett's (1986a, 1986b, 1982, 1977) *isochrestism* in material culture. However, the two differ in that the proponents of the *chaîne opératoire* are interested in showing that individuals recognised and selected particular technical options from a range of known alternatives. Thus, practitioners of the *chaîne opératoire* are involved with the goal of seeking emic distinctions in material culture. Hence the emphasis on the identification of 'ethnic groups', 'socially bounded entities', 'cultures' or whatever terminology one might happen to adopt. However, this perspective is epistemologically invalid in the study of prehistory, as no artisans remain to provide an emic standpoint (Clark and Lindly, 1991).

In general, proponents of the *chaîne opératoire* rarely acknowledge or discuss their theoretical goals (Sellet, 1993). In contrast, proponents of the American reduction sequence commonly discuss the high-level theoretical basis of their work. The vast majority of work has been primarily been concerned with answering questions from evolutionary ecology through the middle-level theory of technological organisation (e.g. Andrefsky, 1994; Bamforth and Bleed, 1997; Binford, 1979; Bleed, 1986; also see below). However, attempts have been made to tackle the questions relating to differences in technological procedures resulting from different group affiliation (Sackett's *isochrestic* variation) (Close, 1989, 1978, 1977; Mackay, 2011). Importantly, as the higher-level goals are not integrated into the American reduction sequence to the same extent as the *chaîne opératoire*, the former might be used to answer a broader range of questions.

Despite these differences there are a number of similarities between the two approaches. For instance, both the *chaîne opératoire* and the American reduction sequence have adopted ethnography, experiment replication, and refitting, to better understand the technological procedures involved in stone knapping. The methods of gathering data utilised in both the *chaîne opératoire* and American reduction sequence also have similarities. For instance, both often utilise attribute analysis in describing the products and by-products of stone-tool manufacture. However, whilst quantification

and standardisation in recording is integral to the American reduction sequence, proponents of the *chaîne opératoire* have largely rejected these procedures (Soressi and Geneste, 2011). The problem is that "the absence of standard reporting of data produces a scientifically unconvincing argument beyond the appeal to authority" (Tostevin, 2011, p. 356). Nonetheless, the adoption of sequential models in different contexts, developing from different traditions probably says something about the utility of the approach for studying variability over that of traditional typology (Bleed, 2001). In light of the weaknesses of the *chaine opératoire,* a sequence approach is adopted here more in keeping with the American tradition.

Chapter 4

Grotte des Pigeons, Taforalt (Morocco): Background

4.1. Location

Grotte des Pigeons (34°48'38"N, 2°24'30"W) is situated in the Eastern Rif in northeast Morocco (Fig. 4.1). The cave lies about 500 m east of the village of Taforalt and around 55 km northwest of the regional capital of Oujda. It is located in an upland massif known as the Beni Snassen Mountains and lies about 720 metres above sea level.

The cave is situated halfway up a cliff of dolomitic limestone that dates to the Kimmeridigian, having formed by the erosion of an ancient karstic fill consisting of travertines and fluvial conglomerates. It overlooks an intermittently fed tributary of the river Zegzel. This river cuts through the Beni Snassen Mountains, forming a natural pathway to the river Moulouya and beyond to the Mediterranean Sea, which lies about 40 km north of the site. The cave is well lit and spacious. The mouth of the cave is about 30 m wide and the roof of the cave reaches about 15 m above the present floor. The present floor covers ~400m^2, with the main chamber extending about 25 m back from the mouth the cave.

Today the cave falls within the 'thermo-Mediterranean' biozone (Blondel and Aronson, 1999). The vegetation cover consists of Aleppo pine (*Pinus halepensis*) together with evergreen oak (*Quercus ilex*) and cypress (*Tetraclinis articulata*), which has been much reduced due to human overexploitation. Water is at a premium in the region, suffering from a summer water deficit, with annual rainfall only 400 mm and a mean annual temperature of ~18 ˚C (Courty and Vallverdu, 2001).

The first mention of the site in the archaeological literature was in the early 20th century by Pinchon (1908) who referred to it by the name of Aïn Taforalt. It had previously been called 'Kef en Najjar' (Carpenter's Cave) by the local Berber population, after a craftsmen who reputedly once lived there (Roche, 1953, p. 89). Since the first major excavations in the 1940s the site has been most frequently referred to as 'Grotte des Pigeons' (Cave of Pigeons) or 'Taforalt', and in the following these terms are used interchangeably.

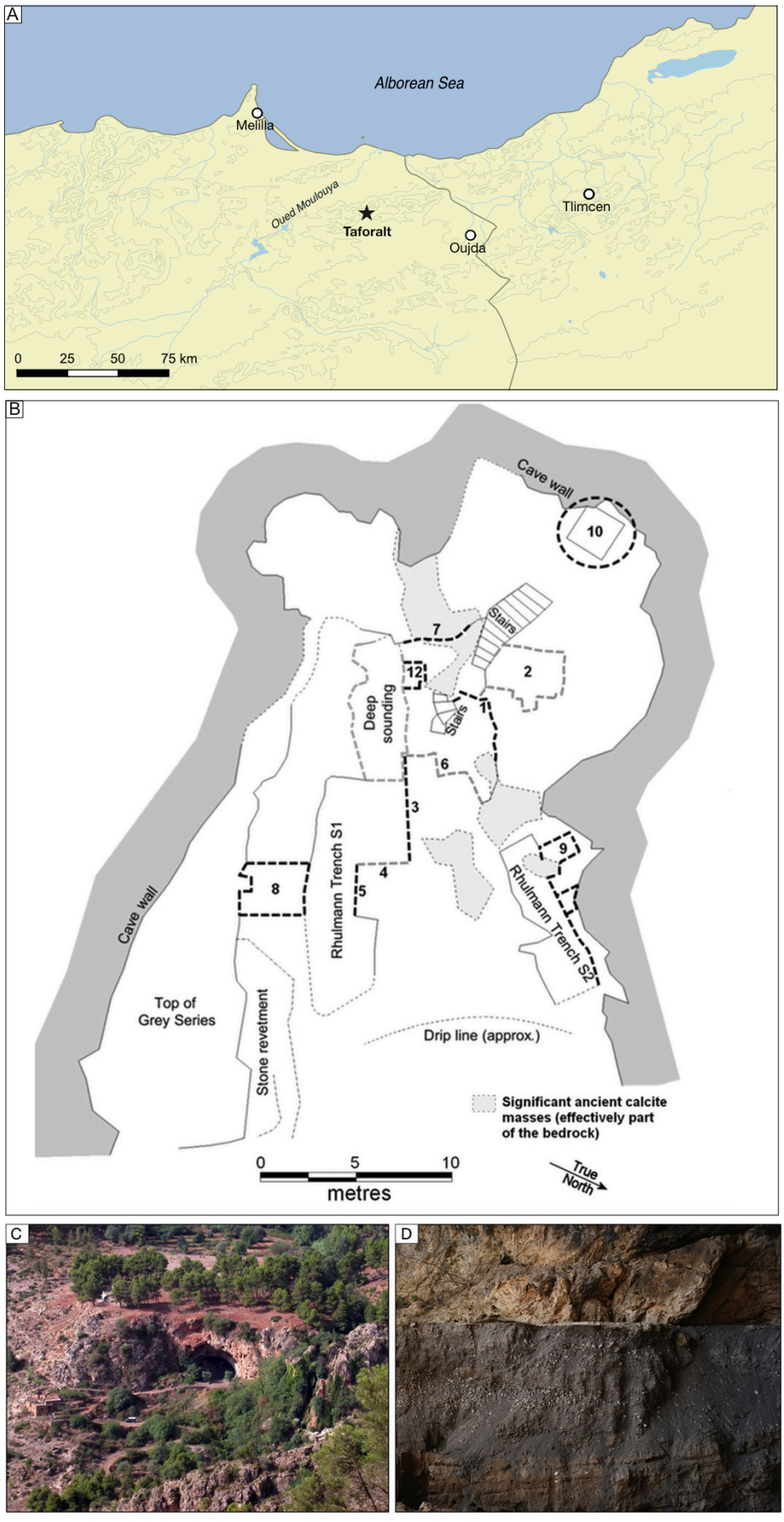


Figure 4.1. Grotte des Pigeons (Taforalt): Site information
a) location; b) floor plan; c) external view; d) main stratigraphic profile in Sector 8

4.2. History of Research

Discovery & Early Research

The cave was first discovered in 1907 (Pinchon, 1908). The site received little attention following its initial discovery and was left largely undisturbed apart from some small excavations first by R.P. Bienvenu Blondeau, a local priest from Taforalt (probably in 1932), then by M.J. Marion, which established the existence of *in situ* 'Iberomaurusian' finds (Ruhlmann, 1945, p. 81). In 1939 the French military, recognising the strategic importance of the site, artificially levelled the floor to accommodate men and livestock. Fortunately for later archaeologists, lime mortar was used to cap the sediments and dampen the effects of dust, which helped to preserve the remaining deposits (Roche, 1963, p. 46).

Excavations 1944-1947

In 1944, A. Ruhlmann began the first major excavations at the site, conducting work over three seasons in 1944, 1945, and 1947. During the first two seasons an extensive trench (S1) about 18 m long, 2 m wide and 7 m deep, as dug on the south side of the cave. In the final season a second trench (S2) covering a similar area but slightly shallower was dug on the north side of the cave. Plans to continue work at the site were brought to an end with the untimely death of Ruhlmann, who died as a result of a fall at El Aïoun in eastern Morocco on May 15th 1948. There is little known of this work except that reported by J. Roche, who wrote an initial report on the excavations (Roche, 1953) and later referred to – now missing – excavation notes (Roche, 1963, pp. 46–7). Based on the information given by Roche (1953) the cave sediments were divided into ashy (upper) and yellow (lower) clays. The upper ashy series were subdivided into three levels (*niveaux* A, B, and C), each separated by a bed of pebbles, and the lower yellow clays were subdivided into five levels (*niveaux* D, E, F, G, and H). He concluded that the site was occupied during the Iberomaurusian (a term he used synonymously with Mesolithic in the paper), Aterian, and Mousterian. In addition, it was suggested that the Iberomaurusian could be divided into two more recent assemblages (*niveaux* A and B), which resemble the collections from La Mouillah, and an older assemblage (*niveau* C) that was "…less microlithic and where the oldest influences are felt…*"* (Roche, 1953, p. 115, own translation).

Excavations 1951-1955

In 1951, J. Roche began his own excavations focusing on the Pleistocene LSA, which he referred to as the *Épipaléolithique*. He excavated over five seasons between 1951 and 1955 (Roche, 1963, 1959a, 1959b, 1955, 1953)(Fig. 4.2). In 1951, a trench about 6.6 m long, 3.3 m wide, and 1.6 m deep, was excavated across the middle of the site in square coordinates F-M/20-21, joining the trenches S1 and S2 (Roche, 1963, p. 47). In addition, the ashy sediments abutting the cave wall to the north of trench S2 were removed from grid squares Q-R/18-29. The first evidence of human burials were recorded at the time with the discovery of a parietal bone whilst section cleaning (Roche, 1963, p. 47, 1955).

In 1952, section collapse led to the discovery of two more or less complete skeletons associated with the LSA, which lead to the excavation of a small exploratory trench in grid squares L-N/14-15in and resulted in the recognition of a *nécropolis* or cemetery. In 1953, extensive removal of sediment was undertaken from either side of the transverse trench. Near the front of the cave the sediments were excavated from grid squares B-R/22-36 in order to grant better access to the burial area. However, large areas were not fully investigated and the sediments were simply discarded (Roche, 1963, p. 48). In the following two seasons the cemetery was excavated with the help of A. Jodin. During this period a large ellipsoidal area, 10 m long and 7 m wide, was removed towards the rear of the cave, covering approximately square coordinates M-S/10-18. There is also a brief note that work began on a second cemetery in the extreme west of the cave (ibid).

Work ceased at the site in 1955 to allow for the preparation of the site monograph. In this publication, Roche (1963) divided the upper ashy series into nine levels. The uppermost eight (*niveaux* I-VIII) were described as being characterised by alternating layers of powdery ash, more or less continuous beds of small limestone blocks with evidence of burning, hearths, and beds of terrestrial mollusc remains, sometimes crushed through trampling, whereas the basal level (*niveaux* XI) was described as characterised by brown-red earth lenses mixed with ash and clay. Radiocarbon determinations were published from *niveaux* II, VI, and VIII, and from the cemetery, which indicated for the first time the extension of the LSA before 10,000 years ago (Roche, 1963, 1959a, 1959b)(Table 4.1).

The monograph focused primarily on the typological description of the lithic assemblages. In concluding, Roche (1963, p. 236) suggested the LSA horizons were relatively homogenous and this might be explained by limited outside influence due to the isolating effects of the local geography. Nonetheless, he noted the following trends: microburin products (including La Mouillah points) became less important through time; *lamelles à dos arqué* (curve backed bladelets) were replaced by higher frequencies of *lamelles à dos convexe* (convex backed bladelets) and *lamelles à dos rectiligne* (straight backed bladelets); geometrics, specially segments, were most common towards the top of the sequence (1.07% in *niveau* II); and, in parallel, backed bladelet forms became more regular (Roche, 1963, pp. 234–5).

In contrast to the lithic assemblages, the fauna, microfauna, mollusca, and wood charcoals, received little attention, with only the presence/absence of each species given (Roche, 1963, pp. 152–4). Likewise, whilst the human skeletal remains were studied from a physical anthropological perspective in a separate monograph (Ferembach et al., 1962), there is little information regarding their context, arrangement, or associated artefacts, despite the brief mention of future publications that would cover such issues (Roche, 1963, p. 48). Ferembach et al. (1962) suggested that there were 80 adult individuals and 100 sub-adults from twenty-eight multiple graves.

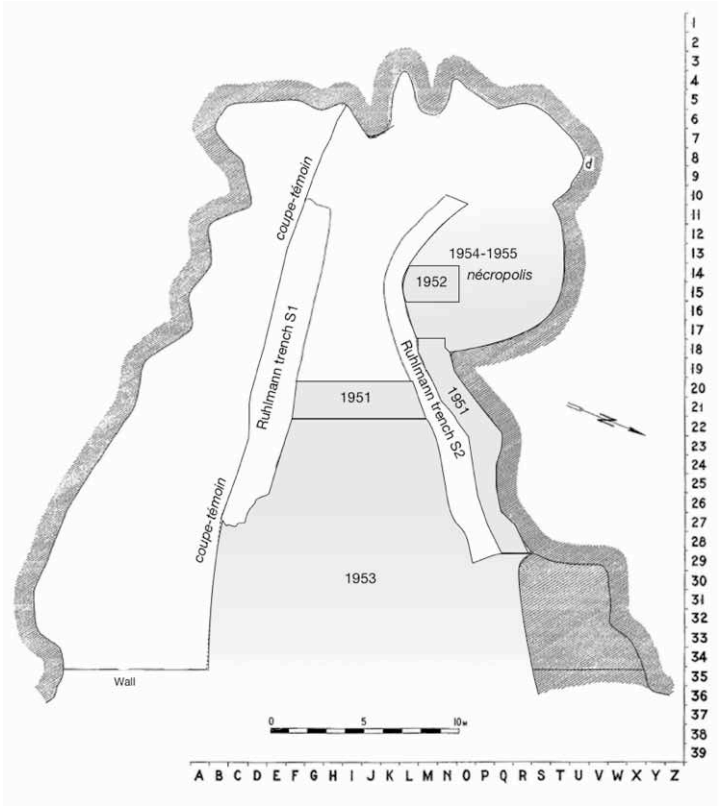


Figure 4.2. Grotte des Pigeons (Taforalt): Plan of 1951-1955 excavations.
(The location of excavation trenches is based on the available published information given by Roche, (1963))

Table 4.1. Grotte des Pigeons (Taforalt): Radiocarbon determinations from 1951-1955 excavations

Lab No.	^{14}C	cal BP (95.4%)[a]	Material	Context
Sa-13	10,800±400	13,474-11,406	Charcoal	Level 2
Sa-14	12,070±400	15,359-13,140	Charcoal	Level 6
Sa-15	10,500±400	13,162-11,197	Charcoal	Level 8
L-399E	11,900±240	14,639-13,257	Charcoal	Necropolis

a. All cal BP determinations are corrected using IntCal13 (Reimer et al. 2013) and OxCal 4.2 (Bronk-Ramsey 2009).

Excavations 1969-1972

In 1969, J. Roche restarted work at the site as part of a joint collaboration between the Service marocain de l'Archéologie and the Mission archéologique française (Delibrias and Roche, 1976; Roche, 1976, 1975). Between 1969-1972 the team excavated four trenches; a longitudinal trench in grid squares H-L/18-24 with a maximum depth of 4 m, and three traverse trenches in grid squares I-K/18-19, H-E/17-18, and L/19-21 with maximum depths between 1.6 and 2.2 m (Fig. 4.3).

Based on these excavations the lower yellow clay sediments were divided into twenty levels. The uppermost eight (*niveaux* X-XVII) were described as 'Epipalaeolithic' and the lower eleven

(*niveaux* XVIII-XXIX) as 'Aterian' and 'Mousterian'; few notes are provided on the nature of the sediments. A series of 11 radiocarbon determinations were published from the 'Epipalaeolithic' levels dating from between ~13.1-21.9 ka BP (Delibrias and Roche, 1976; Roche, 1976, 1975)(Table 4.2). None of the archaeological remains from these excavations have been described.

Table 4.2. Grotte des Pigeons (Taforalt): Radiocarbon determinations from 1969-1972 excavations

Lab No.	^{14}C	cal BP (95.4%)[a]	Material	Context
Gif-2267	13,140±150	16,186-15,290	Charcoal	Level 10
Gif-2268	13,500±150	16,755-15,826	Charcoal	Level 10
Gif-2269	14,020±160	17,500-16,515	Charcoal	Level 11
Gif-2269	14,130±160	17,627-16,662	Charcoal	Level 11
Gif-2270	15,240±180	18,860-18,065	Charcoal	Level 11
Gif-2271	15,700±180	19,440-18,610	Charcoal	Level 11-12
Gif-2272	15,460±180	19,127-18,326	Charcoal	Level 12
Gif-2273	15,500±180	19,174-18,368	Charcoal	Level 12
Kn-1559	16,420±190	20,316-19,343	Charcoal	Level 12
Gif-2586	21,100±400	26,135-24,388	Carbonaceous earth	Level 14
Gif-2587	21,900±400	27,167-25,495	Carbonaceous earth	Level 15-16

a. All cal BP determinations are corrected using IntCal13 (Reimer et al. 2013) and OxCal 4.2 (Bronk-Ramsey 2009).

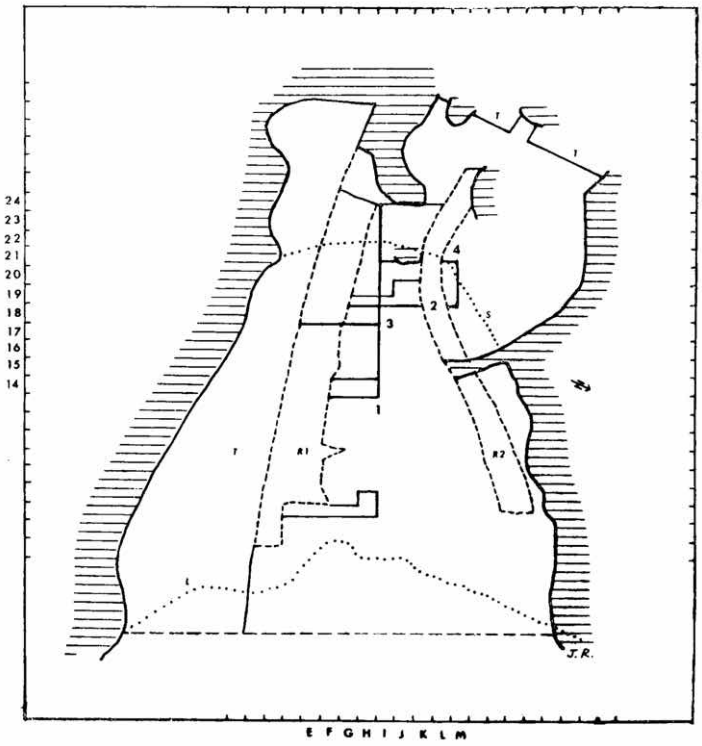


Figure 4.3. Grotte des Pigeons (Taforalt): Plan of 1969-1971 excavations (Roche, 1975) 1-4) principle sections analysed; R1, R2) Ruhlmann trenches

Excavations 1977

In 1977, J.-P. Raynal, described in detail the stratigraphic sequence for the standing section in grid square M-N/21 and correlated his divisions with those from the 1969-1972 excavations (Raynal, 1980). He provided a brief account of a lithic assemblage at the base of the sequence, which is said to have a minor Levallois component and be devoid of artefacts typical of the Aterian. In addition, a deep trench, with a base ~10 m from the summit of the archaeological deposits, was excavated in squares F-H\18-24 (Raynal, 1980, p. 69).

4.3. The Role of Past Research

Past research at Grotte des Pigeons (Taforalt) has played a role in discussions of variation within the Pleistocene LSA. The most evident is that of G. Camps (1974a) who based his divisions on published information on the lithic assemblages from the 1950s excavations. He suggested that *niveaux* IX-VI belonged to the earliest variant, that he called the Iberomaurusian *ancienne* and that overlying *niveaux* V-I characterised the Iberomaurusian *classique*. However, a number of factors inhibit a clear understanding of variation within the Pleistocene LSA based on these earlier excavations.

A major issue concerns the methods of the excavators. Based on the available published information there is a clear lack of stratigraphic control concerning the excavations at the site undertaken in the 1950s. For instance, Roche (1963, p. 48) notes that he discarded huge volumes of sediment without further investigation, indicating excavation was carried out hurriedly. Many of the levels he described are meant to extent along the entire standing section, although more recent work indicates that the stratigraphy is highly localised and that there are few stratigraphic horizons that can be traced throughout the site (pers. comm. S. Collcutt). Furthermore, the stratigraphic levels identified, especially those from the upper ashy grey series, are extremely poorly dated. There are only four radiocarbon determinations from these horizons, which are all problematic as they are on bulked charcoals with large error margins and there is no coherence in the date order (see above). In contrast, the lower yellow clays have a more coherent series of radiocarbon determinations, although the lithic assemblages have never been fully described from these horizons and it is therefore unclear what, if any, variation is observable in the associated LSA assemblages.

There are also a number of other issues surrounding the method utilised for describing the chipped-stone assemblages from the earlier excavations. Roche (1963) focused almost exclusively on the basic counts of retouched tools, with little discussion of the debitage. In fact, even at basic level, information on the unmodified blanks is unavailable, with only an approximate count given for the total number of these artefacts from each horizon. Thus, it is not possible to assess the knapping techniques utilised at the site based on the published information. Furthermore, whilst he gives lists of the retouched tools recovered during the excavations, this was accomplished using his own typology that has not been widely adopted and it is therefore difficult to compare with other studies. Camps (1974) re-organised the available published typological data into broad tool classes (e.g. end-scrapers, burins, etc) for comparison with other sites, but it is difficult to make any meaningful comparisons beyond this basic level.

One of the original intentions of the study was to re-analysis the archive material now held at Musée Archéologique (Rabat, Morocco), in order to give a better understanding of variation within these assemblages from the Roche excavations. However, due to poor storage conditions information is now lacking linking the lithic artefacts to a specific stratigraphic context. None of the finds are individually labelled and have been stored en masse in four large crates. The archive collections were therefore excluded from this study as they were deemed of little value in their current state, for shedding light on variation within the Pleistocene LSA. Instead this research aims to give a fresh perspective on variation, through focusing on a series of lithic assemblages recovered during new excavations at Grotte des Pigeons (Taforalt).

4.4. Recent Excavations 2003-2010

The most recent excavations were conducted between 2003 and 2010 under the direction of Abdeljalil Bouzouggar of the Institut National des Sciences de l'Archeologie et du Patrimoine (INSAP) and Nick Barton of the University of Oxford. This work has focused on the detailed sampling and excavation of the standing profiles left from previous excavations. The primary aim has been to collect new dating samples and provide a high-resolution record in order to better understand the occupational history of the site (N. Barton et al., 2013; Bouzouggar et al., 2008, 2007; Clark-Balzan et al., 2012; Clark-Balzan, 2013). This work has been complimented by a series of

palaeoenvironmental, sedimentological, and malacological studies (Jones, 2013; Oh, 2011; Taylor, 2014; Taylor et al., 2011; Ward, 2007). In addition, some horizontal excavation of sediments was undertaken at the rear of the cave in order to investigate a series of human burials in the area (Humphrey et al., 2014, 2012). Nonetheless, it should be noted that, whilst the focus on the excavation of vertical sections offers a detailed record of chronological trends, the current lack of detailed horizontal excavations limits the potential for spatial analysis at this time.

Each area investigated during this new phase of work was allocated an arbitrary number, which are referred to here as *sectors* according to the site nomenclature. The location of each sector is shown in relation to the standing sections and earlier excavation trenches in Figure 4.4. The sediments, as with earlier work, have been divided into two major units; a *Grey Series* of ash-rich multiple midden deposits with large quantities of burnt terrestrial molluscs shell, cut-marked and modified bone, and vast amounts of lithic debitage and retouched tools; and, an underlying *Yellow Series* of well stratified fine-grained sandy and silty cave earths. However, beyond this coarse division, the stratigraphy at the site is complex and highly localised. It is still unclear how all the different sectors are correlated (pers. comm. S. Collcutt). The basis of this work is on sediments associated with the LSA, which were identified in Sectors 3, 8, 9, and 10.

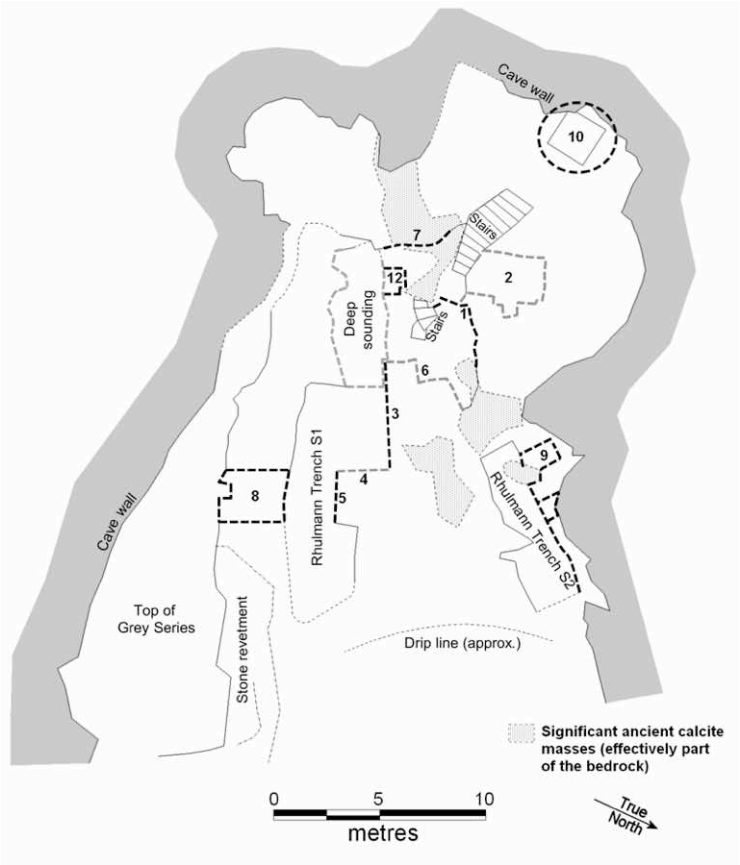


Fig. 4.4. Grotte des Pigeons (Taforalt): Plan of 2003-2010 excavations (N. Barton et al., 2013)

4.4.1. Sector 3

Sector 3 is located at the middle of the site along the south-facing section of trench S1. It consists of a ~1.2 m long sequence through the Yellow Series (Fig. 4.5). The sediments comprise mainly of silts, with coarse material recorded in the top ~5 cm, and calcification of the sediments at the base (Oh, 2011, p. 38). There are a number of artefacts indicative of LSA technology in the top 44 cm occurring above the marker horizon Y5. A total of eight unpublished AMS radiocarbon determinations on single charcoals are associated with the LSA sediments, which range in age between 20,832-20,355 cal BP (17,070±75 BP, OxA-26643) and 17,254-16,620 cal BP (13,980±80 BP, OxA-26484)(Table 4.3). The available chronostratigraphic information indicates that LSA sediments are broadly time-coincident with contexts Y2 through Y4 in Sector 8.

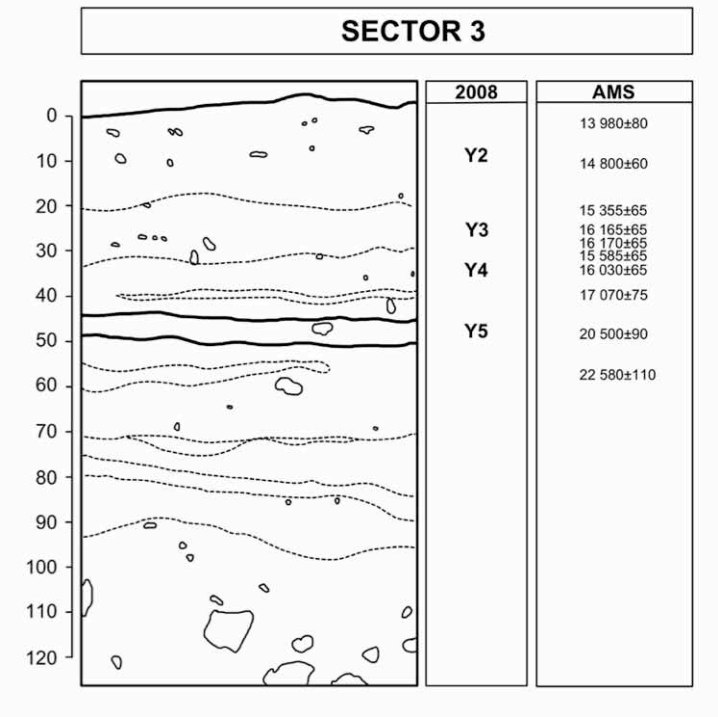


Figure 4.5. Grotte des Pigeons (Taforalt), Sector 3: Schematic representation of stratigraphic profile

Table 4.3. Grotte des Pigeons (Taforalt), Sector 3: Radiocarbon determinations associated with LSA

Lab No.	^{14}C	$\delta^{13}C‰$	cal BP (95.4%)[a]	Material	Species	Depth (cm)
OxA-26484	13,980±80	-21.0	17,254-16,620	Charcoal	*Cupressus/Juniperus*	5-7
OxA-26639	14,800±60	-24.3	18,204-17,824	Charcoal	*Prunus* sp.	11-13
OxA-16264	15,355±65	-24.8	18,781-18,471	Charcoal	*Quercus* sp.	22
OxA-16265	15,585±65	-23.4	18,976-18,692	Charcoal	*Pinus halepensis*	30
OxA-26640	16,170±65	-22.0	19,726-19,278	Charcoal	*Cupressus* sp.	28-30
OxA-26641	16,165±65	-22.2	19,717-19,272	Charcoal	*Cupressus* sp.	28-30
OxA-26642	16,030±65	-22.2	19,561-19,140	Charcoal	*Juniperus/Tetraclinus*	30-32
OxA-26643	17,070±75	-20.9	20,832-20,355	Charcoal	*Juniperus/Tetraclinus*	38-40

a. All cal BP determinations are corrected using IntCal13 (Reimer et al. 2013) and OxCal 4.2 (Bronk-Ramsey 2009).

4.4.2. Sector 8

Sector 8 is located along the north-facing section of trench S1 and consists of a ~5.7 m long sequence through both the Grey Series and Yellow Series (Fig. 4.1). Beyond this major stratigraphic division, subtle variations were observed in the nature of the sediments. A full description of the deposits based primarily on the author's own observations during the 2009-2010 excavations with additional information by S. Collcutt (pers. comm.) is given in Table 4.4 and shown in Figure 4.6. The excavations in this area offer the most complete record of the LSA occupation of the site and it serves as the master sequence for evaluating the variation within the Pleistocene LSA.

Mode 5 technology occurs soon after the marker horizon Y5, towards the top of Y4 sp4, and is observed throughout the overlying deposits into L1. A total of 40 AMS radiocarbon determinations on charcoals and cut-marked bone are associated with these LSA sediments, which range in age between 21,430-20,894 cal BP (17,515±75 BP, OxA-16273) and 12,713 - 12,568 cal BP (10,680±45 BP, OxA-24111)(Table 4.5). An earlier description of the radiometric evidence for LSA, for which this thesis provides the basis of the stone-tool descriptions, alongside a discussion of its relationship to the preceding industries, is available elsewhere (N. Barton et al., 2013). The following is a discussion of the available radiocarbon evidence calibrated using the most recent IntCal13 (Reimer et al., 2013) and software OxCal 4.2 (Bronk-Ramsey, 2009). Figure 4.7 shows calibrated ages from Sector 8 plotted against variation in $\delta^{18}O$ composition from GISP2 ice core with arrows indicating position of Heinrich events. It also shows the AMS radiocarbon determinations from Sectors 3, 9, and 10.

The earliest LSA horizon in Sector 8 is dated to 21,430-20,894 cal BP (OxA-16273, 17,515±75 BP) emerging around the time of the Last Glacial Maximum. The underlying deposits are associated with debitage from non-Levallois cores and bifacial tools made on coarser-grained metamorphic raw materials that is distinct from the LSA technology. The end of the underlying non-Levallois flake industry is dated to 24,945-24,253 cal BP (OxA-16271, 20,420±90 BP) and is separated from the earliest LSA by a chronological gap of ~3,500 years, which is broadly time-coincident with a severe cooling episode associated with Heinrich event 2.

The LSA occupation is continuous with the exception of a chronological gap of ~1,600 calibrated years between the top of Y2 sp1 that dates at 17,256-16,716 cal BP (OxA-16267, 14,005±60 BP) and the bottom of overlying Y1 that dates 15,576-15,144 cal BP (OxA-22788, 12,850 BP). The transition is marked by an erosive boundary with the sediments in Unit Y2 sp1 showing raised silt content suggesting wash input was capturing aeolian dust from the exterior surroundings and plastic deformation of the sediments indicating wetness and possibly even transient ground freezing, which appears broadly time-coincident with the onset Heinrich event 1.

The Grey Series began to accumulate from 15,285-14,731 cal BP (OxA-22784, 12,660±70 BP) broadly time-coincident with the start of the Bølling-Allerød. Interestingly, there is some overlap in the radiocarbon determinations recovered from the top of the Yellow Series and the bottom of the

Grey Series. It is thought that this is related to a sudden change in site formation within the cave, rather than vertical movement and mixing of material across the sediment boundary. This is suggested by the sharp and well-defined interface between these major stratigraphic units. In the Grey Series the sedimentation rate was extremely rapid (at *c.*1.7 m/kyr) and it has a heavy anthropogenic influence, whilst in the Yellow Series accumulation was slower with intervals where aeolian dust characterises the sediments and rates fell to less than 0.05 m/kyr (N. Barton et al., 2013).

There is little evidence for discontinuities in the occupation of the site throughout the Grey Series. However, it should be noted that at the very top of the sequence, from G89, the presence of cedar (*Cedrus* sp.) charcoals might indicate cooler conditions associated with the onset of the Younger Dryas (Ward, 2007). The final LSA assemblages were recovered from L2 that can be dated to 12,713 - 12,568 cal BP (OxA-24111, 10,680±45 BP). However, the overlying deposits above this were removed in the early 20th century, so this date only provides a *terminus post quem* for the end of the LSA.

Table 4.4. Grotte des Pigeons (Taforalt), Sector 8: Description of stratigraphic profile

	Contexts	Stratigraphic Description
	L1	Trample; equivalent to top of G88
Grey Series	L2-L5	Mid brownish-grey (10YR 5/2); slightly gritty ashy-silt series; churned and fractured fabric; frequent small (<5mm) mollusc shell fragments; moderate charcoal flecks; with bioturbation (10 cm in scale) throughout deposits; middle context [3] looser and less compressed; less friable mid-grey speckled ash towards bottom [5]; and mollusc shell and charcoal lens [4]; lenticular in nature;
	L6-L9	Mid-grey (7.5YR 5/1); speckled ashy-silt series; variably bedded fabric; with abundant small snail shell pieces; frequent charcoal flecks and large (>20mm) charcoal pieces; occasional large burnt limestone fragments; interstratified with very fine ash 'hearth' deposits; clear boundary; intra LC 5/6 contact is equivalent to the bottom of MMC 19/17 and top of MMC 20; equivalent to bottom of G88, G89, and top of G90
	L11-L14	Light grey (7.5YR 7/1); 'sterile' very fine ash series; compact; finely laminated; dipping into cave; occasional charcoal flecks; small mollusc shell fragments; sometimes forming discreet very thin lens; few faunal remains; occasional medium size limestone fragments near base [14]; equivalent to G91 and G92
	L15	Horizon of large (60-120mm) burnt limestone fragments (c.40%); with interfiling dark grey (7.5YR 4.1); loose; charcoal (60%), mollusc shell (30%) silt matrix; poorly bedded; LC14/15 contact equivalent to top of MMC 46; and equivalent to top of G93
	L16-L20	Mid brownish-grey (10YR 5/2) slightly sandy-silt deposits; poorly sorted; churned and fractured fabric; frequent small mollusc shell fragments; frequent charcoal flecks; frequent medium-large cindered limestone fragments; frequent animal bone fragments; often forming concentrated clusters; less churned towards base of unit; fewer limestone fragments; numerous terrestrial snail shell fragments; equivalent to bottom of G93, G94, and top of G95
	L21	Mid grey (7.5YR 5/1) slightly sandy-silt; moderately well-bedded; with numerous small mollusc shell fragments; clear boundary; LC 21/22 contact equivalent to intra MMC57; and equivalent to intra G95
	L22-L23	Mid grey (7.5YR 5/1); firm; slightly sandy-silt; moderately sorted; relatively homogenous; occasional charcoal flecks; very small mollusc shell fragments (<2mm); and animal bone fragments; occurrence of limestone fragments medium-large (40-120mm) towards the bottom of the deposit [23]; matrix sits in-between clasts in underlying deposit; equivalent to bottom of G95 and top of G96
	L24	Rubble horizon; consisting of medium-large (40-150mm) burnt limestone fragments; loosely packed; lithic artefacts and animal bone orientated vertically; voids between rocks towards base of deposit; clear boundary; equivalent to intra-G96
	L25	Very distinct mid brown(7.5YR 4/2); 'sterile' sandy-silt; occasional charcoal flecks; increasing in proportion towards base; occasional small shell fragment; occasional medium-large limestone clasts; matrix sits in-between clasts in top of underlying deposit; equivalent to intra-G96
	L26-L27	Rubble horizon; consisting of medium-large (40-150mm) burnt limestone pieces; loosely packed; with numerous voids; mid brownish-grey (10YR 5/2); loose; slightly sandy-silt; infilling between clasts; frequency of rocks decreasing towards base [27]; clear horizon; equivalent to bottom of G96
	L28	Mid brownish-grey (10YR 4/4); homogenous compact ashy-silt; well sorted; frequent charcoal flecks giving speckled appearance; occasional small mollusc shell fragments; occasional recent disturbance from carpenter bees; equivalent to G97 and G98
	L29	Mid brown (7.5YR 4/2) firm gravely sandy-silt matrix; interlocking with large dolomite clasts (60% of deposit) from the make up of the cave; infrequent evidence of burning; occasional charcoal flecks; equivalent to G99 and G100
Yellow Series	Y1	Mid brownish-yellow (10YR 6/6); cemented; silty-sand; moderate medium (20mm-60mm) stones occurrences; frequent large bone fragments; numerous lithic artefacts; absence of mollusc shell; localised brown/black charcoal lenses and ashy hearth deposits; equivalent to L30, Yell06[0-17], and Yell08[2-12]
	Y2 sp1	Middle yellow-red (5YR 5/6) interval, contains occasional charcoal flecks; infrequent lithic artefacts; higher grit content at top and towards base; approximately equivalent to L31, L32, Yell06[17-31] and Yell08[12-28]
	Y2 sp2-5	Mid-brown (7.5YR 5/4); purer silt; variable grit content; with 'ginger' bands; increase in charcoal and lithics towards base [sp5]; equivalent to Yell06[31-69] and Yell08[28-61]
	Y3	Greyish-brown (10YR 5/2); silt sediment; texture becomes more sandy; rich in charcoal; frequent bone fragments; few lithic artefacts; equivalent to Yell06[69-72] and Yell08[61-64]
	Y4 sp1-4	Reddish-brown (5YR 4/4); silt; slightly more grit at top [sp1-2]; darker more strongly banded towards bottom of sequence; decrease in charcoal and artefacts with depth; platy stony silt at bottom [sp4]; equivalent to Yell06[72-114] and Yell08[64-107]
	Y5	Dark brown (7.5YR 3/3); ~1-3 cm deposit; thickens towards cave entrance; multiple black smears, but very poor individual charcoal survival; low frequencies of bone and lithic artefacts; represents a marker bed that can be traced widely around sections; equivalent to Yell06[114-116] and Yell-08[107-109]
	Y6 sp1-6	Mid-brown(7.5 5/4)/yellow-red (5YR 5/6) silt rich deposits, often more gritty, with better individual charcoal survival (sp1, sp2, sp4, and sp6), interstratified with grey ashy beds (sp3 and sp5); evidence of micro-faulting throughout; equivalent to Yell06[116-163] and Yell08[109-156]
	Y7	Dark brown (7.5YR 3/3); ~4 cm deposits; high silt content; less gritty; no rocks; runs across the section; occasional lithic artefacts; slight decrease in charcoal abundance; marker horizon; equivalent to Yell06[164-170] and Yell08[156-165]
	Y8-Y13	Poorly defined sequence of banded sub-units, very small charcoal flecks; interstratified brown(7.5 5/4)/yellow-red (5YR 5/6) silt rich beds (Y8, Y10) with deposits containing higher charcoal content (Y9, Y11, Y13); equivalent to Yell06[170-190] and Yell08[165-179]

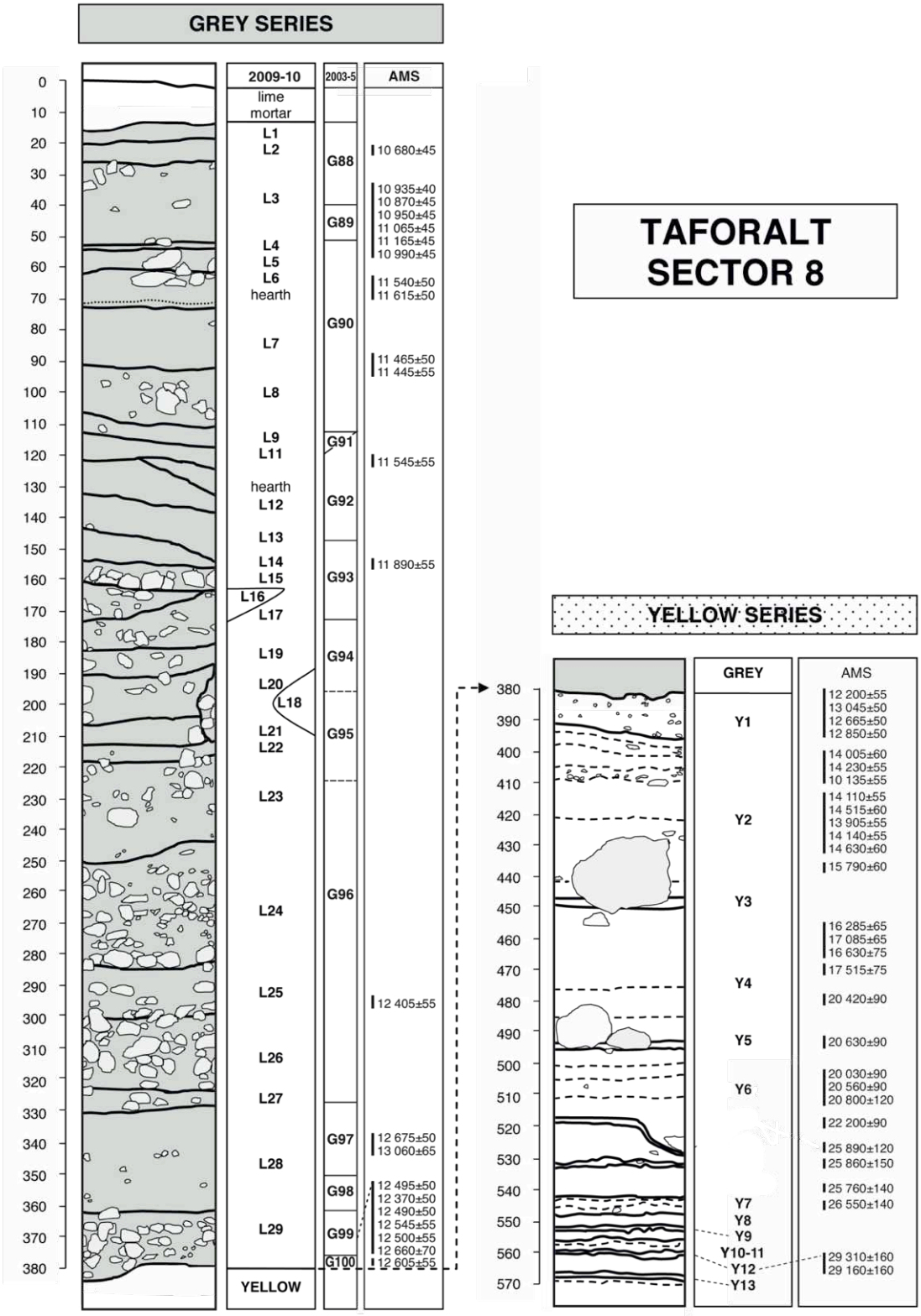


Figure 4.6. Grotte des Pigeons (Taforalt), Sector 8: Schematic representation of stratigraphic profile (after N. Barton et al., 2013)

Table 4.5. Grotte des Pigeons (Taforalt), Sector 8: Radiocarbon determinations associated with the LSA

Sample	^{14}C	$\delta^{13}C‰$	cal BP (95.4%)[a]	Material	Species	Context
OxA-24111	10,680±45	-19.3	12,713-12,568	Bone	*Ammotragus*	L2
OxA-13479	10,935±40	-23.8	12,900-12705	Charcoal	*Pinus sp.*	G88
OxA-23404	10,870±45	-24.2	12,813-12,693	Charcoal	*Pinus sp.*	L3
OxA-13480	10,950±45	-23.3	12,950-12,711	Charcoal	*Pinus sp.*	G89
OxA-13516	11,065±45	-23.9	13059-12,799	Charcoal	*Pinus sp.*	G89
OxA-24112	11,165±45	-19.7	13,125-12,905	Charcoal	*Ammotragus*	L4
OxA-13517	10,990±45	-26.8	12,990-12,730	Charcoal	*Dicotyledonous*	G90
OxA-24113	11,540±50	-19.0	13,468-13,281	Charcoal	*Juniperus / Tetraclinus*	L6
OxA-23405	11,615±50	-22.3	13,562-13,329	Bone	*Gazella*	L6
OxA-23406 OxA-23407	11,465±50 11,445±55	-21.9 -21.9	13,406-13,205	Charcoal	*Juniperus / Tetraclinus*	L8
OxA-23408	11,545±55	-22.3	13,476-13,275	Charcoal	*Pinus sp.*	L11
OxA-23409	11,890±55	-24.6	13,828-13,555	Charcoal	*Pinus sp.*	L15
OxA-23410	12,405±55	-22.6	14,855-14,156	Charcoal	*Juniperus / Tetraclinus*	L25
OxA-13477	12,675±50	-21.4	15,271-14,829	Charcoal	Conifer	G97
OxA-23411	13,060±65	-20.3	15,895-15,345	Charcoal	*Juniperus / Tetraclinus*	L28
OxA-13478	12,495±50	-21.2	15,052-14,314	Charcoal	*Juniperus / Tetraclinus*	G99
OxA-22902	12,370±50	-22.4	14,740-14,129	Charcoal	Conifer	G99
OxA-22904	12,490±50	-22.0	15,042-14,303	Charcoal	Conifer	G99
OxA-22787	12,545±55	-22.4	15,131-14,443	Charcoal	Conifer	G99
OxA-22784 OxA-22785	12,500±55 12,660±70	-22.8 -23.9	15,142-14,579	Charcoal	*cf Juniperus*	G99
OxA-24109	12,605±55	-18.6	15,199-14,684	Bone	*Bos*	G100
OxA-22786	12,200±55	-21.7	14,292-13,910	Charcoal	*cf Cedrus*	Y1
OxA-22903	13,045±50	-21.1	15,838-15,356	Charcoal	*cf Juniperus*	Y1
OxA-22905	12,665±50	-23.4	15,256-14,406	Charcoal	*cf Arbutus*	Y1
OxA-22788	12,850±55	-23.7	15,576-15,144	Charcoal	Conifer	Y1
OxA-16267	14,005±60	-21.1	17,256-16,716	Charcoal	*Tetraclinus articulata*	Y2
OxA-22907	14,230±55	-21.3	17,523-17,120	Charcoal	*cf Juniperus*	Y2
OxA-22906	14,135±55	-20.7	17,437-16,996	Charcoal	Conifer	Y2
OxA-22908	14,110±55	-22.7	17,413-16,954	Charcoal	*cf Arbutus*	Y2
OxA-16268	14,515±60	-22.5	17,903-17,500	Charcoal	*Tetraclinus articulata*	Y2
OxA-13519	13,905±55	-20.9	17,075-16,585	Charcoal	*Juniperus / Tetraclinus*	Y2
OxA-22909	14,140±55	-21.4	17,443-17,004	Charcoal	Conifer	Y2
OxA-16272	14,630±60	-23.3	17,995-17,621	Charcoal	*Quercus sp.*	Y2
OxA-16269	15,790±60	-21.1	19,217-18,882	Charcoal	*Juniperus sp.*	Y2
OxA-16270	16,285±65	-23.6	19,908-19,477	Charcoal	*Pinus sp.*	Y3
OxA-13518	17,085±65	-20.8	20,835-20,404	Charcoal	*Quercus sp.*	Y3
OxA-16242	16,630±75	-24.8	20,315-19,816	Charcoal	*Dicot unidentified*	Y4
OxA-16273	17,515±75	-23.6	21,430-20,894	Charcoal	*Pinus sp.*	Y4

a. All cal BP determinations are corrected using IntCal13 (Reimer et al. 2013) and OxCal 4.2 (Bronk-Ramsey 2009).

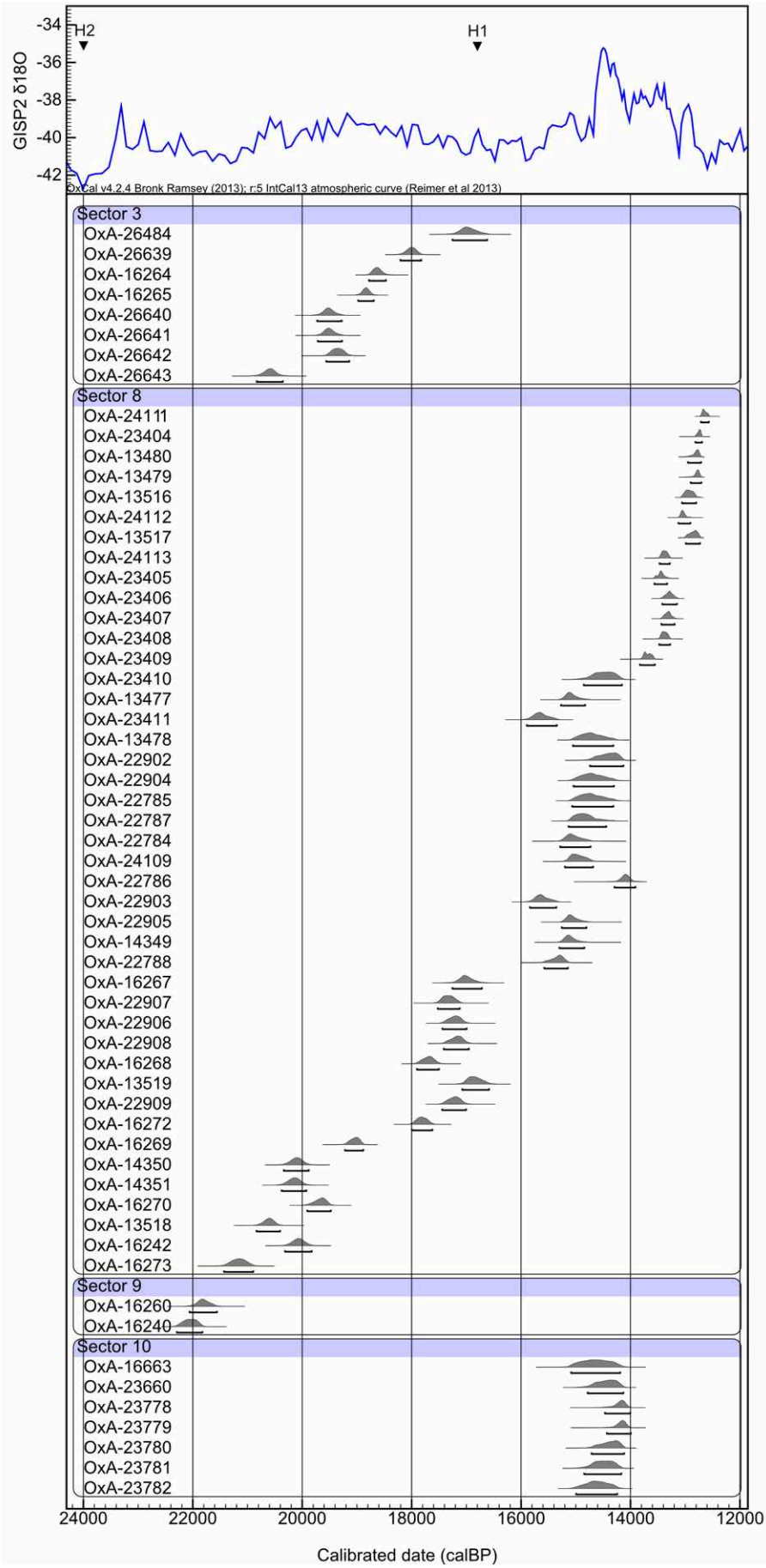


Figure 4.7. Grotte des Pigeons (Taforalt): AMS dates for Sectors 3, 8, 9 and 10 in relation to ice core data. All cal BP determinations are corrected using IntCal13 (Reimer et al. 2013) and OxCal 4.2 (Bronk-Ramsey 2009). The AMS dates are plotted against variation in $\delta^{18}O$ composition from GISP2 with arrows indicating position of Heinrich events as defined by Bond et al., 1992.

4.4.3. Sector 9

Sector 9 is located along the south-facing section of Ruhlmann's trench S2. It consists of a ~1.0 m long sequence through the Yellow Series (Fig. 4.8). No stratigraphic descriptions are available for this area, although the sequence is divided into five layers (Ward, 2007, p. 212). There are numerous artefacts indicative of the LSA from Layers 1 through 3. There are two radiocarbon determinations relating to the LSA in this area of 22,058-21,559 cal BP (18,005±75 BP, OxA-16260) and 22,292-21,825 cal BP (18,185±75 BP, OxA-16240) (Table 4.6). These dates show that the sediments are broadly time-coincident with the emergence of the LSA as recorded in Sectors 3 and 8, although the dates are slightly earlier and the oldest for the LSA at Grotte des Pigeons (Taforalt).

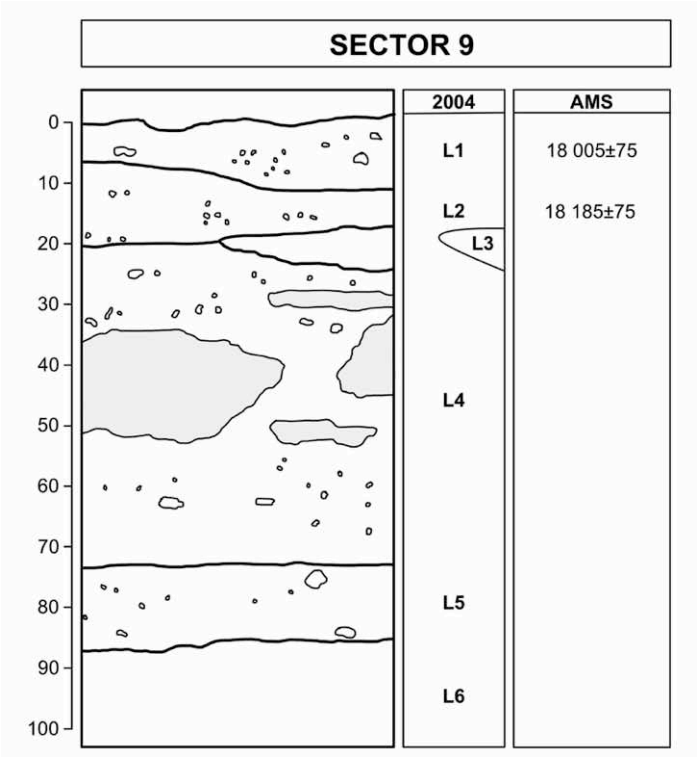


Figure 4.8. Grotte des Pigeons (Taforalt), Sector 9: Schematic representation of stratigraphic profile

Table 4.6. Grotte des Pigeons (Taforalt), Sector 9: Radiocarbon determinations associated with the LSA

Lab No.	^{14}C	$\delta^{13}C$‰	cal BP (95.4%)[a]	Material	Species	Layer
OxA-16260	18,005±75	-20.7	22,058-21,559	Charcoal	*Tetraclinus articulata*	1
OxA-16240	18,185±75	-21.7	22,292-21,825	Charcoal	Unidentified	2

a. All cal BP determinations are corrected using IntCal13 (Reimer et al. 2013) and OxCal 4.2 (Bronk-Ramsey 2009).

4.4.4. Sector 10

Sector 10 is located in a recess at the back of the cave on the edge of the burial area exposed during the 1951-1955 excavations. Here, archaeological materials were collected from a ~4m^2 area (Fig. 4.9). The deposits comprised of fine, powdery, ashy sediments, which are rich in human and non-human bones, burnt land snails, and lithic debitage and tools. In contrast to the other sectors, many artefacts were found to be eroding out of the deposits and were no longer thought to be *in situ* and no stratigraphic sub-divisions were discernable. Based on the numerous distribution of articulated and disarticulated human remains, it appears that the area was used and re-used intensively (Humphrey et al., 2012; 2014). Consequently, it was not possible to define grave cuts for the burials or discern if lithic artefacts were buried with an individual burial. As graves were dug through earlier burials the associated chipped-stone assemblages could be an admixture of material of different ages.

There is a series of seven radiocarbon determinations available on human bone (Table 4.7). The earliest is an age of 15,086-14,189 cal BP (OxA-16663, 12,470±100 BP), which was considered problematic as it was very small with a starting weight of 100 mg (Humphrey et al., 2014). Excluding the aforementioned date, the available radiocarbon determinations have a narrow age range between 14,783-14,130 cal BP (OxA-23660, 12,380±55 BP) and 14,431-13,993 cal BP(OxA-23779, 12,255±50 BP). A potential issue in radiocarbon dating the human remains from the site is that there is some limited evidence for the consumption of both terrestrial and marine sources within the coastal assemblages of Pleistocene LSA (see Chapter 2), which can complicate matters as it is unclear how much carbon is derived from each source with different reservoir effects (Molto et al., 1997). Nonetheless, there is no clear evidence for consumption of marine resources at the site and consequently the IntCal13 carbon curve was utilised. Based on the available radiocarbon determinations, the burial activity is broadly time-coincident with the formation of the sediments at the bottom of the Grey Series in Sector 8. The Sector 10 lithic assemblages are described in the following, although the primary emphasis of this work is on the well-stratified sediments in Sector 3, 8, and 9.

Table 4.7. Grotte des Pigeons (Taforalt), Sector 10: Radiocarbon determinations associated with the LSA

Lab No.	^{14}C	$\delta^{13}C$‰	cal BP (95.4%) [a]	Material	Species
OxA-16663	12,470±100	-19,8	15,086-14,189	Bone	*H. sapiens*
OxA-23660	12,380±55	-18.6	14,783-14,130	Bone	*H. sapiens*
OxA-23778	12,265±50	-18.9	14,468-14,005	Bone	*H. sapiens*
OxA-23779	12,255±50	-19.0	14,431-13,993	Bone	*H. sapiens*
OxA-23780	12,355±50	-18.8	14,712-14,116	Bone	*H. sapiens*
OxA-23781	12,410±50	-19.0	14,846-14,168	Bone	*H. sapiens*
OxA-23782	12,460±55	-19.0	14,995-14,242	Bone	*H. sapiens*

a. All cal BP determinations are corrected using IntCal13 (Reimer et al. 2013) and OxCal 4.2 (Bronk-Ramsey 2009).

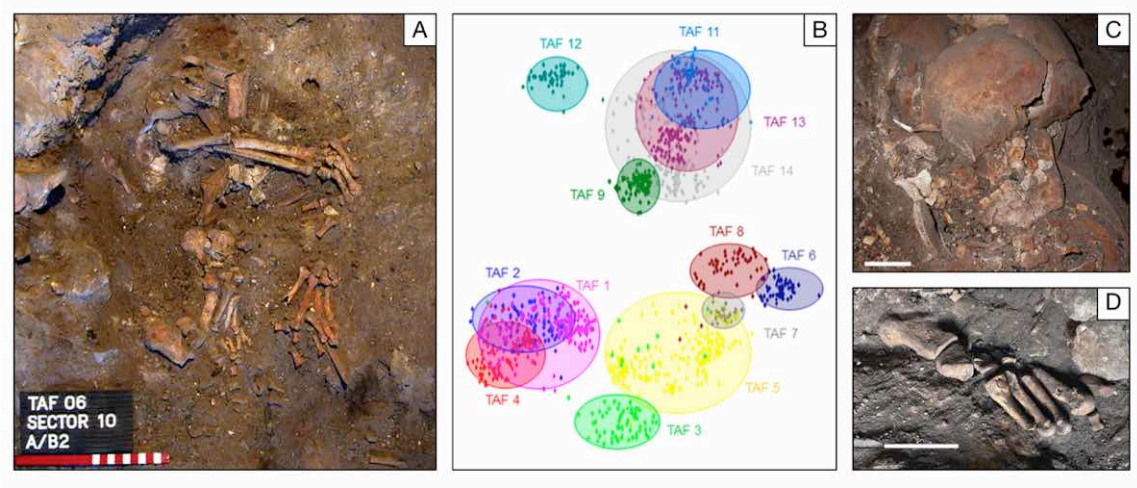


Figure 4.9. Grotte des Pigeons (Taforalt), Sector 10: Human burials
a) cranium of TAF 13; b) plot of x-y coordinates of skeletal elements; c) skeletal elements of TAF 14; d) articulated human foot associated TAF 4 (modified after Humphrey et al., 2014; 2012)

Chapter 5

Grotte des Pigeons, Taforalt (Morocco): Methodological Procedures

5.1. Laboratory Procedures

The focus of this study is on LSA chipped-stone assemblages from Sectors 3, 8, 9, and 10, at Grotte des Pigeons (Taforalt)(see Chapter 4 for stratigraphic descriptions). The collections were excavated over a number of seasons, using a range of different methods, including sieving and collection strategies, in order to address hypotheses relating to the anthropological, archaeological, palaeonenivironmental, sedimentological, and malacological, history of the site (Barton et al., 2013; Bouzouggar et al., 2008; Humphrey et al., 2012, 2012; Jones, 2013; Oh, 2011; Taylor, 2014; Taylor et al., 2011; Ward, 2007).

Due to varied excavations methods, including sieving and collection strategies, between Sectors 3, 8, 9, and 10, the lithic assemblages were first size sorted in order to create some level of standardisation. During the 2009-2010 excavations in Sector 8, the author dry sieved all sediments through a 4mm mesh and this serves as the minimum size of artefacts investigated in this study. Earlier work in this area, along with studies in Sector 3 and 9, concentrated on the bulk retrieval of sediments. As such, this material was sieved in the laboratory in order to exclude the smaller 'microchips' (< 4mm). A 4mm mesh size was selected as experimental studies have shown that a 1/8-inch mesh is adequate to elevate technological bias (Ahler, 1989) and the chosen mesh size was the nearest metric equivalent available. It should be noted that sieving is not entirely objective and different shaped artefacts might get trapped in the mesh in an unsystematic manner. For instance, elongated objects might pass through on one occasion, but not the next time due to the orientation of the artefact. Nonetheless, sieving offers an increased level of standardisation (Andrefsky, 2007). Having excluded this size fraction, the size sorted lithic artefacts were classified according to the methods outlined below. The examinations of artefacts were carried out with a 10x hand lens. Mitutoyo® electronic callipers with a precision of 0.01 mm were used for all linear measurements.

The same methods were used to sort and study the material from Sector 10. However, an obvious deficiency was observed in the number of small artefacts from the area. It is unclear if this reflects a real phenomenon or relates to different recovery procedures between excavations in the main chamber (Sectors 3, 9, and 10) and the burial area (Sector 10). If it is a genuine observation, then this might reflect the use of different areas of the cave for different activities. However, the principle excavator has suggested smaller artefacts might not have been picked out during sieving by the workmen, although all sediment was sieved through a 1 mm mesh (pers. comm. L. Humphreys). New excavations are to focus on the careful sieving of sediments, in order to ascertain whether or not the artefact size discrepancies reflect real variation in the use of the site (ibid). Due to the apparent interpretative difficulties, the main focus of this work is on a better understanding of variation through the excavations in Sectors 3, 8, and 9, although an account of the lithic assemblages from Sector 10 is also given.

5.2. Classification Methods

The classification system used in this study to describe the *lithic artefacts*, a term used here to refer to all items resulting from the knapping process, including the discards of manufacture as well as final tool forms, is based upon the one devised by J. Tixier (1963) entitled *Typologie de L'Épipalaeolithic du Maghreb*. This volume is divided into two parts. The first of these is a glossary of terms for the description of lithic artefacts. This section has subsequently been translated from the original French into English (Newcomer, 1974) and forms the basis of the first edition of *Terminologie et technologie* (Tixier et al., 1980). This volume was relatively rudimentary focusing on typological rather than technological variation, however it has since been amended forming precise and well thought out lexicon for the description of knapped stone assemblages (Inizan et al., 1999, 1995, 1992). In addition, the classification system utilised here is based on the method outlined by A. Close (1977) for describing the collections from Tamar Hat (Algeria) and other sites throughout North Africa.

5.2.1. Cores

In this thesis the term *core* is used to refer to a block of raw material that is struck in order produce blanks (Inizan et al., 1999, p. 59). The cores are categorised according to the number and relative position of the striking platforms. The definitions by and large followed those of those outlined by

Marks (1968, pp. 394–7) and subsequently modified by Close (1977, pp. 54–5). A slight modification to the classification system was made with the addition of the term *core-on-flake,* to refer to a flake that has been struck in order produce subsequent blanks and is therefore itself a core. Unless otherwise stated it should be assumed that direct percussion (using a hard or soft hammer) was used in the reduction of core. In addition, there was some evidence for the use of bipolar reduction, which as a knapping technique is discussed below.

Bipolar reduction and related products

At a basic level, bipolar reduction can be understood as a method for detaching blanks from a block of raw material that is held firm on an anvil and struck using a hard or soft hammer. A blank is detached at the impact point of the hammer, with the counter strike of the anvil, or less often simultaneously from both ends. The use of bipolar reduction is usually associated with the presence of fracturing, splintering, Hertizan cones, micro-chipping, and pulverisation of the nodule at each end. This method of reduction is less controlled than other techniques, although a level of predictability over the detachment of the blank can be achieved through manipulating a number of variables (e.g. impact point of the percussion, resting point on the anvil)(Vergès and Ollé, 2011). The term *bipolar core* has been typically used to refer to a nodule reduced in this manner (cf. Close, 1977).

Tixier (1963, p. 163) defines *pièces esquillées* as pieces with bifacial splinters, most often at two extremities (rarely one), caused by violent percussion. A number of scholars have argued that on morphological grounds there is little to distinguish these artefacts and bipolar cores (e.g. Barham, 1987). However, other scholars have noted that *pièces esquillées* tend to be on blanks rather than nodules (e.g. Hayden, 1980; Olszewski et al., 2011). This certainly appears to be a useful distinction. Here, the English translation *splintered piece* is used to refer to a piece that has splintering at one (or more) of the extremities, which may avoid some of the functional connotations (after Shott, 1999).

A major on-going question exists as to whether *pièces esquillées* are exhausted remnants of bipolar reduction or tools. However, the idea that these served as bipolar cores has only very recently been discussed in relation to the LSA of Northwest Africa (Olszewski et al., 2011). Here, *pièces esquillées* have almost exclusively been interpreted as tools, typically wedges (e.g. Brahimi, 1970; Camps, 1974;

Roche, 1963; Sari, 2012; Tixier, 1963), although no use-wear or residue analyses have been conducted on these artefacts to support this assumption.

5.2.2. Debitage

The objects struck from the cores include blanks, but also by-products from shaping out, preparation, and maintenance. These are collectively referred to as debitage products (Inizan et al., 1999). The term *flake* is used to refer to any simple debitage product. The term *blade* is used to refer to all laminar flakes whose length is at least twice the width. Tixier (1963, pp. 36–9) attempted, in relation to the Epipalaeolithic of the Maghreb, to sub-divide the blades. He suggests that a blade *sensu stricto* has length of at least 50 mm and width of 12 mm, whereas smaller blades, so-called bladelets, have shorter and usually narrower dimensions. A number of authors have suggested alternative cut-offs between blades/bladelets (e.g. De Heinzelin, 1962; Marks, 1968). An alternative approach has been to discriminate between blades/bladelets on an assemblage-by-assemblage basis through statistical procedures (Kaufman, 1986). In order to avoid nomenclatural confusion, the term blade is used in a general sense unless stated otherwise. This is not uncommon in the study of the LSA of North Africa (e.g. Brahimi, 1970, 1969; Close, 1980-1981, 1977; Vermeersch, 2000) and has also been adopted in adjacent regions of the Mediterranean (Garrard and Byrd, 2013).

A number of preparations/maintenance techniques were enacted on the core and leave characteristic elements. Here, these are referred to as core-trimming elements (CTE). These include *crested blades*, a laminar removal that has ridge consisting of series of negative bulbar scars on the dorsal surface, that are perpendicular to the direction of removal. These can be either prepared in the same direction forming a single versant (unifacial) or can be struck from both directions having two versants (bifacial) (Inizan et al., 1999, pp. 137–9). Occasionally part of the preparation crest is retained on the core and the subsequent removals constitute secondary removals. This is observed where the first removal attempt has failed to propagate along the entirety of the crest, and the subsequent removal retains a proportion of the prepared crest, along with the negative of the previous failed removal.

The term *flanc de nucleus* is used to describe a removal that is struck to rejuvenate the flaking surface of the core. The removal tends to be relatively thick, often with negatives of knapping errors

(hinged/stepped terminations) on the dorsal surface. In contrast, the term *platform rejuvenation flake* is used to describe a removal that is struck to renovate the striking platform of the core. The removal has a butt with the negatives of the flaked surface of the core, and the dorsal surface consists of the striking platform of the core. In addition, the term *core tablet* is used to refer to a platform rejuvenation flake that removes the entirety of the striking platform of the core (Inizan et al., 1999, p. 153).

The broken pieces are classified in their respective category where the original form could be ascertained. Most often is was possible to establish between flake and blade fragments based on their dimensions. However, the term *indeterminate blade/flake* was used in the sorting stage to refer to fragments thought to be from blades (judging by the alignment of the lateral margins), although no longer retaining a length at least twice the width. Herein, they are grouped with the blade fragments. A number of pieces were too fragmentary to ascertain their original form and were classified as *debris* (Inizan et al., 1999, p. 34). The class was divided into 'chips' and 'chunks. The former are pieces less than 20 mm in maximum dimension and the latter are greater in size (Rosen, 1997, p. 30).

5.2.3. Microburins & related products

The microburin technique has been written about exhaustively (e.g. De Wilde and De Bie, 2011; Henry, 1974; Kaufman, 1995; Miolo and Peresani, 2006; Tixier, 1963). In brief, it is a method for sectioning a blank, with the objective of creating a blade or bladelet with an oblique angle at the end (a *piquant-trièdre* or 'trihedral point'). This is achieved by making a retouched notch at the margin of the blank, which is deepened until a spontaneous fracture occurs. The section that is removed is known as the 'microburin'. It retains part of the notch on the upper surface, while a fracture facet can be observed extending from the hollow of the notch on the lower surface. It is commonly understood that *piquant-trièdre* were retouched into a variety of different microlith forms including, convex backed bladelets *sensu lato* (type 56-59), scalene bladelets (type 68), truncated blades and bladelets (type 80), segments (type 82), trapezes *sensu lato* (types 83-88), triangles *sensu lato* (type 89-93), and elongated scalene triangles *sensu lato* (types 94-100)(Brahimi, 1970, p. 13; Hachi, 2003; Sari, 2014; Tixier, 1963, p. 141).

An object that has been commonly related to the microburin technique is the 'Krukowski microburin'. These have retouch along a margin, retain a microburin facet, but lack a distinct notch. These are usually considered to be the result of a knapping accident, specifically the removal of the end of a blade during backing, and it has been suggested that accidental breakage and resulting Krukowski microburin might have led to the development and formalisation of the true microburin technique (De Wilde and De Bie, 2011). However, some have suggested that the Krukowski microburin might result from the intentional sectioning of the blank (Hachi, 2003).

Here, *piquant-trièdre,* microburins, and Krukowski microburins, are described separately. The 'La Mouillah points' (type 62), a backed bladelet with a *piquant-trièdre* at an end, are discussed amongst the tools, as typical in the region (e.g. Brahimi, 1970; Camps, 1974; Close, 1977; Roche, 1963; Sari, 2012; Tixier, 1963). However, it should be noted that whilst these might be desired final end products, it is also possible that these represented unfinished/discarded tools (Neeley and Barton, 1994).

5.2.4. Retouched tools

The classification of the retouched tools is essentially that outlined by Tixier (1963), which has been widely adopted throughout the Northwest Africa. This work also forms the basis of a number of typologies in use in other areas, which have highlighted and sought to rectify a number of latent issues with this classification system (e.g. Bar-Yosef, 1970; Goring-Morris, 1987; Hours, 1974). In contrast, the typology has received little critical discussion in relation to its utility for discussing variability within the LSA of the Northwest Africa. A notable exception are the insights into this topic provided by A. Close (1977; see discussion below). Nonetheless, the most frequent and often only published data available on collections of the LSA is numerical counts of retouched tools classified according Tixier's (1963) typology. Here, discussion is provided of some of the most salient issues with the typology, outlining several modifications that were made to help more adequately describe the collections studied. A full type-list is given in Appendix II.

Microliths

As noted in Chapter 3, there have been many definitions for the term 'microlith', although two factors appear to be consistent amongst the application of the term; 1) the small size of artefacts, and

2) the assumption that they formed part of composite tools (Torrence, 2002). Here, the term microlith is utilised to refer to the groups of non-geometric 'backed bladelets and 'geometric microliths' defined by Tixier (1963), which in addition to these features have signs of intentional retouch. A distinction was made between 'microliths' and 'microlith fragments'. A microlith was considered an item that retained diagnostic features to assign it to a specific type, which could be either a whole or broken artefact. A microlith fragment was an item too fragmentary to identify to a specific type.

A number of other tools defined by Tixier (1963) were also added to the class of microliths in order to reflect apparent technological similarities. These included 'perforators on backed bladelets' (type 13), 'Aïn Khanga piercers' (type 14), and '*Mèche de forets*' (type 16), which are forms of backed bladelets (Fig. 5.1: 2-6 & 8-12). Tixier (1963, pp. 63–6) grouped these originally with the 'perforators', a class containing a diverse range of types, and which appear to reflect the tools' assumed function. For example, the 'perforators' also include 'large Capsian perforators' (type 15), which are a type of core-tool with a triangular cross-section forming a point (Fig. 5.1: 7).

No strict size cut-off has been established between 'microlithic' and 'normal' tools for the study of the Pleistocene LSA of North Africa. Tixier (1963, p.36-9) suggested that 'backed bladelets' might be considered less than 50mm long and/or less than 12mm wide, whilst 'backed blades' might be considered more than or equal to 50mm long and more than 12 mm wide. However, Close (1977, p. 35-6) abandoned any such distinction and argued that the latter formed no more than the tail end of a single continuous size distribution. Whilst the latter might be true in certain cases, most scholars have tended to adopt the former size cut-offs, and in order to aid comparability between studies this distinction was maintained throughout the thesis. A scatterplot showing the size distribution of unbroken microliths is shown in Figure 5.2.

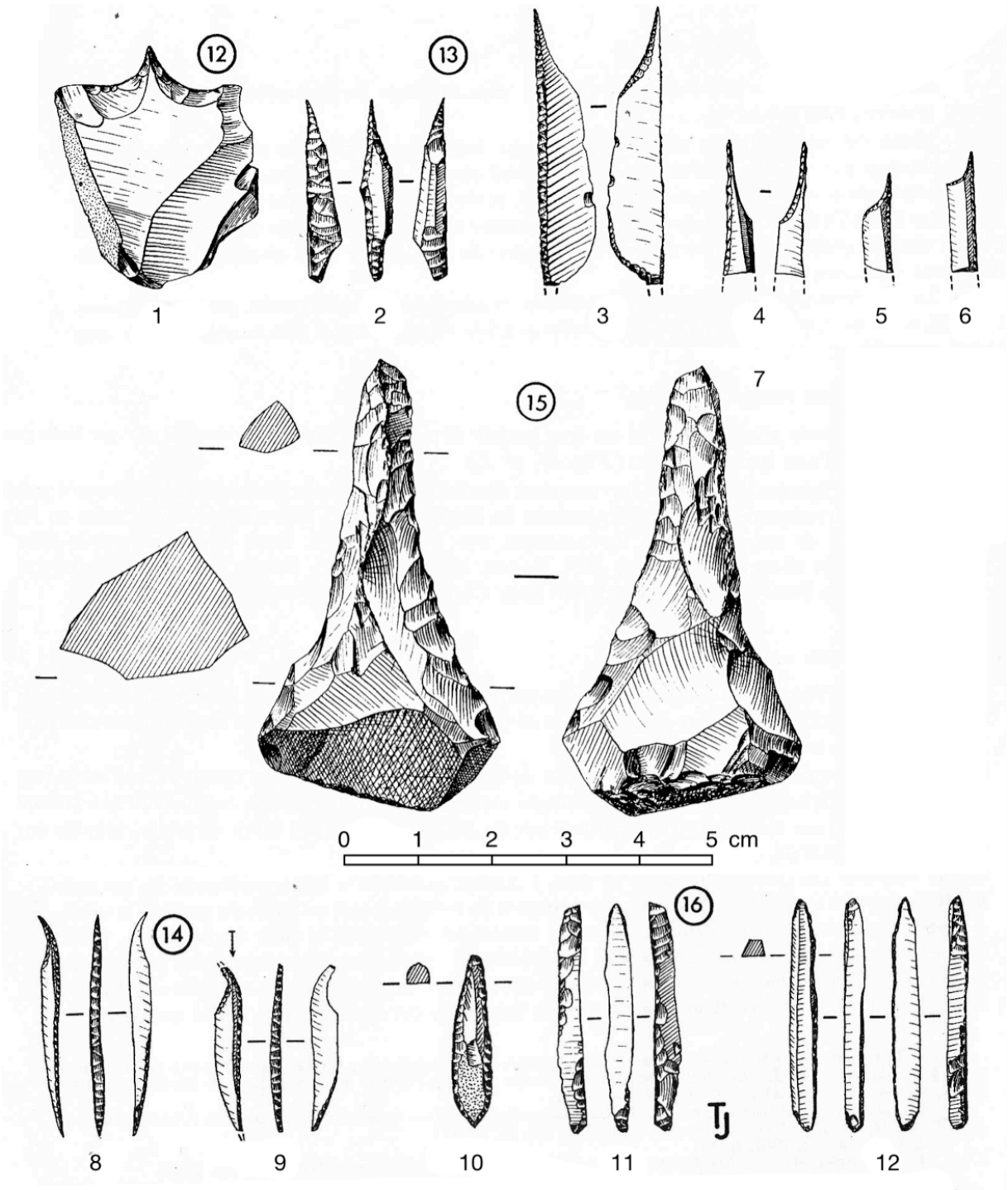


Figure 5.1. Lithic artefacts designated perforators by J. Tixier (1963): 1) Simple perforator – type 12; 2-6) Perforator on a backed bladelet – type 13; 7) Large Capsian perforator – type 15; 8-9) Aïn Khanga piercer – type 14; 10-12) Mèche de foret – type 16

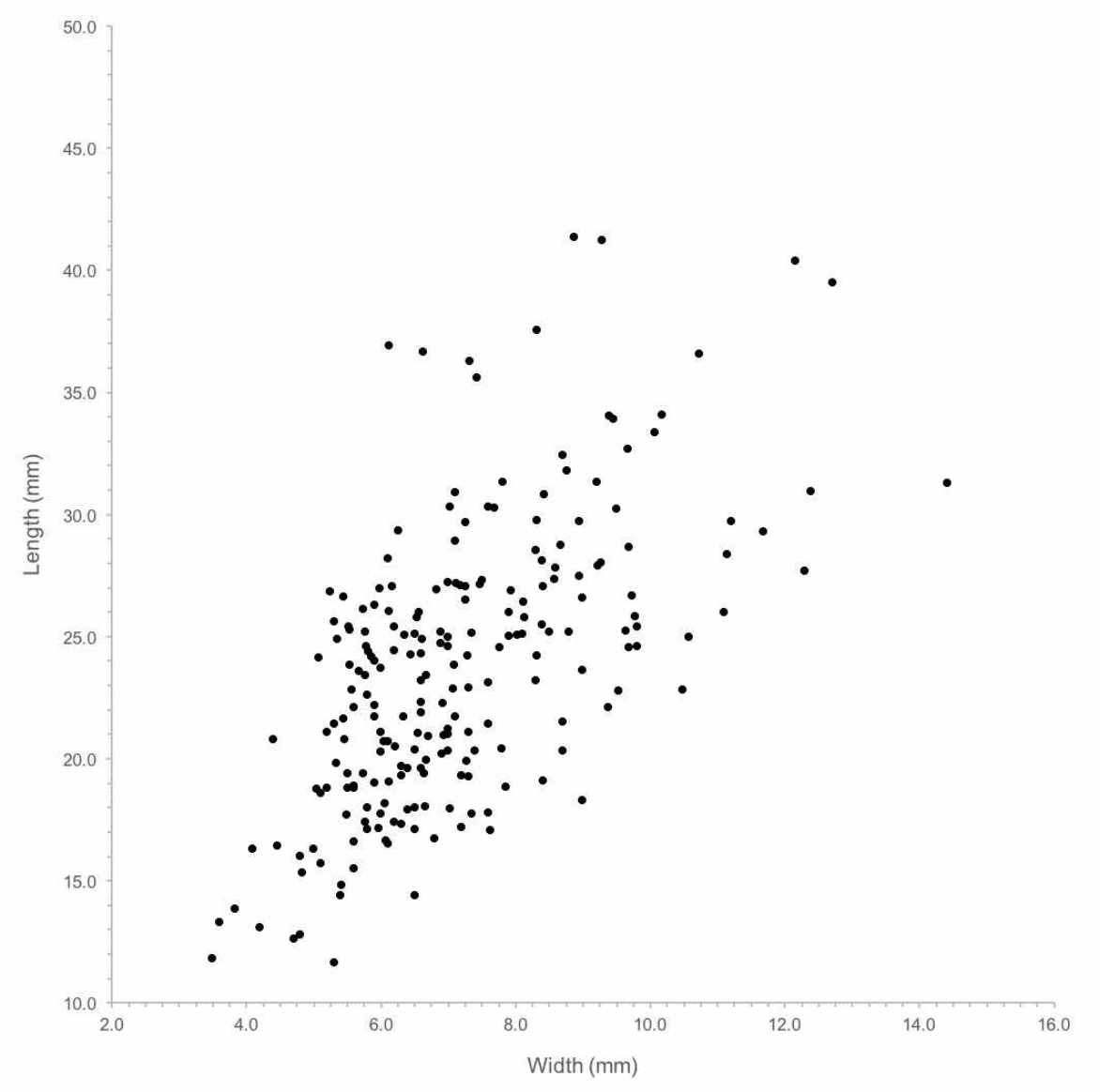


Figure 5.2. Size distribution of unbroken microliths from Sectors 3, 8, 9, and 10

A few additional notes need to be given relating to the use of terminology surrounding 'microliths' and 'microlith fragments'. The term 'pointed straight backed bladelets *sensu lato*' is used to refer to 'pointed straight backed bladelets *sensu stricto*' (type 45)(Fig. 5.3: 1-4) and the seven variants identified by the morphology of the base and/or additional retouch (types 46-52)(Fig. 5.3: 5-14), although these are listed separately in type-lists. It should be noted that a 'pointed straight backed bladelet *sensu lato*' is defined as having straight or slightly curved back, which can make them difficult to differentiate from 'convex backed bladelets *sensu lato*' (see below)(Tixier, 1963, pp. 96–8).

The term ‘convex backed bladelets *sensu lato*’ is used to refer to ‘convex backed bladelets *sensu stricto*’ (type 56)(Fig. 5.3: 15-19) and three other variants identified by the morphology of the base (type 57-59)(Fig. 5.3: 22-24). Tixier (1963, p.104) notes the presence of a variant that he terms a ‘convex backed bladelet leading to segment’, which he classifies amongst the convex backed bladelets *sensu stricto* (type 56)(Fig. 5.3, 18-19). This form has a truncation at both ends, but the ‘cutting edge’ is less regular, or part of the backed edge is straighter, than observed on the ‘segments’ (type 82)(Fig. 5.3: 20-21). It is essentially an irregular ‘segment’ (type 82). This has been recognised in a number of derived and modified typologies, which have referred to similar artefacts as ‘atypical’, ‘asymmetrical’, and ‘irregular’, ‘segments’, ‘crescents’ or ‘lunates’ (e.g. Bar-Yosef, 1970; Goring-Morris, 1987; Hours, 1974). Here, typical ‘convex backed bladelets *sensu stricto*’ (type 56a) and ‘convex backed bladelets leading to segments’ (type 56b) are assigned sub-types in order to highlight differences/similarities to the ‘segments’ (type 82).

Tixier (1963, p.110) defined a ‘partially backed bladelet’ (type 63) simply as a bladelet with abrupt retouch along part of one margin. There is undoubtedly scope for variation within this type and a number of authors have attempted to describe this via a variety of different means (e.g. Close, 1980-1981; Sari, 2012). In the following an important technological distinction is emphasized, the presence (or absence) of partial backing forming a truncation. Herein, the term ‘partially backed bladelet with retouch at the edge’ (type 63a) is used to refer to a piece where the distal end and striking platform is retained, but where partial backing is observed along the lateral margin. In contrast, a microlith with an acute truncation, formed by partial backing at one end, is referred to as a ‘partially backed bladelet with a retouched end’ (type 63b). A microlith with a convex truncation, formed by partial backing at one end, has already been designated the term ‘bladelet with a convex backed end’ (type 55)(Tixier, 1963, p.103). Likewise, a microlith with a shouldered truncation is referred to as a ‘shouldered bladelet’ (type 64)(Tixier, 1963, p.110).

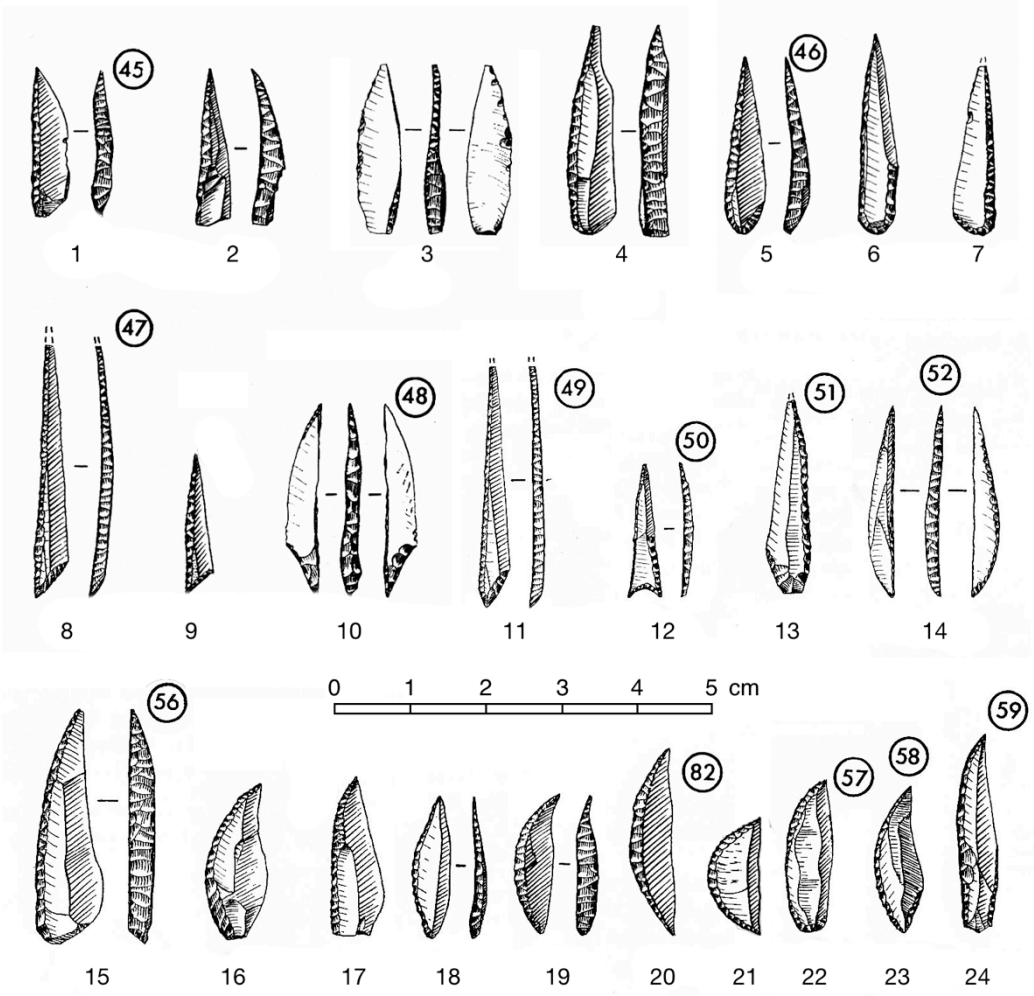


Figure 5.3. Lithic artefacts designated as backed bladelets sensu lato and segments by J. Tixier (1963): 1-4) Pointed straight backed bladelets – type 45; 5-7) Pointed straight backed bladelets with rounded base – type 46; 8-9) Pointed straight backed bladelet with truncated base – type 47; 10) Mechta el-abri point – type 48; 11) Chacal point – type 49; 12) Aïn Berriche point – type 50; 13) Pointed straight backed bladelet with basal retouch – type 51; 14) Aïn Kéda point – type 52; 15-17) Convex backed bladelet – type 56; 18-19) Convex backed bladelet leading to segment – type 56; 20-21) segment – type 82; 22) Convex backed bladelet with rounded base – type 57; 23) Convex backed bladelet with truncated base – type 48; 24) Convex backed bladelet with basal retouch – type 59

Tixier (1963, p. 113) defined a 'scalene bladelet' as a bladelet that has a retouch (semi-abrupt, abrupt, or Ouchata) along the entirety of one margin with a straight delineation, an oblique truncation at the distal end, and retains the butt (Fig. 5.3: 4-7). Close (1977, pp. 27-38) included these along with those without the butt, which she collectively referred to as 'backed and truncated bladelets'. Here the term 'scalene bladelet *sensu lato*' is used, as the term 'backed and truncated bladelets' could easily apply to a wide range of other microlith forms.

Close (1977, pp. 38-41) also defined several other microlith forms. In each case these forms might be better classified within the existing nomenclature given by Tixier (1963). For instance, Close (1977) defined a 'straight backed and pointed and truncated bladelet' (type 68e), which she stated, "…may, in effect, be an elongated scalene triangle (Tixier Type 94), but… they are *usually* larger and more irregular…" [own emphasis](Close 1977, p. 40). This sort of definition is particularly ambiguous, as it there are no absolute criteria for distinguishing it from pre-existing forms. Nonetheless, it should be noted that the few 'triangles' and 'elongated triangles' described below were generally irregular (though not necessarily larger), than what are normally considered geometric microliths, and might therefore be considered comparable to Close's 'straight backed and pointed and truncated bladelets'.

Tixer (1963, p.113) defined 'obtuse backed bladelets' (type 67)(Fig. 5.4: 1-2) as a bladelet with abrupt retouch along one margin, and with either, a natural blunt distal termination, or made blunt with retouch. In order to distinguish between these in the following, the terms 'obtuse backed bladelet with natural end' (type 67a) and 'obtuse backed bladelet with retouch end' (type 67b) are used. A couple of artefacts had retouch at both ends forming an obtuse (or slightly oblique) truncation. Close (1977, p. 40) recognised a similar form that she referred to as a 'backed bladelet with two oblique truncations', which she considered similar to the scalene bladelets *sensu lato*. Tixier (1963, p. 128) used the term 'rectangle', although did not assign a type number, to refer to similar items he discussed amongst the 'geometric microliths'. Shea (2013), in a recent overview of stone-tool technology in the Near East, elaborates on this terminology, using terms 'rectangle', 'trapeze/rectangle', 'trapeze', and 'asymmetrical trapeze,' to refer to similar forms with slight differences in the angle of the truncation. Here the term 'rectangle' is preferred for nomenclatural priority and simplicity.

Tixier (1963, pp. 94-116) distinguished between genuine backed bladelet *sensu stricto* (Fig. 5.3 & Fig. 5.4: 1-7) and bladelets with Ouchtata retouch (Fig. 5.4: 8-35) , although both were classified within his retouched tool group VI 'backed bladelets'. Close (1977, pp. 41-3) suggested that backing *sensu stricto* and Ouchtata retouch were simply alternative methods of making the same tool types, and as such, argued that these should be classified using the same types, with the retouch being described at the attribute level. It is beneficial in some respects, in that it highlights morphological

similarities between artefacts, but somewhat inhibits comparisons with other works using classic examples of the typology, which is almost exclusively the case in the Maghreb (*cf.* Close, 1980-1981, 1977).

In the following, an attempt is made to reconcile the differences between the two approaches, so that this work may be of use to both those attempting to make comparisons with a broad range of sites across the entirety of North Africa. Each bladelet with Ouchtata retouch was initially classified according to the original typology, but its morphological 'partner' amongst the backed bladelet *sensu stricto* was also recorded. In addition, the 'Ouchtata bladelets' (type 70) were subdivided into those with retouch down the entirety of one margin (type 70a) and those with partial retouch restricted to the proximal portion of one edge (type 70b).

A moment should be taken to elaborate on the term *Ouchtata* as its use is convoluted and needs clarification. It is principally used to refer to a type of retouch that is defined as "Direct retouch (very rarely inverse), short or very short, never encroaching deeply into the edge it is worked on, semi-abrupt or slightly abrupt, never forming a back…" (Tixier, 1963, p. 48; translated by Newcomer, 1974, p. 21). Furthermore, as noted above, it is used to describe a range of different microlith forms (types 69-72) that are classified amongst retouched tool group VI, the backed bladelets, and that should be referred to collectively as bladelets with Ouchtata retouch (Tixier, 1963, pp. 115-6).

The term 'Ouchtata bladelet' has also been utilised in the English literature to refer to these different microlith forms with marginal (so-called Ouchtata) retouch (e.g. Olszewski et al., 2011). However, this is misleading as the term 'Ouchtata bladelet' (type 70) was originally defined and continues to be best understood a specific type of retouched blade tool with "…[Ouchtata] retouch, beginning on the proximal part without removing the butt, tending to weaken leaving the distal part of the debitage, so that the latter is [naturally] pointed or obtuse." (Tixier, 1963, p. 115; own translation), which is considered diagnostic of the Pleistocene LSA Iberomaurusian (Camps, 1974a; Gobert, 1954; Lubell et al., 1984).

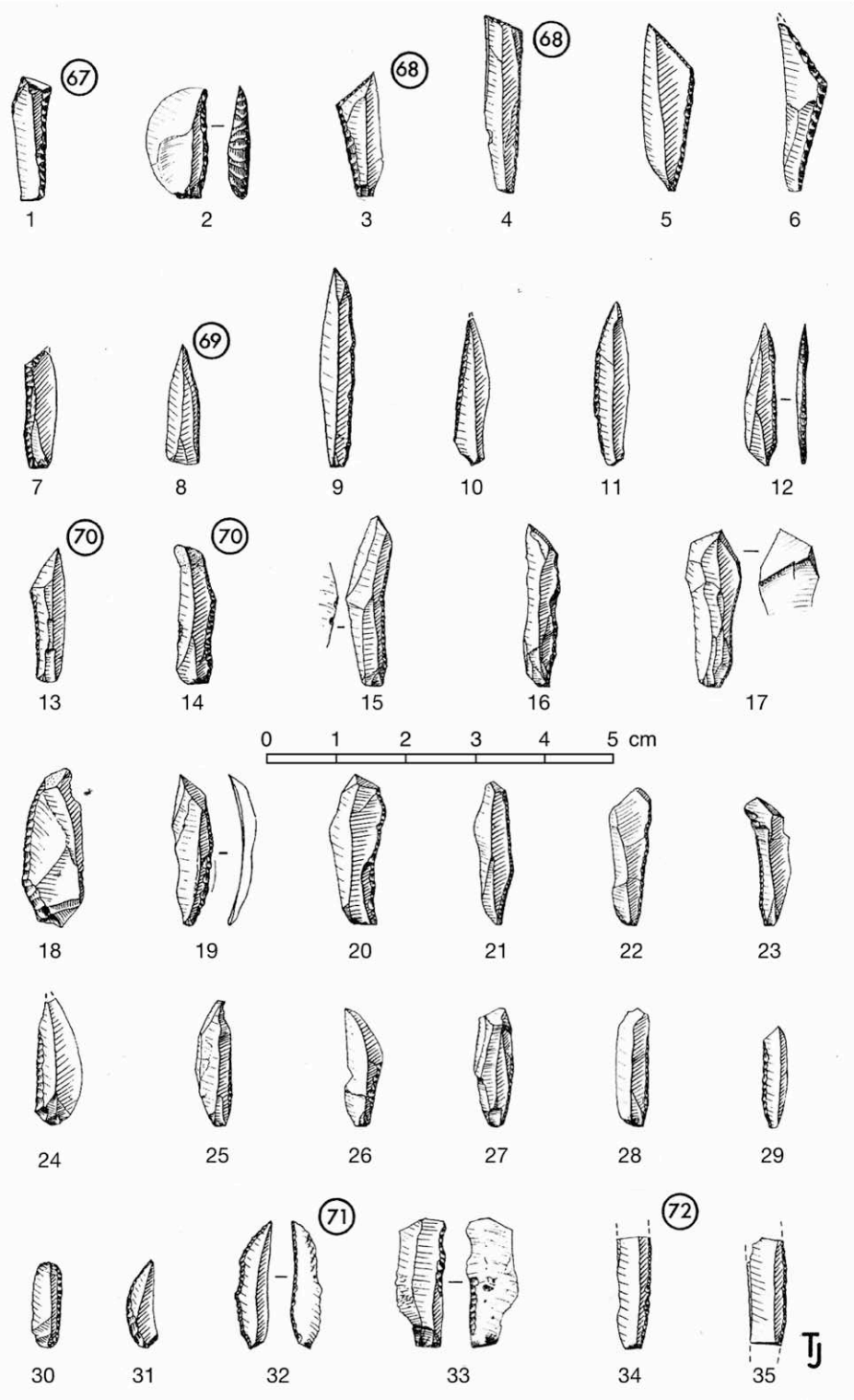


Figure 5.4. Lithic artefacts designated obtuse ended bladelets scalene bladelets, and bladelets with Ouchtata retouch by J. Tixier (1963): 1-2) Obtuse ended backed bladelets – type 67; 3-7) scalene bladelets – type 68; 8-12) Pointed bladelet with Ouchtata retouch - type 69; 13-29) Ouchtata bladelets – type 70; 30-33) Bladelets with Ouchtata retouch – type 71; 34-35) Fragment of a bladelet with Ouchtata retouch – type 72 (modified after Tixier, 1963)

The term *Ouchtata* was chosen to reflect the dominance of characteristic marginal retouch at a site in the Ouchtata tribal area of northern Tunisia (Tixier, 1963, p. 21). In fact, there are now a total of five sites in this vicinity that take the name Ouchtata: Ouchtata rive droite (O.R.D)(originally referred to simply as Ouchtata)(Gobert and Vaufrey, 1932), Ouchtata rive gauche 1, 2, and 3 (O.R.G. 1, 2, and 3)(Gobert, 1962), and Ouchtata nord (O.N)(Gragueb, 1983). Given that the label *Ouchtata* is used to refer to a type of retouch, four retouched tool types, a group of retouched tools, and five archaeological sites, it is understandable that confusion surrounds the term.

5.3. Attribute analysis

Detailed attribute analysis was conducted on the lithic assemblages from Grotte des Pigeons. The selected attributes were recorded in order to better understand the primary (i.e. core reduction/blank manufacture) and secondary (i.e. blank modification/tool manufacture) technological procedures. A full list of attributes with corresponding states is given in Appendix II. These include, raw material, colour, cortex amount, dorsal scar, striking platform, distal termination, linear dimensions, etc. The majority of these attributes were recorded using the definitions set out by Inizan et al. (1999). Those attributes not described using this standardised terminology are discussed below.

In general, the classification of the raw materials follows that outlined by Andrefsky (2005). However, it should be noted that the term 'chert' is used to refer to all microcrystalline/cryptocrystalline quartz (after Luedtke, 1992). Many authors distinguish between cherts on their colour and/or texture. Numerous terms have been used in the archaeological literature to refer to these, such as flint, chert, chalcedony, jasper, agate, carnelian, etc. Many of these have been used inconsistently or at least differ in their usage between regions. The term 'chalcedony' is in usage common in the study of the LSA of Northwest Africa (e.g. Olszewski et al., 2011; Sari, 2012). Andrefsky (2005, p. 54) uses the term to refer all fibrous forms of microcrystalline quartz regardless of colour. In this study a distinction between chert/chalcedony is not made. An extremely high proportion of the artefacts showed evidence of burning/heating (i.e. changes in colour and texture) that made it very difficult, if not impossible, to distinguish 'chalcedony' from the other 'cherts', and as such, only the latter term is used here.

Nonetheless, colour is often thought to be reflective of raw material source, and thus was recorded. In order to better understand colour variation, a system based on the Munsell® soil chart was used to record the colour of all the unburned artefacts. The colour names were: black, dark grey, grey/light grey, pale brown/yellowish brown, brown/strong brown, reddish brown, dusky red/weak red, and white. It should be noted that many of the colours graded into each other. For instance, the grey/light grey, pale brown/yellowish brown, brown/strong, reddish brown, and dusky red/weak red, might best be understood as variation along a continuum.

The amount of cortex (i.e. natural exterior surface) is often used as an indicator of the reduction stage. Its presence/absence was recorded on each artefact. In addition, the amount of cortex on the dorsal surface was recorded. Here, the attribute states are: none, less than 25%, between 25-50%, more than 50%, and 100%. In general, the terms 'primary', 'secondary', and 'tertiary' are avoided due to the lack of consistency in their use between authors (Sullivan & Rosen, 1985). If used, their use follows the convention established for the area by Close (1980-1981): primary (>50%), secondary (25-50%), and tertiary (<25%).

5.4. Statistical Analysis

All statistical analysis was conducted using Stata®. Kruskal-Wallis tests were used to test for variance in the metric data across three or more groups. Mann-Whitney *U* is used with the comparisons of two groups. It uses a different test statistic (*U* instead of *H*), but the *p*-value is mathematically identical to that of the aforementioned test. The Kruskal-Wallis and Mann-Whitney *U* tests were selected as they are nonparametric test do not rely on the assumption that the data are normally distributed. The Mood's Median test was also utilised where the number of samples within one or both comparison groups were small (less than or equal to 10). The Mood's Median test is also nonparametric, but is usually less powerful than the aforementioned tests with larger sample sizes. The mean (μ), standard deviation (S.D), median ($\tilde{x}$), range, and midrange, is given for each variable.

Fisher's Exact test was used to test for significance with categorical data. It provides an equivalent statistic to that of Pearson's chi-square, but it is more robust with small sample sizes. However, it should be noted, with unconditioned data (as is the case with archaeological data) it is

somewhat conservative. Pearson's chi-square was used as an alternative where computational limits were insufficient. In order to avoid type II errors due to small sample size (i.e. failure to detect variation), a minimum expected count of five or more in each cell was necessary.

Chapter 6

Grotte des Pigeons, Taforalt (Morocco): Description of Lithic Assemblages

A description is given here of the chipped-stone assemblages from the stratified sequences within the main chamber (Sectors 3, 8, and 9) and also those from the burial area (Sector 10) at Grotte des Pigeons (Taforalt). The results are given in numerical order according to the designated sector number. It should be reiterated the most critical findings relating to the LSA inhabitation at the site come from the main section in Sector 8, with corresponding findings from less extensive excavations in the various other sectors. The information presented here forms a descriptive catalogue and the basis of research to be published in an upcoming monograph on the 2003-2010 excavations (Barton and Bouzouggar, in prep), for which some preliminary observations have already been given (Hogue in Barton et al., 2013). In addition to the descriptive catalogue detailed statistical analyses were undertaken and are given in Chapter 7.

6.1. Sector 3

A small collection of 191 lithic artefacts were analysed from Sector 3. These were collected from 22 spits that have been placed into two groups for description (0-28 cm and 28-44 cm) due to the small number of artefacts for each spit. These groups were based on the major stratigraphic units identified and the divisions are broadly equivalent to the lowermost groups from Sector 8, Units Y3 and Y4 (see Chapter 4 for stratigraphic descriptions).

6.1.1. 0-28 cm

There are only 137 lithic artefacts from spits 0-28 cm. The absolute frequencies of artefacts classes according to spit, along with the totals and relative frequencies, are given in Table 6.1. Each of the major artefact classes is represented with the exception of trihedral points and Krukowski microburins.

Cores

There are only three cores from spits 0-28 cm. These account for 3.4% of the diagnostic artefacts (Table 6.1). One of these is a tested/prepared core. It is on a split pebble of pale brown/yellowish brown chert. A platform has been prepared at each end with extensive faceting, however only two removals have been made. The final removal has a very intrusive hinge termination; the core may have been abandoned for this reason. It measures 45.3 x 25.7 x 12.5 mm. There are also two bladelet core fragments. Both are on chert with extensive signs of burning.

In addition to the cores, two artefacts were classified as splintered pieces, which account for 2.3% of the diagnostic artefacts from 0-28 cm. These are both of chert; one greyish brown and one burnt. Both come from spit 26-28 cm, which did not yield cores or core-trimming elements, but had a number of flakes and tools. These both have bipolar splintering. All of the removals are less than 10 mm.

Table 6.1. Grotte des Pigeons (Taforalt), Sector 3, 0-28 cm: Number of artefacts in each class by deposit

	Blades	**Flakes**	**CTE**	**MB**	**TP**	**KMB**	**Cores**	**SP**	**Tools**	**Subtotal**	**Chips**	**Chunks**	**Total**
1-3 cm	2	4							2		2	1	11
3-5 cm	1	4		1					1		4		11
5-7 cm	1		1										2
7-9 cm	1	9		1			1		3		11		26
11-13 cm	1	1							2				4
13-14 cm		2							1				3
14-16 cm							1		1		1		3
16-18 cm											2		2
18-19 cm		1											1
19-21 cm		5							3		8	1	17
21-22 cm									1		3		4
22-24 cm	2	2					1		4		4		13
24-26 cm	1	7		1					1		4	2	16
26-28 cm		8						2	7		7		24
Total	9 10.3%	43 49.4%	1 1.2%	3 3.4%			3 3.4%	2 2.3%	26 29.9%	87 100.0%	46 (33.6%)	4 (2.9%)	137

Debitage

There is only a small sample (n=43) of flakes from spits 0-28 cm. These account for 49.4% of the diagnostic artefacts (Table 6.1). They are found almost exclusively on chert (97.6%), with exception of a single limestone flake (2.3%). The complete flakes (≥20 mm maximum dimension)(n=15) were analysed in detail. These were predominately on chert; grey/light grey (6.7%), greyish brown (13.3%), pale brown/yellowish brown (46.7%), heavily patintated (6.7%), and burnt (20.0%). There is one of the sample on limestone, which is burnt (6.7%). The flakes (n=15) tend to retain cortex, divided between those with less than 25% cortex (40.0%), between 25-50% cortex (13,3%), more than 50% cortex (6.7%), and 100% cortex (6.7%). There are far fewer with no cortex (20.0%). The butts include cortical (13.3%), plain (13.3%), dihedral (13.3%), faceted (7.7%), and crushed (26.7%) varieties. The abrasion of the platform edge is recorded in a high number of cases (40.0%). Of the identifiable dorsal scar patterns (n=12) they are most often unidirectional (83.3%), with isolated examples of crossed (8.3%) and multidirectional (8.3%) patterns. The flakes are generally short, squat, and thick, with median length, width, and thickness, of respectively 21.5 mm (range 14.0-30.3 mm, n=15), 15.9 mm (range 11.5-33.9 mm, n=15), and 3.4 mm (range 1.2-12.4 mm, n=15).

Whilst, there are only two blades and seven blade fragments from 0-28 cm, they account for a similar proportion (10.3%) of the diagnostic material, as observed in other deposits. Both the blades are made exclusively on pale brown/yellowish brown chert (n=2). Neither retains cortex. Each has a punctiform butt with an abraded edge. There is one with unidirectional dorsal scars and one with opposed dorsal scars. The former is 27.5 x 10.3 x 2.7 mm, and the latter 22.9 x 5.4 x 2.7 mm.

Of the blade fragments (P:2; M:2; D:3) each is on chert; grey (n=1) and pale brown/yellowish brown (n=6). There are three retaining cortex. The proximal fragments include, one plain and one punctiform butt, both with signs of abrasion at the edge. Of the fragments with identifiable dorsal scars (n=7) these include six unidirectional and one crossed pattern. The fragments have a median width of 9.0 mm (range 6.2-11.5 mm, n=7) and thickness of 2.5 mm (range, 1.5-6.6 mm, n=7).

There is a single core-trimming element, which accounts for 1.2% of the diagnostic artefacts, from 0-28 cm. It is a crested blade with a single prepared versant made on brown/strong brown chert. It has a length of 39.4 mm, width of 13.8 mm, and thickness of 5.2 mm.

Microburins and related products

There are only three microburin products, these account for 3.4% of the diagnostic artefacts, from 0-28 cm. These are all true microburins; there are no trihedral points or Krukowski microburins. Each is on chert and are proximal forms with a notch on the right edge. Notches are direct in each cases and quite intrusive. The median values for length, width, and thickness, are respectively, 18.9 mm (range 17.9-19.8 mm, n=3), 10.0 mm (range 7.1-13.8 mm, n=3), and 2.6 mm (range 2.4-5.5 mm, n=3). The microburin index is 0.125. None of the microliths described in this group retained visible remnants of microburin scars.

Retouched tools

In total there are 26 retouched tools from spits 0-28 cm. They account for quite a high proportion (29.9%) of the diagnostic material. The microliths (38.5%) and microlith fragments (42.3%) are overwhelmingly the most common tool class in the sample, whilst end-scrapers (7.7%), notches and denticulates (7.7%), and truncations (3.9%), account for much smaller frequencies (Table 6.2).

Table 6.2. Grotte des Pigeons (Taforalt), Sector 3, 0-28 cm: Absolute and relative frequencies of tool types

	N	%
End-scrapers	**2**	**7.7**
1. End-scraper on a flake	1	50.0
5. Denticulated end-scraper	1	50.0
Microliths	**10**	**38.5**
55. Bladelet with convex backed end	1	10.0
56. Convex backed bladelet	2	20.0
67. Obtuse ended backed bladelet		
a. natural end	1	10.0
b. retouch at the end	1	10.0
68. Scalene bladelet	1	10.0
69. Pointed bladelet with Ouchtata retouch	1	10.0
70. Ouchtata bladelet		
a. retouched along entire edge	2	20.0
112. Asymmetrical trapeze	1	10.0
Microlith fragments	**11**	**42.3**
66. Fragment of a backed bladelet	8	72.7
72. Fragment of a bladelet with Ouchata retouch	3	27.3
Notches and denticulates	**2**	**7.7**
76. Notched blade or bladelet	2	100.0
Truncations	**1**	**3.9**
80. Truncated piece	1	100.0
Total	**26**	**100.1**

End-scrapers

Only two end-scrapers were recovered from these deposits. One is an end-scraper on a flake (type 1) made on light grey chert. It is retouched at the distal end. It measures 36.4 x 35.7 x 15.2 mm. The other is a denticulated end-scraper (type 5) on a flake. It is a patinated on the top surface. The retouched end is indeterminate as the artefact could not be orientated along the debitage axis. It is of a similar size, measuring 31.2 x 29.6 x 16.1 mm.

Microliths

There are 10 microliths. These include, one bladelet with convex-backed end (type 55), two convex backed bladelets (type 56), two obtuse ended backed bladelets (type 67), one scalene bladelet (type 68), one pointed bladelet with Ouchtata retouch (type 69), and one Ouchtata bladelet (type 70). In addition, one microlith could not be classified using the existing types as defined by Tixier (1963) and

was assigned as various (type 112). It could best be described as a trapeze or rectangle. It does not differ greatly from the obtuse ended backed bladelet with retouch end (type 67b), with the exception that, rather than retaining the butt, the base is formed by a straight truncation.

Five of the microliths are broken. All of the microliths are made on chert; brown/strong brown (n=2), pale brown/yellowish brown (n=6), and burnt (n=2). There are equal numbers with retouch on the left lateral and right lateral sides. In each case the retouch is direct. The backing is typically semi-abrupt, although marginal Ouchtata retouch is relatively common (n=3). None of the microliths retain microburin scars. As a class, these tools have median values of length, width, and thickness, respectively of, 27.8 mm (range 13.6-31.3 mm, n=10), 8.2 mm (range 5.2-12.4 mm, n=10), and 1.9 mm (range 1.9-3.2 mm, n=10).

Microlith fragments

There are 11 microlith fragments. These include, five distal (45.5%), one mesial (9.1%), four proximal (36.4%), and one indeterminate end fragment (9.1%). All of these are made on chert; grey/light grey (9.1%), pale brown/yellowish brown (45.5%), brown/strong brown (9.1%), heavily patinated (18.2%), and burnt (18.2%). There is a preference for retouching the right lateral edge (81.8%) over the left lateral edge (9.1%); one piece was indeterminate (9.1%). Retouch is generally direct (81.8%), with fewer examples of crossed (9.1%) and inverse (9.1%) retouch. The backing is typically semi-abrupt, although marginal Ouchtata retouch is relatively common (27.3%). The microlithic fragments have median values for width and thickness, of respectively, 9.0 mm (range 5.5 – 10.4 mm, n=11) and 3.2 mm (range 2.2 – 4.7 mm, n=11).

Notches and denticulates

This class consists of two notched bladelet (type 76) fragments. Both are on chert. One is a proximal fragment with an inverse notch at the right lateral edge and cutting edge damage on the opposite edge (28.1 x 12.7 x 4.0 mm). The other is a distal fragment with direct notch at the distal end (22.5 x 14.7 x 3.6 mm).

Truncations

There is only one artefact in this class. It is a truncated bladelet (type 80). The truncation is direct, irregular, slightly oblique, and at the distal end. The piece is complete measuring 31.4 x 11.8 x 1.6 mm.

6.1.2. 28-44 cm

There are only 54 lithic artefacts from spits 28-44 cm. The absolute frequencies of artefacts classes according to spit, along with totals and relative frequencies for each group, are given in Table 6.3. A number of major artefact classes are not represented. Excluding chips and chunks, the assemblage consists of only 40 artefacts divided amongst the blade, flake, and tools classes.

Table 6.3. Grotte des Pigeons (Taforalt), Sector 3, 28-44 cm: Number of artefacts in each class by group and deposit

	Blades	**Flakes**	**CTE**	**MB**	**TP**	**KMB**	**Cores**	**SP**	**Tools**	**Subtotal**	**Chips**	**Chunks**	**Total**
28-44 cm													
28-30 cm	3	10									2		15
30-32 cm	1	4							1				6
32-34 cm	1										1	2	4
34-36 cm		1							1		3		5
36-38 cm		4							2		1		7
38-40 cm	1								2				2
40-42 cm		5									1		6
42-44 cm		2							2		4		8
Total	6 15.0%	26 65.0%							8 20.0%	40 100.0%	12 (66.0%)	2 (3.7%)	54

Debitage

There are only a small number of flakes (n=26) from 28-44 cm. These are found most often on chert (80.8%), but there are also a small number of flakes on limestone (11.5%) and basalt (7.7%). The basalt artefacts come specifically from spits 34-36 cm and 42-44 cm. Both are small flakes (10-20mm), one has a lipped butt, and appears to be a small bifacial thinning flake. Given that basalt and bifacial technology is found in abundance in the underlying deposits associated with a non-Levallois flake industry, it is almost certain that these small basalt flakes are residual. The complete flakes

(≥20mm maximum dimension)(n=8) all retain some cortex, divided between those with less than 25% (n=2), between 25-50% (n=3), more than 50% (n=1), and 100% (n=2), cortex. The butts include cortical (n=2), plain (n=5), and dihedral (n=1) varieties. There is abrasion at the platform edge recorded in a single instance. The identifiable dorsal scars patterns (n=5) are unidirectional (n=3), crossed (n=1), and multidirectional (n=1). The flakes are generally short, squat, and thick, with median length, width, and thickness, of respectively, 23.5 mm (range 14.3-34.0 mm, n=8), 18.4 mm (range 10.5-34.4 mm, n=8), and 5.8 mm (range 1.1-19.2 mm, n=8).

There are only three blades and three blade fragments. These are all on chert; one grey, three pale/yellowish brown, and two burnt. Of the complete blades (n=3), two retain 100% dorsal cortex, one of which has a plain butt and the other a punctiform butt, the former has a hinged termination and the latter is overshot. The third complete blade has no cortex, a dihedral butt with an abraded edge, feathered termination, and unidirectional dorsal scars. The median values of length, width, and thickness, are respectively, 33.0 mm (range 19.2-35.3 mm, n=3), 11.3 mm (range 9.3-15.1, n=3), and 4.6 mm (range 3.5-5.0 mm, n=3).

Of the blade fragments (P:2; M:1; D:0) all three retain cortex. The proximal ends (n=2) both have punctiform butts and of these has abrasion at the edge. Of the fragments with identifiable dorsal scars (n=2) both have unidirectional patterns. The fragments have median width and thickness values, respectively of, 8.1 mm (range 5.7-12.0 mm, n=3) and 1.9 mm (range 1.8-2.6 mm, n=3).

Retouched tools

There are only eight tools from these deposits. They account for a 20.0% of the diagnostic artefacts (Table 6.3). The tools consist entirely of microliths (62.5%) and microlith fragments (37.5%)(Table 6.4).

Table 6.4. Grotte des Pigeons (Taforalt), Sector 3, 28-44 cm: Absolute and relative frequencies of tool types

	N	%
Microliths	**5**	**62.5**
55. Bladelet with convex backed end	(1)	(20.0)
67. Obtuse ended backed bladelet		
a. natural end	(1)	(10.0)
b. retouched end	(1)	(20.0)
69. Pointed bladelet with Ouchtata retouch	(1)	(10.0)
70. Ouchtata bladelet		
b. retouched at proximal	(1)	(20.0)
Microlith fragments	**3**	**37.5**
66. Fragment of a backed bladelet	(1)	(33.3)
72. Fragment of a bladelet with Ouchata retouch	(2)	(66.7)
Total	**8**	**100.0**

Microliths

There are five microliths. There is one of each of the following: bladelet with convex backed end (type 55), obtuse ended backed bladelet (type 67), pointed bladelet with Ouchtata retouch (type 69), and Ouchtata bladelet (type 70). All of these are made on chert. There is one more retouched at the left lateral (n=3) than at the right lateral (n=2) edge. The retouch is most often direct (n=4), with a single crossed example (n=1). The retouch is most often semi-abrupt, although marginal Ouchtata retouch is common (n=2). As a class, these tools have median values of length, width, and thickness, respectively of, 29.7 mm (range 17.4-31.3 mm, n=5), 8.3 mm (range 5.8-14.4 mm, n=5), and 3.0 mm (range 2.3-5.6 mm, n=5).

Microlith fragments

There are only three microlith fragments. There are one mesial and two distal fragments, each on chert with retouch at the right lateral edge. In two cases the retouch is direct and in one it is inverse. The microlithic fragments have median values for width and thickness of 7.1 mm (range 7.1 – 9.5 mm, n=3) and 3.1 mm (range 1.7 – 3.2 mm, n=3), respectively.

6.2. Sector 8

In total 12,709 lithic artefacts were recovered from Sector 8. These were recovered from 44 excavations contexts, representing the smallest recognisable and often highly localised stratigraphic deposits, with the number of finds associated with each varying dramatically. In order to provide some semblance of structure the individual contexts were grouped into broader stratigraphic divisions that were recognised in collaboration with S. Colcutt (see Chapter 4 for stratigraphic details).

6.2.1. L2-9

There are 5164 lithic artefacts from L2-9. The absolute frequencies of artefacts according to excavation unit, along with the totals and relative frequencies for the group, are given in Table 6.5.

Table 6.5. Grotte des Pigeons (Taforalt), Sector 8, L2-9:
Number of artefacts in each class by deposit

	Blades	**Flakes**	**CTE**	**MB**	**TP**	**KMB**	**Cores**	**SP**	**Tools**	**Subtotal**	**Chips**	**Chunks**	**Total**
L2	22	75	3	4		2	2		20	128	433	26	587
L3	60	166	6				9		56	297	1227	100	1624
L4	3	23							5	31	113	6	150
L5	7	35	2				4		9	57	237	17	311
L6	22	110	4	1		2	4		33	176	675	26	877
L7	10	76	5				4	1	31	127	540	20	687
L8	21	132	2				5	1	37	198	545	25	768
L9	4	31	2						7	44	112	4	160
Total	149 14.1%	648 61.3%	24 2.3%	5 0.5%		4 0.4%	28 2.7%	2 0.2%	198 18.7%	1058 100.0%	3882 (75.2%)	224 (4.3%)	5164

Cores

L2-9 consist of 28 cores, which account for 2.7% of the diagnostic artefacts (Table 6.5). These are most often single platform cores (32.1%), with fewer core-on-flakes (17.9%), opposed platform cores (10.7%), multiple platform cores (10.7%), 90º platform cores (7.1%), and only a single discoidal core (3.6%). There are also five core fragments (17.9%). The raw materials utilised is exclusively chert; pale brown/yellowish brown (7.1%), brown/strong brown (7.1%), red/reddish brown (3.6%), white (3.6%), and a high proportion are burnt (78.6%). A high occurrence of burning is observed throughout the Grey Series and this is discussed further in Chapter 7.

Excluding fragments, there are few cores that do not retain cortex (13.0%). Where preserved, it appears to be exclusively pebble/cobble cortex (69.6%). There are also four cores-on-flakes (17.4%). Overall, the cores are quite restricted in size, as seen in the median length, width, and thickness values, which are respectively, 27.8 mm (range 18.4-34.5 mm, n=23), 18.7 mm (range 10.4-34.7 mm, n=22), and 13.9 mm (range 7.4-31.3, n=23).

The single platform cores most often have blades removals (80.0%) rather than flake removals (20.0%). The flaking surface of the single platform cores tends to have unidirectional scars in accordance with the platform, however in one case there are negatives of previous removals opposite to the retained platform, indicating that at some point during the sequence the core was rotated or a second platform used to regulate knapping. Two other single platform bladelet cores are particularly narrow with sub-parallel margins and thin platforms that have splintering typical of reduction on an anvil (Fig. 6.1a). The single platform cores all appear to be exhausted, with small median values for length 26.1 mm (range 18.4-34.4 mm, n=10), width 17.2 mm (range 10.4-21.9 mm, n=9), and thickness 12.2 mm (range 8.8-20.0 mm, n=10).

The opposed platform cores include one with mixed removals (33.3%) and two with flake removals (66.7%). Each has only a minimal amount of exploitation on the second platform and there are negatives from hinged/stepped terminating removals on the flaking surface; so that it would appear that the exploitation of an additional platform is an attempt to regulate the production of blanks, following the build up of a series of errors (Fig. 6.1b). Each appears to be exhausted, with small median values for length 29.8 mm (range 25.5-31.2 mm, n=3), width 18.8 mm (range 15.1-20.0 mm, n=3), and thickness 13.4 mm (range 7.4-21.7 mm, n=3).

The 90º platform flake cores each have platforms exploiting one face (Fig. 6.1c). Neither is particularly well-made. The median dimensions are shorter, wider, and thicker than on the single and opposed platform cores, with median values for length, width, and thickness, of respectively, 21.2 mm (range 21.0-21.2 mm, n=2), 23.3 mm (range 21.3-25.4 mm, n=2), and 17.5 mm (range 16.5-18.4 mm, n=2). The discoidal core is a flake core (Fig. 6.1d). It is atypical, with a series of smaller removals

around the perimeter, which appear to be an attempt to setup the core for the subsequent removal of a single large flake. It is 20.0 x 34.7 x 31.2 mm. The multiple platform cores have flakes removals (Fig. 6.1e). Each is lacking clear patterning, one is globular, and two have faces exploited via three platforms. These are also small, with median dimensions of 27.8 mm (range 23.1-32.7 mm, n=3), 23.7 mm (range 16.8-32.4 mm, n=3), and 19.2 mm (range 16.8-19.6 mm, n=3).

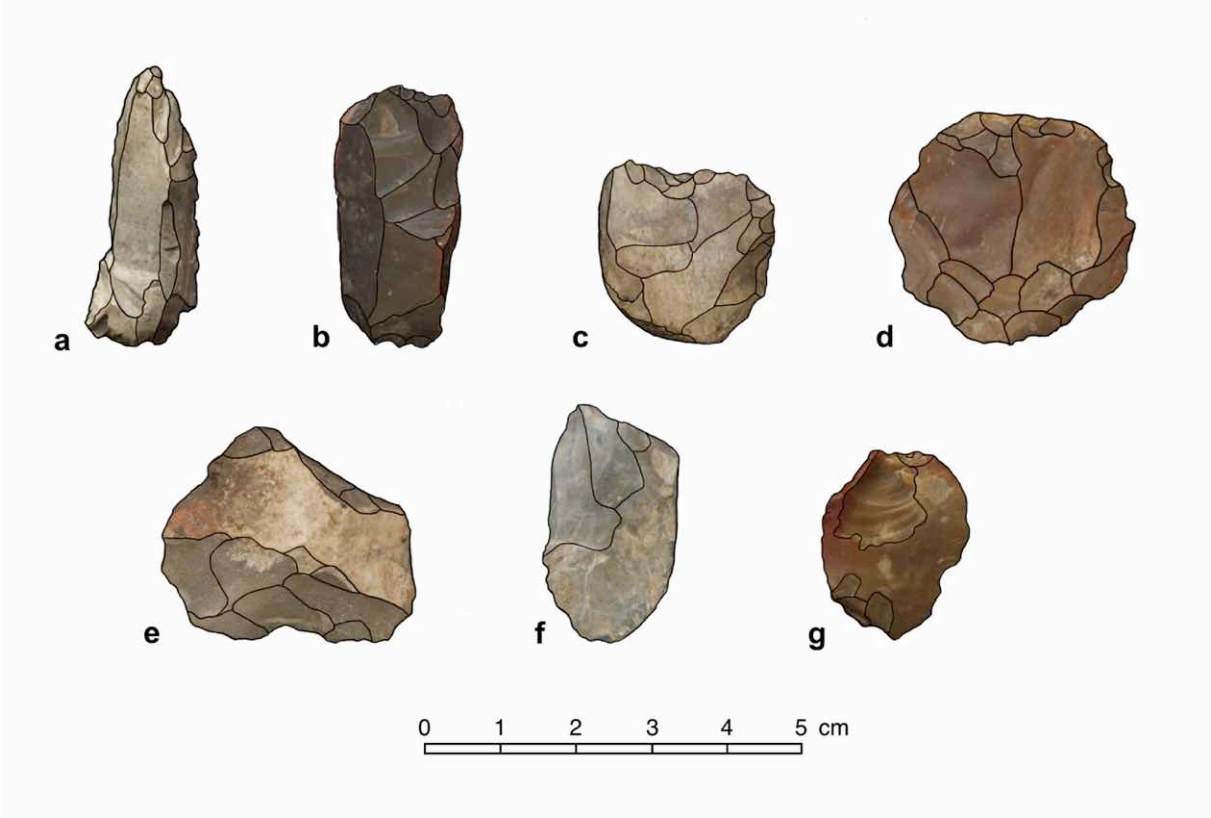


Figure 6.1. Grotte des Pigeons (Taforalt), Sector 8, L2-9: Cores
a) single platform; b) opposed platform; c) 90° platform; d) discoidal; e) multiple platform; f) core-on-flake; g) splintered piece

The core-on-flakes are the second most common form. These all have flake removals. There are two with removals from one direction, including one with a burin-like removal off a break (Fig. 6.1f). The other two have removals from opposed locations. The median values for length, width, and thickness are 28.9 mm (range 23.8-34.5 mm, n=4), 18.2 mm (range 16.8-18.7 mm, n=4), and 9.3 mm (range 9.1-11.7 mm, n=4). There are also five fragments; one blade core, one flake core, and three indeterminate.

In addition to the cores, two burnt chert artefacts were classified as splintered pieces, which account for only 0.2% of the diagnostic artefacts from L2-9. These come from specifically from L7 and L8, which also yielded a number of cores. Each piece has characteristic bifacial splintered removals at opposite extremities. None of these removals seem of sufficient size to be utilised (Fig. 6.1g).

Debitage

In total, 648 flakes were recovered from L2-9. These account for 61.3% of the diagnostic artefacts. The majority of the flakes are on chert (88.0%), with many fewer on limestone (12.0%). All the complete flakes (≥20mm maximum dimension)(n=134) were analysed in detail. These were predominately chert; black (0.8%), dark grey (3.7%), grey/light grey (3.7%) greyish brown (1.5%), pale/brown yellowish brown (5.2%), brown/strong (11.2%), reddish brown (1.5%), white (0.5%), and burnt (52.2%). There are also four limestone flakes; dark grey (3.7%), and burnt (1.5%). The flakes tend to retain cortex, divided between those with less than 25% cortex (18.8%), between 25-50% cortex (18.8%), more than 50% cortex (17.3%), and 100% cortex (14.3%). Only a small proportion of the flakes have no cortex (30.8%). Plain butts (50.4%) predominate, while cortical (31.3%) also are well represented. There are few faceted (13.0%), punctiform (5.2%), and no dihedral, butts. The edge of the striking platform is rarely abraded (3.5%). Of those with identifiable dorsal scar patterns (n=71), unidirectional (43.7%) and multidirectional (39.4%) dorsal scars predominate, with much smaller frequencies of opposed patterns (14.1%). There are only two with crossed scars (2.8%). The flakes are generally short, squat, and thick, with median length, width, and thickness values, respectively of 23.0 mm (range 12.5-77.3 mm, n=134), 19.5 mm (range 9.4-57.6 mm, n=134), and 5.0 mm (range 1.4-19.7 mm, n=134). There are only four flakes greater than 50 mm long; each on limestone.

In total, 53 blades and 95 blade fragments were recovered, accounting for a moderate proportion (14.1%) of the diagnostic artefacts. The blades are made exclusively on chert; black (1.9%), dark grey (1.9%), grey/light grey (3.8%), pale brown/yellowish brown (7.6%), brown/strong brown (3.8%), dusky/weak red (1.9%), reddish brown (3.8%), white (1.9%), and burnt (73.6%). The majority of the blades retain some cortex, divided between those with less than 25% cortex (26.9%),

between 25-50% cortex (23.1%), more than 50% cortex (3.9%), and 100% cortex (1.9%). Nonetheless, a moderate proportion of the blades have no cortex (44.4%). The butts are predominately plain (32.0%), with strong proportions of punctiform (20.8%) and crushed (22.6%), and fewer faceted (13.0%), cortical (9.4%), and dihedral (2.0%), butts. The abrasion at the platform edge is frequent (n=12, 22.6%). Of the identifiable dorsal scars (n=44) these are most often unidirectional (47.7%), with relatively high proportion of opposed (27.3%), and fewer crossed (9.1%) and multidirectional (15.9%) patterns. The blades are generally small in size with median length, width, and thickness values, of respectively, 27.6 mm (range 16.4 – 45.1 mm, n=53), 9.5 mm (range 4.9 – 18.2 mm, n=53), and 3.9 mm (range 1.1 – 8.8 mm, n=53). Of the sample, all are bladelet size, none being blades *sensu stricto* (after Tixier, 1963, p. 38).

Of the blade fragments (P: 36; M: 39; D: 20)(n=95) all are on chert; black (1.1%), grey/light grey (4.2%), pale brown/yellowish brown (4.2%), brown/strong brown (8.4%), dusky red/weak red (3.2%), reddish brown (2.1%), white (1.1%), and burnt (75.8%). There are around a third retaining some cortex (36.8%). The proximal ends (n=36) are predominately plain (44.4%), with fewer punctiform (11.1%), crushed (13.9%), and faceted (22.2%), and only two cortical (5.6%), and one dihedral (2.8%) butt. Of the fragments with identifiable dorsal scars (n=54) they are predominately unidirectional (59.3%), followed by opposed (22.2%) and multidirectional (14.8%) patterns, and only two have crossed (3.7%) scars. The fragments have median width and thickness values, of respectively, 8.7 mm (range 5.0-16.4 mm, n=94) and 2.8 mm (range 1.0-6.6 mm, n=95).

In total, 24 core-trimming elements, accounting for 2.4% of the diagnostic artefacts, were recovered from L2-9. These are all on chert. The overwhelming majority are crested blades (n=18), which tend to be first removals with a single prepared versant (n=11), with a couple prepared in part along both edges (n=2), and only one second removal (n=1). There are also a small number of fragments (n=4). The crested blades have median values for length, width, and thickness, respectively of, 29.4 mm (range 17.1.1-32.8 mm, n=6), 12.1 (range 7.1-17.9 mm, n=13), and 5.5 mm (range 3.0-9.2, n=13). There are also three platform rejuvenations, with median values, for length of 21.6 mm (n=1), width of 20.3 mm (range 12.8-21.6 mm, n=3), and thickness of 5.7 mm (range 4.2-8.3 mm,

n=3). In addition, there are three *flanc de nucleus*, including one struck from the side of the core that appears to be an attempt to remove a series of stacked stepped removals. These have median values for length, width, and thickness respectively of, 25.4 mm (range 21.4-33.5 mm, n=3), 17.9 mm (range 17.7-28.1 mm, n=3), and 8.2 mm (range 6.6-14.9 mm, n=3).

Microburins and related products

There are only nine microburin products from L2-9, which account for 0.9% of the diagnostic artefacts. These include five true microburins. Each is on chert. The microburins are most often from the proximal end of the blade blank (n=3), with lower frequencies from the distal end (n=2). Notching is always direct, quite regular and not very deep. The notch is most often at left lateral margin (n=4) and only at the right edge in a single instance (n=1). There is no clear correlation between the position of the microburin and the lateralisation of the notch. The median values of length, width, and thickness, are respectively, 7.8 mm (range 5.7-15.3 mm, n=5), 7.2 mm (range 3.7-10.3 mm, n=5), and 2.4 mm (range 1.2-3.4 mm, n=5). There are also four Krukowski microburins. These all have retouch of the left edge and most likely represent the accidental removal of the tip during the backing of bladelets. The microburin index is 4.8. In addition, only 0.6% of the microliths and microlith fragments had visible remnants of a microburin scar.

Retouched tools

There are 198 retouched tools from L2-9. They account for 18.7% of the diagnostic material. The microliths (43.4%) and microlith fragments (47.0%) are overwhelming the most common tool class, whilst end-scrapers (2.0%), composite tools (0.5%), notches and denticulates (2.5%), truncations (1.0%), and miscellaneous tools (3.5%), account for much smaller frequencies (Table 6.6)

Table 6.6. Grotte des Pigeons (Taforalt), Sector 8, L2-9:
Absolute and relative frequencies of tool types

	N	%
End-scrapers	**4**	**2.0**
1. End-scraper on a flake	1	25.0
11. Double end-scraper	1	25.0
112. Fragment of an end-scraper	2	50.0
Composite tools	**1**	**0.5**
44. End-scraper/burin	1	100.0
Microliths	**86**	**43.4**
34. Backed flake	1	1.2
45. Pointed straight backed bladelet	9	10.5
46. Pointed straight backed bladelet with rounded base	2	2.3
47, Pointed straight backed bladelet with truncated base	7	9.1
51. Pointed straight backed bladelet with retouched base	1	1.2
52. Aïn Kéda point	3	3.5
56. Convex backed bladelet		
a. typical	16	18.6
b. leading to segment	17	19.8
58. Convex backed bladelet with truncated base	9	10.5
59. Convex backed bladelet with retouched base	2	2.3
60. Backed bladelet with gibbousity	1	1.2
61 Backed bladelet with narrowed base		
a. pointed straight backed bladelet	1	1.2
b. convex backed bladelet	1	1.2
67. Obtuse ended backed bladelet		
a. natural end	1	1.2
68. Scalene bladelet	1	1.2
69. Pointed bladelet with Ouchtata retouch	5	5.8
71. Bladelet with Ouchtata retouch	2	2.3
82. Segment or semi-circle	5	5.8
89. Isosceles or equilateral triangle	1	1.2
90. Scalene triangle	1	1.2
Microlith fragments	**93**	**47.0**
66. Fragment of a backed bladelet	91	97.9
72. Fragment of a bladelet with Ouchata retouch	2	2.2
Notches and denticulates	**5**	**2.5**
76. Notched blade or bladelet	3	60.0
77. Denticulated blade or bladelet	2	40.0
Truncations	**2**	**1.0**
80. Truncated piece	2	100.0
Miscellaneous	**7**	**3.5**
105. Piece with continuous retouch	7	100.0
Total	**198**	

End-scrapers

This tool category is represented by four artefacts; one made on a flake and three on indeterminate debitage. One is a single end-scraper on a flake (type 1) with an irregular shaped scraper retouch at the proximal end (21.5 x 26.3 x 10.7 mm). A second is a double end-scraper (type 11) where the debitage axis is unknown due to being extremely burnt. It has a larger well-formed convex scraper edge and a second narrower and more superficial truncation (17.3 x 11.8 x 5.8 mm)(Fig. 6.2a). There are also two burnt fragments, both with scraper retouch at the distal.

Composite tools

This is rare tool class throughout the site and here consists of a single end-scraper/burin (type 44) (Fig. 6.2b). It is on a flake that retains some cortex on the dorsal surface. There is a convex well-formed scraper at the distal end. The retouch continues onto and extends down the entirety of both lateral margins. The burin is on a break at proximal end with a single removal/spall. It measures 31.4 x 20.5 x 10.7 mm.

Microliths

There are 86 microliths (Figs. 6.2c-t). These are dominated by convex backed bladelets *sensu lato* (types 56-59)(51.2%) and pointed straight backed bladelets *sensu lato* (types 45-52)(24.7%). An additional nine types are also present in frequencies from 5.0% to 1.2% (Table 6.6). These include, seven 'geometrics' accounting for 8.1% of the microliths, which are specifically, five segments (type 82), one isoceles triangle (type 89), and one scalene triangle (type 90).

All of the microliths are made on chert; greyish brown (2.3%), pale brown/yellowish brown (5.8%), brown/strong brown (11.6%), white (2.3%), and overwhelming burnt (77.9%). Most of the microliths are broken (55.8%). There is a preference for left lateral retouch (57.0%) over the right lateral retouch (30.2%); the remaining cases were indeterminate (12.8%). Half of the retouch is direct (50.0%), with high proportions of mixed direct/crossed (23.3%) and crossed (22.1%). There are only three alternating (3.5%) and one inverse (1.6%) example. There is only a small proportion with

marginal Ouchtata retouch (5.8%). A few of the microliths have unmodified ends (3.5%), but the majority are single points (62.3%). There is also a substantial number of double points (33.7%).

Of the single points (n=54) most are found at the distal (64.8%) with the proximal utilised less often (18.5%); nine cases were indeterminate (16.7%). Of all the microliths the butt is retained in around a quarter of cases (23.3%). There is a relatively high frequency of microliths with basal truncations (20.9%), which tend to be acute (n=16) over rounded (n=2). The basal truncations are most often with direct retouch (n=13), although there are also inverse (n=2) and crossed (n=1) examples; another was indeterminate. There are only a few microliths with additional basal retouch (4.7%). There are also few microliths with additional retouch at the tip(s)(4.7%); fine inverse retouch, and at the opposite tip, fine direct retouch, is present on the Aïn Kéda points (type 52)(Fig. 6.2g). As a group the microliths vary somewhat in size, the median value for length, width, and thickness, are respectively, 20.5 mm (range 12.8-28.2 mm, n=38), 6.6 mm (range 3.6-10.6 mm, n=86), and 3.2 mm (range 1.5-7.2 mm, n=86).

Microlith fragments

There are 93 microlith fragments, including 24 distal (25.8%), 24 mesial (25.8%), 25 proximal (26.9%), four partial (4.3%), and 16 indeterminate ends (17.2%). All of these are made on chert; the majority burnt (86.0%). There is a strong preference for retouch at the left lateral edge (49.5%) over the right lateral edge (22.6%); the remaining cases were indeterminate (28.0%). Most of the retouch is direct (65.6%), with high proportions of crossed (24.7%). There is only four inverse (4.3%), three mixed direct/crossed (3.2%), and two alternating (2.2%). The butt is retained on a number of the fragments (14.0%). The fragments have a median width and thickness values, of respectively, 6.3 mm (range 3.1-11.7 mm, n=93), and 3.0 mm (range 2.5-3.7 mm, n=93).

Notches and denticulates

Five pieces were assigned to this class. These are on chert; pale brown/yellowish brown (n=1), brown/strong brown (n=3), and dusky red/weak read (n=1). None show evidence of burning. The blanks include, three bladelets and two blades. The bladelets each have a single notch; one retouched

at the left lateral side and two retouched at the right lateral side. One is complete (18.6 x 5.0 x 1.9 mm) and the other two are fragments, which may be failed examples of the microburin technique (Fig. 6.2u). The blades each have contiguous notches at both lateral margins. One is complete (47.6 x 20.4 x 3.7 mm) and other has a slight break at the distal (38.5 x 18.5 x 3.3 mm)(Figs. 6.2v-w).

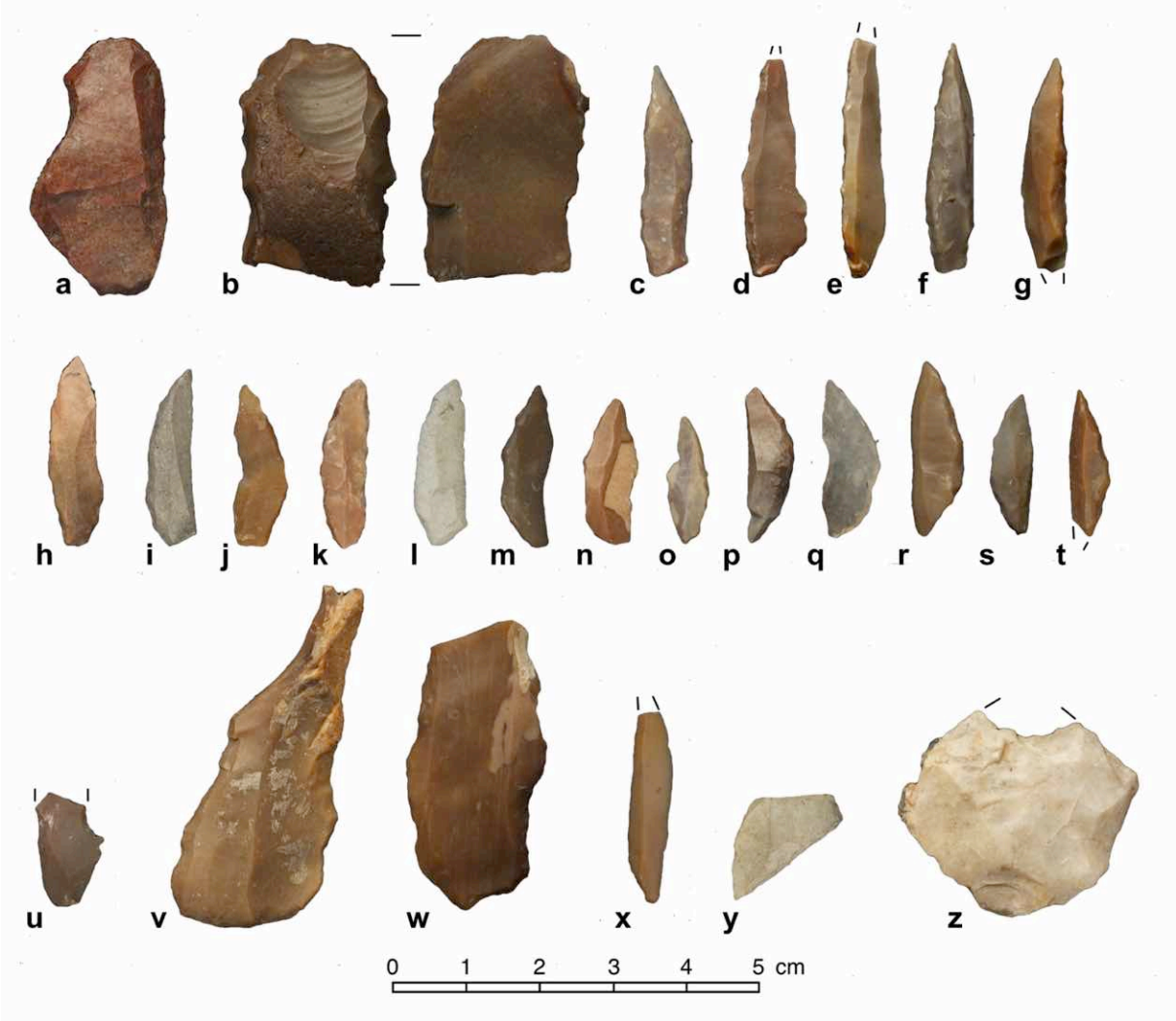


Figure 6.2. Grotte des Pigeons (Taforalt), Sector 8, L2-9: Retouched Tools
a) double end-scraper; b) end-scraper/burin; c-d) pointed straight backed bladelets; e) pointed straight backed bladelet with truncated base; f) pointed straight backed bladelet with retouched base; g) Aïn Kéda point; h) convex backed bladelet with retouched base; i) convex backed bladelet with truncated base; j-o) convex backed bladelets; p-q) convex backed bladelets leading to segments; r-s) segments; t) scalene triangle; u) notched bladelet; v) denticulated blades; x-y) truncations; z) miscellaneous

Truncations

This tool class consists of two truncated pieces (type 80). Both have direct rectilinear obtuse truncations at the proximal end. One is on pale brown/yellowish brown chert, is a bladelet with a small

break at the distal (26.9 x 5.8 x 1.7 mm)(Fig. 6.2x). One is complete and is on a burnt chert flake (14.2 x 16.8 x 4.1 mm)(Fig. 6.2y).

Miscellaneous tools

The group includes seven atypical pieces with continuous retouch (type 105); five made on flakes, one made on a bladelet, and two on indeterminate debitage. These are all on chert. All have direct retouch along at least one edge, but are rather atypical in form. The lengths range from 16.1 to 28.5 mm, widths from 10.9 to 32.8 mm, and thicknesses from 3.6 to 5.5 mm (Fig. 6.2z).

6.2.2. L10-14

There are 1160 lithic artefacts from L10-14. The absolute frequencies of artefacts according to excavation unit, along with the totals and relative frequencies for the group, are given in Table 6.7.

Table 6.7. Grotte des Pigeons (Taforalt), Sector 8, L10-14: Number of artefacts in each class by deposit

	Blades	**Flakes**	**CTE**	**MB**	**TP**	**KMB**	**Cores**	**SP**	**Tools**	**Subtotal**	**Chips**	**Chunks**	**Total**
L11	6	117					3		25	151	469	15	635
L12	4	11	2				4		19	40	126	9	175
L13	12	15	1				2	1	23	54	186	16	256
L14	4	9	3						8	24	66	4	94
Total	26 9.7%	152 56.5%	6 2.2%				9 3.4%	1 0.4%	75 27.9%	269 100.1%	847 (73.0%)	44 (3.8%)	1160

Cores

There are 9 cores, which account for 3.4% of the diagnostic artefacts. These include four single platform cores, one opposed platform core, and one core-on-flake. There are also three core fragments (Table 6.4). All of the cores are on chert; brown/strong brown (n=1), red/reddish brown (n=1), black (n=1), and burnt (n=6). Excluding fragments, the cores retaining cortex appear to be on pebbles/cobbles (n=5). There is also a single core-on-flake (n=1). Overall, the cores are quite restricted in size, as seen in the median length, width, and thickness values, which are respectively, 27.2 mm (range 21.5-28.9 mm, n=6), 18.7 mm (range 12.2-29.9 mm, n=6), and 10.7 mm (range 7.2-14.2 mm, n=6).

The single platform cores include, equal numbers of flake cores (Fig. 6.3a) and blade cores (Fig. 6.3b). There is one of the latter that is sub-pyramidal. In general, and throughout the sequence, there is little formality in core morphology. The single platform cores all appear exhausted, with small median values for length, width, and thickness, respectively of, 24.8 mm (range 21.5-27.6 mm, n=4), 17.7 mm (range 12.2-29.9 mm, n=4), and 10.7 mm (range 7.2-14.2 mm, n=4).

The opposed platform core shows a mixture of flake and blade removals (Fig. 6.3c). It is of broadly similar size to the single platforms cores (28.9 x 18.5 x 12.8 mm). There is on core-on-flake (Fig. 6.3d). It is on a primary flake that has had a blade removal struck orthogonal to the debitage axis (26.9 x 19.1 x 7.8 mm). There are also three fragments; one flake core, and two indeterminate.

In addition to the cores, there is one splintered piece, which accounts for 0.2% of the diagnostic debitage. It is a brown/strong brown chert primary flake that has been split from a pebble using an anvil technique. There may be subsequent attempts to remove a blade, however splintering at each end may have occurred only during the initial splitting of the pebble (Fig. 6.3e). It is 27.8 x 15.2 x 7.4 mm.

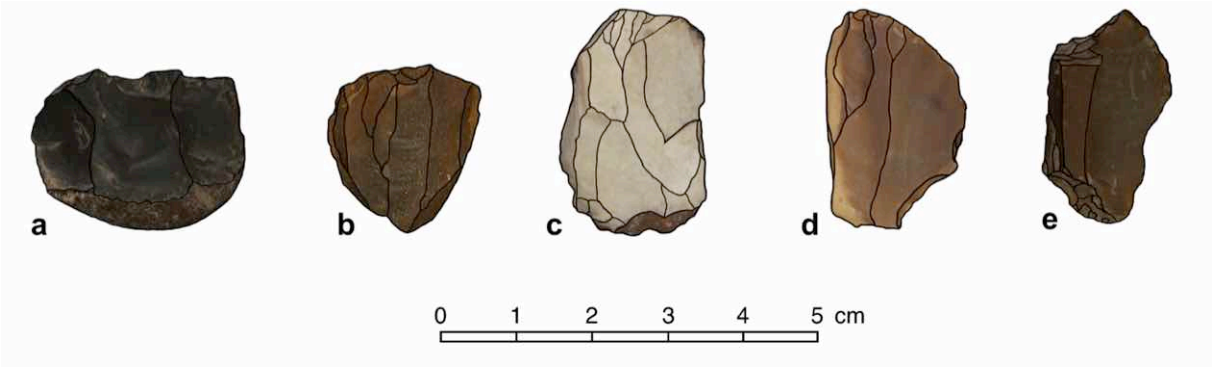


Figure 6.3. Grotte des Pigeons (Taforalt), Sector 8, L10-14: Cores
a-b) single platform; c) opposed platform; d) core-on-flake; e) splintered piece

Debitage

In total, 152 flakes, accounting for 56.5% of the diagnostic artefacts, were recovered from L10-14. The majority of the flakes are on chert (80.0%). The remaining flakes are on limestone (20.0%). Of the complete flakes (≥20mm maximum dimension)(n=45) the majority are on chert; grey/light grey (4.4%), pale brown/yellowish brown (11.1%), brown/strong brown (17.8%), and burnt (66.7%). However, there is a relatively strong proportion on limestone; all burnt (22.2%).

The flakes tend to retain cortex, divided between those with less than 25% cortex (20.0%), between 25-50% cortex (11.1%), more than 50% cortex (22.2%), and 100% cortex (20.0%). Only a small percentage of the flakes have no cortex (26.7%). Plain butts (70.3%) predominate, while cortical (18.9%) also are well represented. There are few dihedral (5.4%) or faceted (5.4%) butts, and only one punctiform. The edge of the striking platform is rarely abraded (2.2%). On the flakes, unidirectional (56.5%) and multidirectional (30.4%) dorsal scars predominate, with much smaller frequencies of opposed (9.1%) and crossed (4.4%) patterns. The flakes are generally short, squat, and thick, with median length, width, and thickness values, of respectively, 22.5 mm (range 6.2-46.4 mm, n=45), 20.3 mm (range 9.3-42.7 mm, n=45), 5.7 mm (range 1.3-24.4 mm, n=45).

Only a small number of 9 blades and 16 blade fragments were recovered, although they account for moderate proportion (9.7%) of the diagnostic artefacts, from L11-14. The complete blades are made exclusively on chert; brown/strong (n=1) and burnt (n=8). These tend to retain cortex, divided between those with less than 25% (n=4), between 25-50% (n=1), more than 50.0% (n=1), and 100% cortex (n=1). There are only two blades that have no cortex. The most frequent butts are crushed (n=4), followed by plain (n=2) and punctiform (n=2), and cortical (n=1) and faceted (n=1). There is abrasion at the platform edge in a couple of cases (n=2). Of the identifiable dorsal scars (n=7) these are all unidirectional (n=6), except one that is opposed (n=1). The blades are generally small in size, with median length, width, and thickness values, respectively of, 21.8 (range 18.8-33.0, n=9), 8.8 mm (range 5.5-12.5 mm, n=9), and 3.2 mm (range 2.2-6.1 mm, n=9). Of the sample, all are bladelet size, none being blades *sensu stricto* (after Tixier, 1963, p. 38).

Of the blade fragments (P: 5; M: 9; D: 2) (n=16) all are on chert; pale brown/yellowish brown (6.3%), brown/strong brown (31.3%), and burnt (68.8%). The blade fragments retain cortex in one in four cases (25.0%). The proximal ends (n=5) include, cortical (n=1), plain (n=1), and faceted (n=3) examples. None of these show evidence of abrasion. Of the fragments with identifiable dorsal scars (n=10), unidirectional (n=4), opposed (n=5), and multidirectional (n=1) patterns were recorded. The fragments have median width and thickness values, of respectively, 8.3 mm (range 5.9-14.2 mm, n-16) and 2.4 mm (range 0.9=5.9 mm, n=16).

In total, six core-trimming elements, accounting for 2.2% of the diagnostic artefacts, were recovered from L11-14. These are all on chert, one is brown/strong brown, and the others are burnt (83.3%). These are most often crested blades, of which three were identified as first removals with a single prepared versant (n=3) and a couple as fragments (n=2). None of the crested blades retain their entire length; the median values for width and thickness are respectively, 7.2 mm (range 5.9-15.8 mm, n=3), and 3.8 mm (range 3.6-7.4, n=3). There is also one platform rejuvenation, which measures 17.7 x 15.5 x 4.8 mm.

Microburins and related products

There are no microburin products from L11-15. In addition, none of the tools retained visible remnants of microburins scars. The microburin index is therefore zero.

Retouched tools

There are 75 tools from L11-14. They account for 27.9% of the diagnostic material. The microliths (42.7%) and microlith fragments (46.7%) are overwhelmingly the most common tools, whilst end-scrapers (1.3%), notches and denticulates (4.0%), truncations (1.3%), and miscellaneous tools (4.0%), account for much smaller frequencies (Table 6.8).

Table 6.8. Grotte des Pigeons (Taforalt), Sector 8, L11-14: Absolute and relative frequencies of tool types

	N	%
End-scrapers	**1**	**1.3**
1. End-scraper on a flake	1	100.0
Microliths	**32**	**42.7**
45. Pointed straight backed bladelet	1	3.1
55. Bladelet with convex backed end	1	3.1
56. Convex backed bladelet		
a. typical	12	37.5
b. leading to segment	5	15.6
57. Convex backed bladelet with rounded base	1	3.1
58. Convex backed bladelet with truncated base	3	9.4
59. Convex backed bladelet with retouched base	1	3.1
61 Backed bladelet with narrowed base	2	6.3
71. Bladelet with Ouchtata retouch	1	3.1
82. Segment or semi-circle	2	6.3
89. Isosceles or equilateral triangle	1	3.1
90. Scalene triangle	2	6.3
Microlith fragments	**35**	**46.7**
66. Fragment of a backed bladelet	34	97.1
72. Fragment of a bladelet with Ouchata retouch	1	2.9
Notches and denticulates	**3**	**4.0**
75, Denticulated flake	1	33.3
76. Notched blade or bladelet	1	33.3
77. Denticulated blade or bladelet	1	33.3
Truncations	**1**	**1.3**
80. Truncated piece	1	100.0
Miscellaneous	**3**	**4.0**
105. Piece with continuous retouch	3	100.0
Total	**75**	

End-scrapers

This tool category is represented by one artefact; an end-scraper on a flake (type 1). It is made on chert and is burnt. It has a rather misshapen and poorly made scraper at the proximal end. It measures, 29.3 x 16.2 x 10.0 mm.

Microliths

There are 32 microliths (Figs. 6.3a-r). These are dominated by convex backed bladelets *sensu lato* (types 56-59)(62.9%). In addition, there are seven types present in small frequencies from 3.1% to 6.3%. The 'geometric' types account for 15.6% of the microliths; these include, two segments (type

82), one isosceles triangle (type 89) and two scalene triangles (type 90). There is also, a pointed straight backed bladelet (type 45), two backed bladelets with narrowed bases (type 61), and one bladelet with Ouchtata retouch (type 71).

All of the microliths are made on chert; dark grey (3.1%), greyish brown (6.3%), pale brown/yellowish brown (3.1%), brown/strong brown (9.4%), white (6.3%), but are overwhelmingly burnt (68.8%). Most of the microliths are broken (59.4%). There is a preference for retouch at the left lateral edge (56.3%) over the right lateral edge (34.4%); the remaining cases were indeterminate (9.4%). The majority of retouch is direct (75.0%), with smaller proportions of mixed direct/crossed (6.3%) and crossed (15.6%); the remaining case was indeterminate (3.1%). There is only a small proportion with Ouchtata retouch (3.2%). None of the microliths have unmodified ends, with the most being single points (65.7%), and there are also a substantial number of double points (28.1%).

Of the single points the majority are found at the distal (78.3%) with the proximal utilised much less often (13.0%); two cases were indeterminate (8.7%). Of all the microliths the butt is retained in just under a third of cases (30.0%). There is a strong proportion of microliths with basal truncations (15.6%), which tend to be acute (n=4) over rounded (n=1). The basal truncations are direct (n=3) and inverse (n=1); another was indeterminate. There is only one microlith with additional basal retouch (3.1%). There are no microliths with additional retouch at the tip(s). None show evidence of microburin scars. As a group, the microliths have median values for length, width, and thickness, of respectively, 20.7 mm (range 16.6-30.3 mm, n=12), 6.8 mm (range 3.9-11.1 mm, n=32), and 3.5 mm (range 1.5-5.6 mm, n=32).

Microlith fragments

There are 35 microlith fragments, including three distal (8.6%), six mesial (17.1%), 13 proximal (37.1%), four partial (11.4%), and nine (25.7%) indeterminate ends. All of these are on chert; the majority show evidence of burning (91.4%). There are slightly more retouched at the left lateral edge (34.3%) over the right lateral edge (28.6%), however the largest proportion (37.1%) were

indeterminate. Most of the retouch is direct (62.8%), and there are also high proportions of crossed (22.7%), but only one of each, inverse (2.9%), mixed direct/crossed (2.9%), and alternating (2.9%) varieties; two were indeterminate (5.7%). The butt is retained on a small number of the fragments (14.3%). The fragments have a median width and thickness values, respectively of, 6.7 mm (range 3.6-13.4 mm, n=35) and 3.3 mm (range 1.6-9.1 mm, n=35).

Notches and denticulates

There are three pieces of this class. These are on chert; each burnt. The blanks include, one flake, and two blades. The first is only a partial tool fragment from a denticulated flake (type 75). It has contiguous notches on the right lateral edge. The others are mesial fragment of a notched blade (type 76) with a single notch at an indeterminate edge (15.4 x 7.3 mm), and a proximal fragment of a denticulated blade or bladelet (type 77) with direct retouched nicks along the left lateral edge (14.1 x 6.1 mm).

Truncations

There is only one artefact in this class, a truncated piece (type 80). It is fragment from the distal end of blade made on brown/strong brown chert. It has an irregular truncation. It retains a width and thickness, of respectively, 7.2 x 4.0 mm.

Miscellaneous tools

This group includes three atypical pieces with continuous retouch (type 105); one flake and two indeterminate fragments. The flake is of limestone (Fig. 6.3s). It is has a small break at the distal end with irregular inverse retouch on the distal aspect of the right lateral edge. It is large, 54.2 x 36.2 x 14.8 mm. The fragments are both burnt and are on chert. One is a left-distal fragment with inverse scalar retouch at the left margin. The other is a proximal fragment with direct retouch at the right margin.

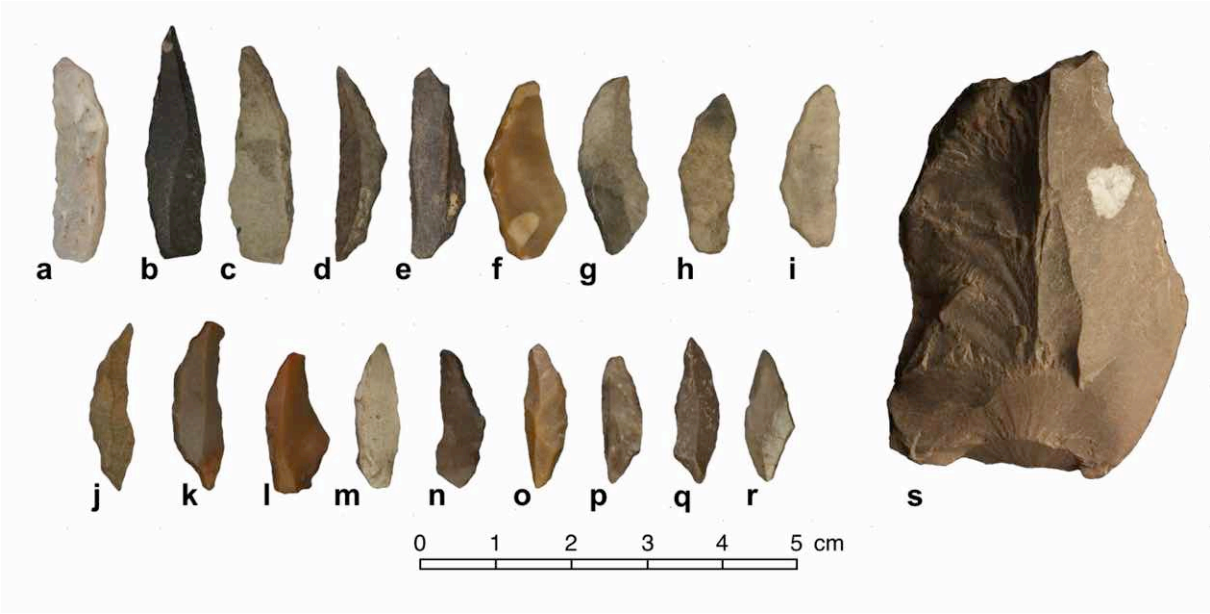


Figure 6.3. Grotte des Pigeons (Taforalt), Sector 8, L10-14: Retouched Tools
a) bladelet with convex backed end; b) pointed straight backed bladelet; c, e, f, m, n) convex backed bladelets; d) segment; g, j) convex backed bladelet with truncated base; h) convex backed bladelet with rounded base; i) convex backed bladelet leading to segment; k) backed bladelet with narrowed base; l) convex backed bladelet with retouched base; o, p) convex backed bladelets leading to segments; q) scalene triangle; r) equilateral triangle; s) piece with continuous retouch

6.2.3. L15-27

There are 2814 lithic artefacts from L15-27. The absolute frequencies of artefacts according to excavation unit, along with the totals and relative frequencies for the group, are given in Table 6.9.

Table 6.9. Grotte des Pigeons (Taforalt), Sector 8, L15-27: Number of artefacts in each class by deposit

	Blades	Flakes	CTE	MB	TP	KMB	Cores	SP	Tools	Subtotal	Chips	Chunks	Total
L15	10	61					4		14	89	211	27	327
L16	8	86	4				1		29	128	498	34	660
L17	8	44	3				1	1	23	80	202	20	302
L19	3	29							12	44	88	16	148
L20	10	51	4			1	1		13	80	242	10	332
L21	3	21							10	34	126	7	167
L22	2	4							5	11	69	3	83
L23	13	37							19	69	270	27	366
L24	10	31	1				2		11	55	120	10	185
L25	6	16							9	31	85	7	123
L26	3	6	1						5	15	56	2	73
L27	1	9				1			0	11	35	2	48
Subtotal	77 11.9%	395 61.1%	13 2.0%			2 0.3%	9 1.4%	1 0.2%	150 23.2%	647 100.1%	2002 (71.1%)	165 (5.9%)	2814

Cores

There are 9 cores, accounting for 1.4 % of the diagnostic artefacts, from Layers 15-27. These include, three single platform cores, four opposed platform cores, one multiple platform core, and one core-on-flake. Each of the cores is made on chert; brown/strong brown (n=1), black (n=1), white (n=1), and burnt (n=6). Excluding fragments, there are no cores without cortex. The cores include size with pebble/cobble cortex and one case with tabular cortex. There is also one core-on-flake. Overall, the cores are quite restricted in size, as seen in the median length, width, and thickness, which are respectively, 27.2 mm (range 16.5-40.8 mm, n=9), 19.4 mm (range 13.1-27.7 mm, n=9), and 12.7 mm (range 8.3-23.3 mm, n=9).

Of the single platform cores one has mixed blade and flake removals and two have flakes removals (Fig. 6.5a-b). These are all simply made and appear to be exhausted. They have small median values for length, width, and thickness values, of respectively, 29.1 mm (range 25.9-32.0 mm, n=3), 17.1 mm (range 13.1-23.5 mm, n=3), and 12.7 mm (range 12.4-12.9 mm, n=3).

The opposed platform cores include one mixed core with two flaking surfaces on opposite sides (Fig. 6.c), a prismatic bladelet cores on tabular chert (Fig. 6.6d), and two flake cores: one with two flaking surfaces on adjacent sides, and another, with a single flaking face. This latter example has scars that converge and are indicative of the reduction of the core using a bipolar reduction technique (Fig. 6.5e). The median values of length, width, and thickness, are respectively, 27.0 mm (range 25.4-40.8 mm, n=4), 21.2 mm (range 19.2-27.7 mm, n=4), and 15.3 mm (range 11.2-23.3 mm, n=4).

The one multiple platform core has flake removals. It is irregular and globular (16.5 x 20. 5 x 19.4 mm). There is also a core-on-flake. It has flakes removals from a single direction off an elongated flake (32.5 x 13.5 x 8.3 mm).

In addition to the cores, one artefact was classified as splintered piece, which accounts for 0.2% of the diangostic artefacts from L15-27. It is specifically from Layer 17, which also provided one core and a number of core trimming elements. The artefact meets the classic definition of a *pièce esquillée* as defined by Tixier (1963, pp. 146-9). It is wedge shaped and there are a couple of small

blade scars, none of which seem to have been of sufficient size to have been utilised as blanks (Fig. 6.5f). It is smaller than the cores, measuring only 19.9 x 14.8 x 6.5 mm.

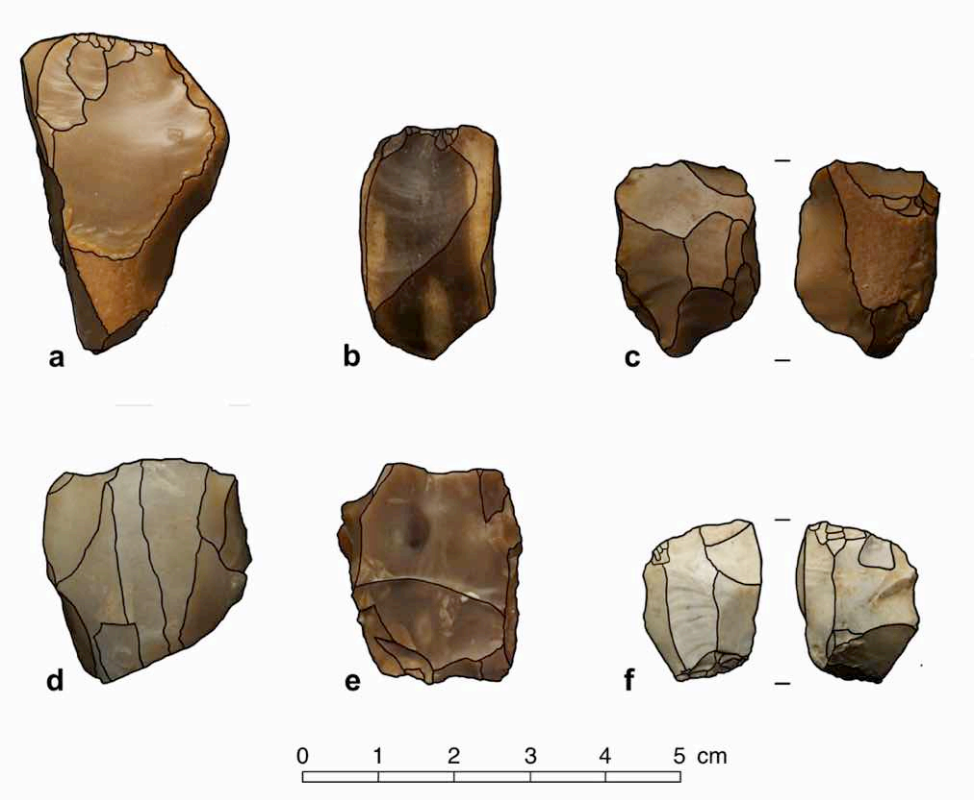


Figure 6.5. Grotte des Pigeons (Taforalt), Sector 8, L15-27: Cores
a-b) single platform cores; c-e) opposed platform cores; f) splintered piece

Debitage

In total, 395 flakes, accounting for 61.1% of the diagnostic artefacts, were recovered from L15-27. The majority of the flakes are on chert (63.5%), although there is a relatively high proportion on limestone (36.5%). The complete flakes (≥20mm maximum dimension)(n=87) are predominantly chert; grey/light grey (1.2%), greyish brown (2.3%), pale brown/yellowish brown (5.8%), brown/strong brown (11.5%), reddish brown (2.3%), and burnt (50.6%). There are fewer limestone flakes; dark grey (1.2%), and burnt (26.4%). The flakes tend to retain cortex, divided between those with less than 25% cortex (32.2%), between 25-50% cortex (10.3%), more than 50% cortex (17.2%), and 100% cortex (11.5%). Only around a third of the flakes have no cortex (28.7%). Plain butts (61.0%) predominate, while cortical (23.4%) also are well represented. There are few dihedral (5.2%) or faceted (6.5%) butts, and only three punctiform. The edge of the striking platform is rarely abraded

(6.5%). Of the flakes, unidirectional (45.7%) and multidirectional (43.5%) dorsal scars predominate, with much smaller frequencies of crossed (11.6%) and no opposed patterns. The flakes are generally short, squat, and thick, with median length, width, and thickness, respectively of 22.9 mm (range 12.4-54.5 mm, n=87), 20.9 mm (range 10.5-59.1 m, n-87), and 5.3 mm (range 1.8-22.6 mm, n=87).

In total, 32 blades and 45 blade fragments were recovered, accounting for 11.9% of the diagnostic artefacts, from L15-27. The blades are made exclusively on chert; greyish brown (3.1%), pale brown/yellowish brown (12.5%), brown/strong brown (6.3%), and burnt (78.1%). The majority retain have some cortex, divided between those with less than 25% cortex (25.0%), between 25-50% cortex (15.6%), more than 50% cortex (9.4%), and 100% cortex (3.1%). Nonetheless, a moderate amount of blades have no cortex (46.9%). There are a high proportion of butts that are crushed (34.4%), the same number that are punctiform (34.4%), and fewer plain butts (18.8%). In addition, there is one cortical (3.1%), one faceted (3.1%), and two dihedral (6.3%) examples. There is abrasion in a similar proportion (21.9%) to the overlying deposits. Of the identifiable dorsal scars (n=26) these are most often unidirectional (57.7%), with relatively high proportion of opposed (34.6%), and fewer crossed (7.7%) and no multidirectional patterns. The blades are generally small in size, with median length, width, and thickness, respectively of, 27.1 (range 11.6-40.5, n=32), 10.9 mm (range 4.1-17.4 mm, n=32), and 3.5 mm (range 1.1-7.7 mm, n=32). Of the sample, all are bladelet size, none being blades *senso stricto* (after Tixier, 1973, p. 38).

Of the blade fragments (P: 19; M: 17; D: 9) (n=45) all are on chert; greyish brown (4.4%), pale brown/yellowish brown (17.8%), brown/strong brown (4.4%), white (2.2%), but the majority overwhelmingly burnt (66.7%). Over a third (37.8%) retain some cortex. The proximal ends (n=19) are most often punctiform (64.2%), followed by plain (31.6%), and only a single faceted (5.3%) butt. There is a high proportion (52.6%) with abrasion at the edge. Of all the fragments with dorsal scars (n=35) they are mostly unidirectional (71.4%), with strong proportions of opposed (22.9%), and only two multidirectional (5.7%) patterns. The fragments have median width and thickness values, respectively of, 9.2 mm (range 4.9-24.1 mm, n=45) and 2.8 mm (range 1.2-5.7 mm, n=45).

There are 13 core-trimming elements from L15-27, which accounts for 2.0% of the artefacts from these deposits (excluding chips and chunks). These are predominantly crested blades (n=10), which tend to be first removals with a single prepared versant (n=7, 70.0%), there are also a couple of first removals with preparation along both versants (n=2, 20.0%), and one fragment (n=1, 10.0%). These are all on chert, one pale brown/yellowish brown, two brown/strong brown, and seven with evidence of burning (70.0%). The crested blades have median values for length, width, and thickness, respectively of, 26.2 mm (range 17.6-37.9 mm, n=8), 8.7 (range 5.6-15.1 mm, n=9), and 4.2 mm (range 3.5-10.7, n=9). There are also three *flanc de nucleus*, including one struck from the side of the core. These are all on chert, one greyish brown, and two burnt. The median values for length, width, and thickness, are respectively, 30.5 mm (range 20.5-38.1 mm, n=3), 18.0 (range 14.5-18.6 mm, n=3), and 9.2 mm (range 6.5-10.1, n=3).

Microburins and related products

There are only two examples, both Krukowski microburins, from L15-27. These account for only 0.3% of the classified artefacts from these deposits. One of the Krukowsi microburins is burnt and cannot be orientated. The other is from the distal end of backed bladelet with the 'notch' at the right edge. The microburin index is 1.7. None of the microliths and microlith fragments retained visible remnants of microburins scars.

Retouched tools

In total there are 150 tools from L15-27. They account for 23.2% of the diagnostic material. The microliths (42.0%) and microlith fragments (36.0%) are the most common tool classes, whilst end-scraper (5.3%), backed flakes and blades (2.0%), notches and denticulates (3.3%), truncations (2.7%), and miscellaneous tools (8.7%), account for much smaller proportions (Table 6.10).

Table 6.10. Grotte des Pigeons (Taforalt), Sector 8, L15-27: Absolute and relative frequencies of tool types

	N	%
End-scrapers	**8**	**5.3**
1. End-scraper on a flake	3+2?	62.5
2. End-scraper on a retouch flake	1	12.5
4. Core-like end-scraper or 'rabot'	1	12.5
5. Denticulated end-scraper	1	12.5
Backed flakes and blades	**3**	**2.0**
35. Straight backed blade	1	33.3
42. Fragment of a backed blade	2	66.7
Microliths	**63**	**42.0**
16. Drill	1	1.6
34. Backed flake	1	1.6
45. Pointed straight backed bladelet	1	1.6
46. Pointed straight backed bladelet with rounded base	1	1.6
47, Pointed straight backed bladelet with truncated base	2	3.2
55. Bladelet with convex backed end	3	4.8
56. Convex backed bladelet		
a. typical	17	27.0
b. leading to segment	17	27.0
57. Convex backed bladelet with rounded base	1	1.6
58. Convex backed bladelet with truncated base	12	19.1
59. Convex backed bladelet with retouched base	1	1.6
70. Ouchtata bladelet		
a. retouched along entire lateral	1	1.6
71. Bladelet with Ouchtata retouch	2	3.2
82. Segment or semi-circle	2	3.2
112. Asymmetrical trapeze	1	1.6
Microlith fragments	**54**	**36.0**
66. Fragment of a backed bladelet	53	98.2
72. Fragment of a bladelet with Ouchata retouch	1	1.9
Notches and denticulates	**5**	**3.3**
75, Denticulated flake	2	40.0
76. Notched blade or bladelet	1	20.0
77. Denticulated blade or bladelet	2	40.0
Truncations	**4**	**2.7**
80. Truncated piece	4	100.0
Miscellaneous	**13**	**8.7**
105. Piece with continuous retouch	11	85.6
106. Side-scraper	2	15.4
Total	**150**	

End-scrapers

This group consists of eight artefacts; six on flakes and two indeterminate fragments. There are three clear single end-scrapers on a flake (type 1); two are very summarily retouched at the distal ends and are not well-made on relatively small brown/strong brown chert flakes (21.1 x 25.7 x 8.7 mm and 20.3 x 16.9 x 6.8 mm); another is made on fine-grained quartz, has a well-defined convex scraper edge at the distal end, and is much larger than aforementioned end-scrapers (41.9 x 32.4 x 10.5 mm)(Fig.6.6a). There are also two burnt partial fragments from the distal ends of well-formed convex end-scrapers on chert. There is one denticulated end-scraper (type 5) at the proximal end of a burnt chert flake; the distal end exhibits a step fracture that may have occurred prior to retouch (18.4 x 18.3 x 7.1 mm). There is also a core-like scraper (type 4) that is on white chert. It cannot be orientated along the debitage axis. The angle of the scraper edge is *c.*40º and has been carefully shaped. To the right of, and forming a near right-angle with the scraper, is a heavily retouch abrupt margin. It is complete (20.5 x 13.4 x 10.8 mm)(Fig. 6.6k). It might be classified as a micro-blade core, rather than a nucleiform scraper, however the careful shaping of the perimeter, and small overall size, appears consistent with the latter classification.

Backed flakes and blades

There are three artefacts in this category. One is a straight backed blade (type 35)(Fig. 6.6b) on greyish brown chert. It has mixed direct/crossed retouch at the right margin forming a point at the distal. There is a break at the tip. It has a width and thickness, respectively of, 14.5 and 7.7 mm. In addition, there are two burnt partial fragments of backed blades (type 42) made on chert, both with direct retouch, one at the right lateral margin, and the other at an indeterminate margin.

Microliths

There are 63 microliths (Figs. 6.6). These are dominated by convex backed bladelet *sensu lato* (types 56-59)(74.6%) and pointed straight backed bladelets *sensu lato* (type 45-47)(12.7%) are also quite important. An additional six types are also present in smaller frequencies ranging from 1.6% to 4.8% (Table 6.10). These include two ‘geometrics’, both segments (type 82), which account for 3.2% of the microliths.

All of the microliths are on chert, including black (4.8%), grey/light grey (3.2%), greyish brown (1.6%), pale brown/yellowish brown (14.3%), brown/strong brown (7.9%), and white (3.2%) varieties, although the overwhelming majority are indeterminate in colour due to burning (63.5%). Around half of the microliths are broken (50.8%). There is a preference for retouch at the left lateral side (47.6%) over the right lateral side (39.7%); one has backing on both margins (1.6%); the others are indeterminate (11.1%). The majority of retouch is direct (71.4%), but there are relatively strong proportions of mixed direct/crossed (11.1%) and crossed (14.3%). There are also two (3.2%) with alternating retouch. There is only a small proportion with marginal Ouchtata retouch (4.8%).

Only one (1.6%) of the microliths has an unretouched end. The majority are single points (65.1%), but there are also a reasonable number of double points (33.3%). Of the single points (n=41) the majority are at the distal (65.9%) with the proximal utilised less often (12.7%); in six cases the orientation was indeterminate. Of all the microliths the butt is retained in around a quarter of cases (23.2%). There is a relatively high frequency of microliths with basal truncations (25.4%), which tend to be acute (n=14) over rounded (n=2). The basal truncations are most often with direct retouch (n=12), but there are also inverse examples (n=4). There is only one microlith with additional basal retouch (1.6%). There is also one microlith with additional retouch at the tip. None of the microliths show evidence of microburin scars. As a group the microliths have median values for length, width, and thickness, of respectively, 22.8 mm (range 11.7-41.2 mm, n=31), 7.4 mm (range 3.5-12.3 mm, n=63), and 3.4 mm (range 1.4-5.8 mm, n=63).

Microlith fragments

There are 54 microlith fragments, including 14 distal (25.9%), 12 mesial (22.2%), 15 proximal (27.8%), six partial (11.1%), and seven indeterminate ends (13.0%). All of these are made on chert; the majority show evidence of burning (79.6%). There are slightly more with retouch on the left lateral side (40.7%) than on the right lateral side (37.0%); the remaining cases were indeterminate (22.2%). Most of the retouch is direct (62.9%), with relatively high proportions of mixed direct/crossed (11.1%) and crossed (14.8%) retouch. There is also one example with inverse (1.9%) and two with alternating (3.7%) retouch. The remaining two cases were indeterminate. The butt is retained on a few fragments

(9.3%). The fragments have a median width and thickness, of respectively, 6.6 mm (range 4.4-10.2 mm, n=47) and 3.4 mm (range 1.9-5.4 mm, n=48).

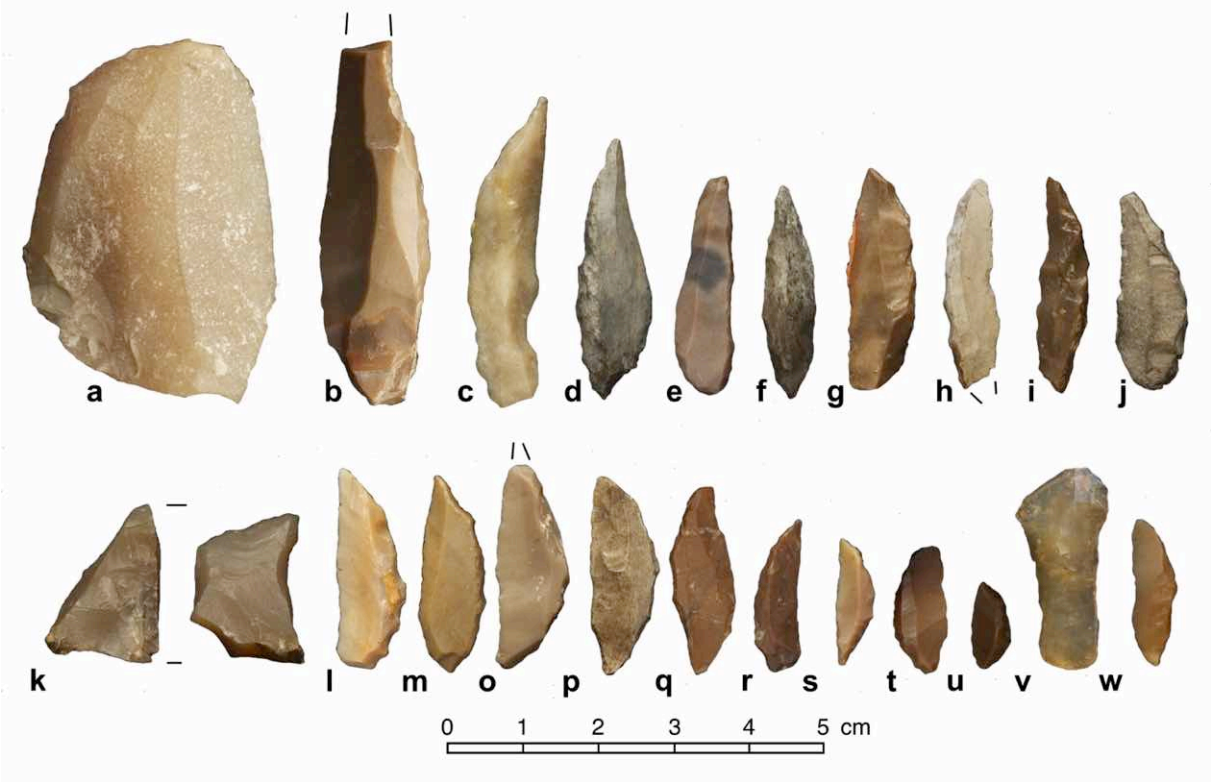


Figure 6.6. Grotte des Pigeons (Taforalt), Sector 8, L15-27: Retouched Tools – Part A
a) single end-scraper on a flake; b) straight backed blade; c) backed bladelet with convex backed end; d) pointed straight backed bladelet with truncated base; e) pointed straight backed bladelet with rounded base; f) pointed straight backed bladelet; g-h, l-m, r) convex backed bladelets; k) core-like end-scraper or 'rabot'; o-p, u) convex backed bladelet leading to segments; t-u) segments; v) Ouchtata bladelet; w) bladelet with Ouchtata retouch

Notches and denticulates

This class consists of five artefacts. There are two denticulated flakes (type 75). The first is made on a burnt limestone cortical flake. There are four single nicks/notches along the left lateral margin; they increase in size as they approach the distal, the first is 6.5 x 1.5 mm, and the last, 32.9 x 3.2 mm. There is ochre covering the dorsal surface of the flake. It is large, measuring 81.08 x 64.34 x 16.37 mm (Fig. 6.7a). The second is on chert and burnt. The denticulations are made with direct retouch and partly cover the distal end and right edge. The individual teeth/notches vary in size; the smallest are 2 x 1 mm, and the largest is 6 x 2 mm. The butt is retained. It measures 27.76 x 27.73 x 6.20 mm (Fig. 6.7b).

There is a single notched bladelet (type 76). This artefact is made on pale brown/yellowish brown chert. It is a distal fragment with a direct retouched notch (5.3 x 1.1 mm) on the left edge adjacent to the break. There are also two denticulated bladelets (type 77). The first is pale brown/yellowish brown chert. It has denticulations along the entirety of both lateral margins; near the proximal end that are direct on the left side, and inverse of the right margin; towards the distal end they are inverse on the left side, and direct of the right margin. The piece measures 29.80 x 11.30 x 5.00 mm (Fig. 6.7c). The second is on brown/strong brown chert. It is similar size (29.0 x 12.9 x 5.3 mm), but differs in retouch position, with denticulations produced by direct retouch at the left margin. The right margin has a natural cortical back (Fig. 6.7d).

Truncations

There are four truncated pieces (type 80) in this class. These are all are made on chert; one pale brown/yellowish brown, dusky/weak red, and two burnt. Each has a direct truncation; two at the proximal end, both from the right side (one convex, one straight); and, two distal, one from the right (and concave), the other is straight, forming a right-angle with edge. One is complete measuring 15.9 x 9.0 x 3.1 mm (Fig. 6.7e). The fragments measure in width, from 6.4 to 14.5, and thickness, from 2.0 – 4.9 mm.

Miscellaneous tools

This group includes 11 atypical pieces with continuous retouch (type 105). Each is fragmentary and therefore the overall form cannot be established. These are all on chert; one grey/light grey, two pale brown/yellowish brown, one brown/strong brown, and seven burnt. One has alternating retouch, and ten have direct retouch. In four cases the retouch is on the left margin, with six modified on the right margin, and one is indeterminate. Two cases have fine marginal retouch, five short sub-parallel semi-abrupt removals, and four long scaled/stepped retouch. There are also two burnt fragments of side-scrapers (type 106) made on chert (Figs. 6.7f-g). Each has direct scaled scraper retouch, one at the right edge, and the other on both lateral margins. The former is a proximal fragment, is it 17.40 mm wide and 5.60 mm thick. The latter is a distal fragment with an obtuse end; 19.30 mm wide, and 7.80 mm thick.

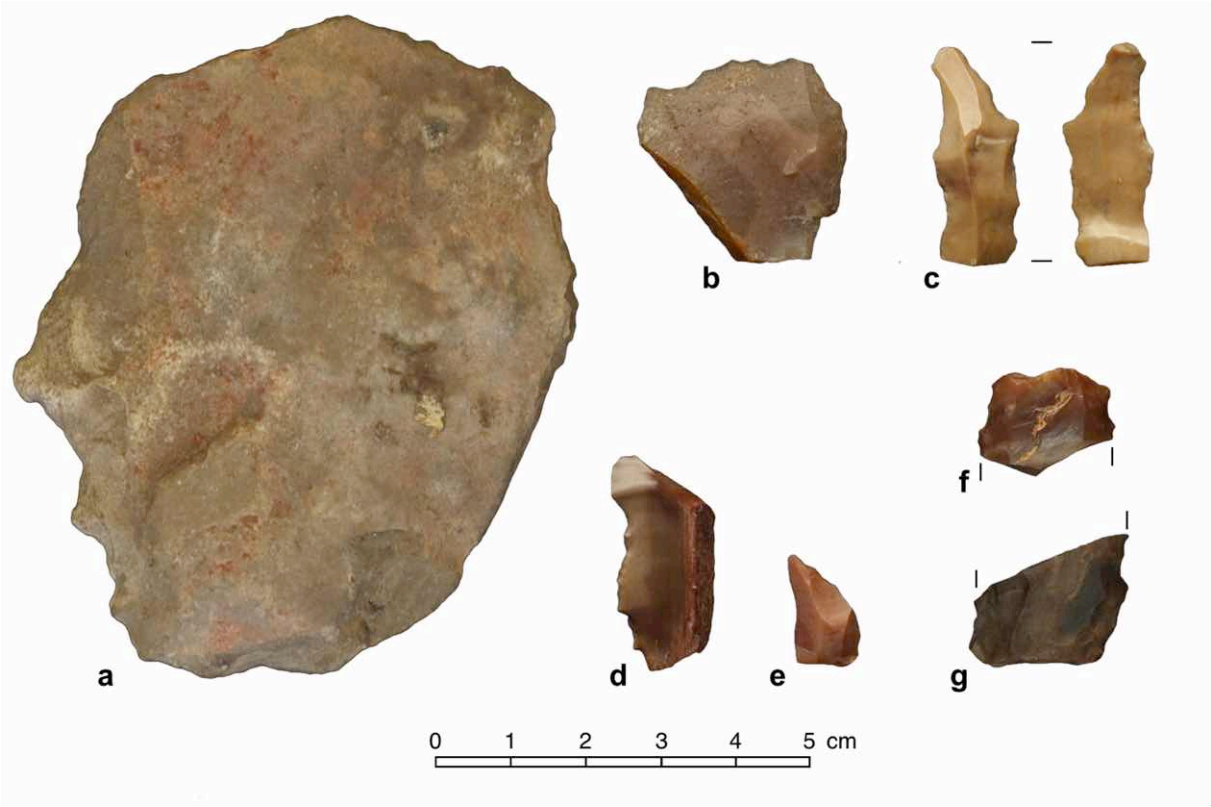


Figure 6.7. Grotte des Pigeons (Taforalt), Sector 8, L15-27: Retouched Tools – Part B
a-b) denticulated flakes; c-d) denticulated bladelets; e) truncation; f-g) side-scrapers fragments

6.2.4. L28-29

There are 941 lithic artefacts from L28-29 (including associated contexts G97-100). The absolute frequencies of artefacts according to excavation unit, along with the total and relative frequencies for the group, are given in Table 6.11.

Table 6.11. Grotte des Pigeons (Taforalt), Sector 8, L28-29:
Number of artefacts in each class by deposit

	Blades	Flakes	CTE	MB	TP	KMB	Cores	SP	Tools	Subtotal	Chips	Chunks	Total
L28	5	48		2			1		10	66	229	18	313
L29	34	56	2	24			3		17	136	267	17	420
G97	1	2					1		1	5			5
G98	6	46	1	13			5		16	87	19	9	115
G99	4	5	1				1		1	12	1	2	15
G100	7	20	7	6			8	1	7	56	7	10	73
Total	57 15.7%	177 48.9%	11 3.0%	45 12.4%			19 5.2%	1 0.3%	52 14.4%	362 99.9%	523 (55.6%)	56 (6.0%)	941

Cores

There are 19 cores, accounting for 5.2% of the diagnostic artefacts, from L28-29. These are most often single platform cores (36.8%), with fewer opposed platform cores (15.8%) and multiple platform cores (21.1%), and one core-on-flake (5.3%). There are also two core fragments (10.5%) and two tested cores (10.5%)(Table 6.4). The raw materials are exclusively chert; pale brown/yellowish brown (15.8%), brown/strong brown (21.1%), greyish brown (5.3%), red/reddish brown (5.3%), dark grey (5.3%), black (5.3%), white (5.3%), and burnt (31.6%). Excluding fragments, there are few cores that do not retain cortex (29.4%). Where preserved, it appears to be most often pebble/cobble cortex (58.8%) and in one instance tabular (5.9%). There is also one core-on-flake (5.9%). Overall, the cores are quite restricted in size, as seen in the median length, width, and thickness values, which are respectively, 26.8 mm (range 17.8-43.2 mm, n=17), 19.5 mm (range 13.1-28.9 mm, n=17), and 14.6 mm (range 11.3-23.8 mm, n=17).

The single platform cores include one with mixed bladelet and flake removals (14.3%) and six with bladelet removals (85.6%). The single platform cores in general are quite regular (Fig. 6.8a), although the mixed core is quite irregular with negatives of previous removals from alternative directions to those of the remaining platform, indicating that the core was rotated during reduction (Fig. 6.8b). One is a sub-pyramidal core (Fig. 6.8c) and another is on distinctive black tabular chert (Fig. 6.8d). There are negatives from hinged/stepped terminating removals on the flaking surface of four of the cores. The single platform cores all appear to be exhausted, with small median values for length 25.2 mm (range 17.8-43.2 mm, n=7), width 16.9 mm (range 13.1-25.0 mm, n=7), and thickness (range 11.3-23.8 mm, n=7).

There are three opposed platform cores. One of these is a bladelet core (Fig. 6.8e). It has a single flaking surface, there are a series of stacked hinged/stepped terminating removal scars, so that it would appear that the core was abandoned due to the build-up of a sequence of errors. The remaining two are opposed platform flake cores, of which neither are particularly well-made (Fig. 6.8f). Both are worked on one face. The opposed platform cores have median values of length, width, and thickness,

of respectively, 27.0 mm (range 20.5-32.2 mm, n=3), 23.6 mm (range 19.6-23.8 mm, n=3), and 14.4 mm (range 14.0-18.8 mm, n=3).

The multiple platform cores are all poorly made, irregular, and were used to produce flakes (Fig. 6.8g). The median dimensions are 26.2 mm (range 21.7-27.1 mm, n=4), 19.7 mm (range 15.1-21.5 mm, n=4), and 15.0 mm (range 12.4-16.2 mm, n=4). There is one core-on-flake with a flake removal on the ventral surface. There are also two core fragments, one prepared single platform core, and a cobble that has a few preliminary test flakes struck from each end. Interestingly, the latter is stained with ochre of its surface (Fig. 6.9).

In addition to the cores, there is one splintered piece, which accounts for 0.3% of the diagnostic artefacts. It is on greyish brown chert with characteristic bifacial splintered removals at opposite extremities. It measures 26.4 x 15.0 x 8.3 mm.

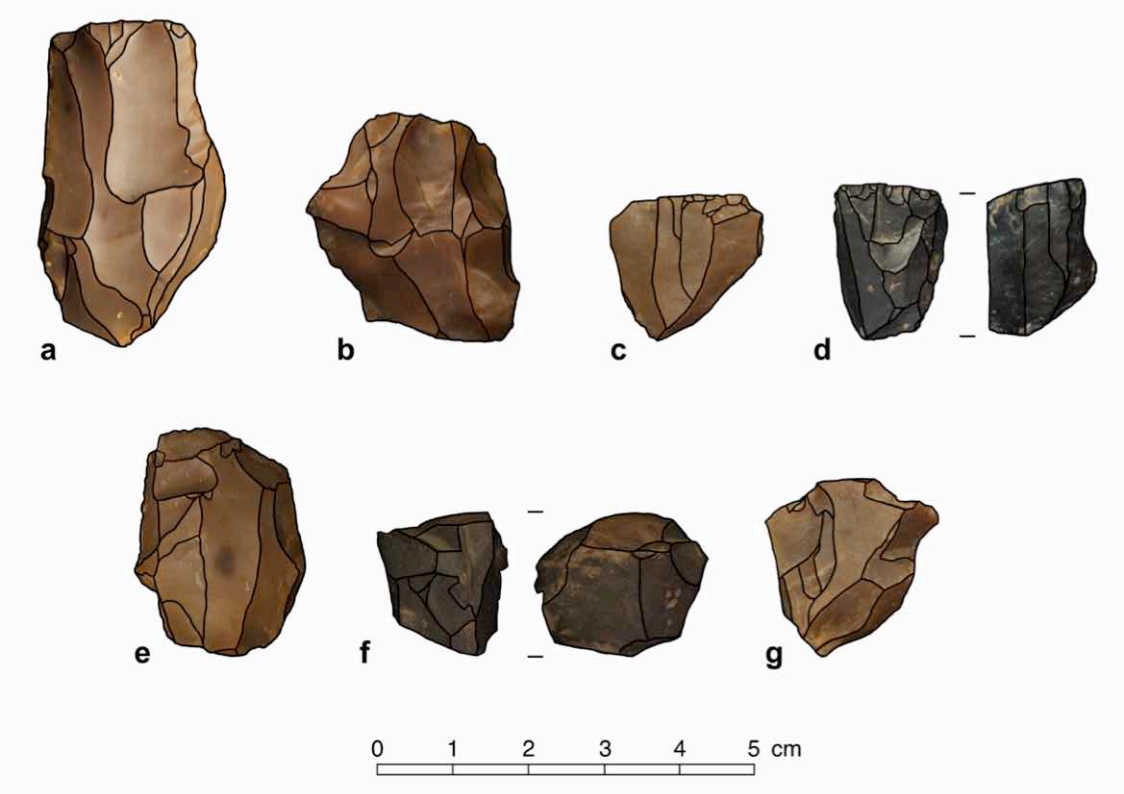


Figure 6.8. Grotte des Pigeons (Taforalt), Sector 8, L28-29: Cores
a-d) single platform cores; e) opposed platform core; f-g) multiple platform cores



Figure 6.9. Grotte des Pigeons (Taforalt), Sector 8, L28-29:
Tested core with ochre on the surface

Debitage

There are 177 flakes, accounting for 48.9% of the diagnostic artefacts, from Layers 28-29. The vast majority of these are on cherts (92.7%), with the remaining flakes on limestone. The complete flakes (≥20mm maximum dimensions)(n=55) are overwhelmingly on chert; black (1.8%), dark grey (1.8%), grey/light grey (1.8%), greyish brown (9.1%), pale brown/yellowish brown (5.5%), brown/strong brown (14.5%), reddish brown (7.3%), white (1.8%), and in the majority of cases burnt (50.9%). There are only a small number of limestone flakes; each burnt (5.5%). The flakes tend to retain cortex, divided between those with less than 25% cortex (29.1%), between 25-50% cortex (10.9%), more than 50% cortex (12.7%), and 100% cortex (18.2%). Less than a third have no cortex (29.1%). The striking platform on flakes is most often plain (53.2%), but there are also high proportions of cortical butts (53.2%). There are many fewer dihedral (6.4%), faceted (6.4%), and only one, punctiform (2.1%) form. Abrasion at the platform edge is relatively infrequent (10.6%). Of the non-primary flakes, unidirectional (40.6%) and multidirectional (43.8%) dorsal scar patterns predominate, whilst opposed (9.4%) and crossed (6.3%) varieties are infrequent. The flakes are generally short, squat, and thick,

with median length, width, and thickness of 22.1 mm (range 12.6-40.8 mm, n=55), 20.3 mm (range 9.3-45.1 mm, n=55), and 5.3 mm (range 2.3-16.8 mm, n=55), respectively.

In total, 23 blades and 34 blade fragments were recovered, which account for 15.7% of the diagnostic artefacts, from L28-29. The blades are made exclusively on chert; greyish brown (8.7%), pale brown/yellowish brown (17.4%), brown/strong brown (8.7%), reddish brown (4.4%), white (4.4%), and burnt (56.5%). The majority have no cortex (72.0%). The blades retaining cortex were divided between those with, less than 25% cortex (16.0%), between 25-50% cortex (4.0%), and more than 50% cortex (8.0%); there are none with 100% cortex. There is a high proportion of crushed butts (43.5%), with punctiform (30.4%) and plain (17.4%) being the next most important, and there are also two faceted (8.9%) examples. The striking platform edge is quite frequently abraded (30.4%). Of the identifiable dorsal scars (n=22) the most common are unidirectional (72.7%), with strong counts of opposed (18.2%), and only one of each of the other patterns, crossed (4.6%) and multidirectional (4.6%). The blades are generally small in size, with median length, width, thickness, respectively of, 26.0 mm (range 19.1-39.7, n=23), 10.8 mm (range 5.7-16.0mm, n=23), and 3.2 mm (range 2.1-8.6 mm, n=23). All are of bladelet size, none being blades *sensu stricto* (after Tixier, 1963, p. 38).

Of the blade fragments (P:6; M: 20; D:8) (n=34) all are on chert; dark grey (5.9%), greyish brown (5.9%), pale brown/yellowish brown (2.9%), brown/strong brown (17.6%), reddish brown (5.9%), and burnt (61.8%). Around half retain some cortex (47.1%). The proximal ends (n=6) are plain (n=4) and punctiform (n=2). There is abrasion on half of the butts (n=3). Of all the fragments with identifiable dorsal scars (n=26) these are predominantly unidirectional (73.1%), with opposed patterns quite important (23.1%), and one multidirectional example (3.9%). There are none crossed. The fragments have median width and thickness values, respectively of, 9.4 mm (range 5.2-15.4 mm, n=34) and 2.6 mm (range 1.1-5.1 mm, n=34).

There are 11 core-trimming elements, accounting for 3.0% of the diagnostic artefacts, from L28-29. These are mostly crested blades (n=9), which tend to be first removals with a single prepared versant (n=4), with one fewer first removals with preparation along both versants (n=3), one second

removal (n=1), and two fragments (n=2). These all on chert, greyish brown (n=1), pale brown/yellowish brown (n=3), brown/strong brown (n=2), and white (n=1) varieties, and a couple burnt (n=2). The crested blades have median values for length, width, and thickness, respectively of, 29.9 mm (range 24.6-35.1 mm, n=2), 9.1 (range 6.6-16.3 mm, n=7), and 5.4 mm (range 3.6-11.9, n=7). There are two *flanc de nucleus*, including one piece that was struck opposite to the main striking platform to regular the core. These are both on burnt chert. These have lengths 25.6-35.8 mm, widths 23.1-29.5 mm, and thicknesses 5.0-11.3 mm.

Microburin and related products

There are 45 true microburins products, accounting for 12.4% of the diagnostic artefacts, from Layers 28-29. There are no trihedral points or Krukowski microburins. The microburins are all made on chert. Most of the microburins are distal examples (76.7%), with much lower frequencies of proximal forms (23.3%). Notching is always direct, usually quite regular, and forms a distinct and deep notch in most cases. The notch is overwhelming applied to the left edge (76.7%) and less frequently at the right lateral margin (23.3%). The distal microburins are almost exclusively notched at the left edge (93.9%) and, in contrast, the proximal microburins have a strong tendency to be notched at the right edge (80.0%). The median values of length, width, and thickness, are respectively, 18.2 mm (9.6-32.3 mm, n=45), 9.9 mm (range 4.5-22.6 mm, n=45), and 4.5 (range 1.6-8.1 mm, n=45). The microburin index is 56.3. There are 13.2% of microliths and microlith fragments retain visible remnants of microburins scars.

Retouched tools

In total there are 51 retouched tools from L28-29. They account for 14.4% of the diagnostic artefacts. The microliths (48.1%) and microlith fragments (30.8%) are the most common tool classes, whilst end-scrapers (13.5%), truncations (1.9%), and miscellaneous tools (5.7%) make up the rest (Table 6.12)

Table 6.12. Grotte des Pigeons (Taforalt), Sector 8, L28-29: Absolute and relative frequencies of tool types

	N	%
End-scrapers	**6**	**11.5**
1. End-scraper on a flake	3	50.0
2. End-scraper on a retouch flake	1	16.7
5. Denticulated end-scraper	1	16.7
112. Fragment of an end-scraper	1	16.7
Microliths	**25**	**48.1**
45. Pointed straight backed bladelet	2	8.0
47, Pointed straight backed bladelet with truncated base	1	4.0
56. Convex backed bladelet		
a. typical	6	24.0
b. leading to segment	2	8.0
58. Convex backed bladelet with truncated base	2	8.0
59. Convex backed bladelet with retouched base	1	4.0
62. La Mouillah point	4	16.0
63. Partially backed bladelet		
b. with unmodified ends	1	4.0
68. Scalene bladelet	2	8.0
82. Segment or semi-circle	3	12.0
89. Isosceles or equilateral triangle	1	4.0
Microlith fragments	**16**	**30.8**
66. Fragment of a backed bladelet	14	87.5
72. Fragment of a bladelet with Ouchata retouch	2	12.5
Truncations	**2**	**3.9**
80. Truncated piece	2	100.0
Miscellaneous	**3**	**5.7**
105. Piece with continuous retouch	3	100.0
Total	**52**	

End-scrapers

There are seven artefacts in this class. Three are end-scrapers on a flake (type 1); one very summarily retouched at the distal end on a cortical burnt chert flake; two have a well-defined convex scraper edge at the distal end on chert flakes, one pale brown/yellowish brown, and one burnt (Fig. 6.10a). These are similar in size; length ranges from 27.9 to 31.2; width, from 19.9 to 23.9 mm; and thickness, from 9.4 to 11.5 mm. In addition, there is a burnt fragment from the distal end of a well-formed scraper on chert (Fig. 6.10b).

There is also a single end-scraper on a retouched flake (type 2). The blank form is in fact a *flanc de nucleus* of grey/light grey chert. It is quite unusual in form, with a denticulated end-scraper at the distal end and very straight direct abrupt retouch on the right lateral margin. It is 28.9 x 26.8 x 10.0 mm. There is also a more typical denticulated end-scraper (type 5) at the distal end of a wide flake on brown/strong brown chert. It is 21.6 x 31.5 x 7.2 mm (Fig. 6.10c).

Microliths

There are 25 microliths (Figs. 6.10d-s). These are dominated by convex backed bladelet *sensu lato* (types 56-59)(44.0%) and La Mouillah points (type 62)(16.0%). The latter microlith form does not occur in any of the overlying deposits. There are also three pointed straight backed bladelets *sensu lato* (types 45-47)(12.0%), two scalene bladelets (type 68)(8.0%), and one partially backed bladelets (type 63)(4.0%).

All of the microliths are on chert; black (8.0%), dark grey (4.0%), greyish brown (8.0%), pale brown/yellowish brown (20.0%), brown/strong brown (12.0%), reddish brown (4.0%), white (4.0%), and burnt (40.0%). Just over half are broken (56.0%). There is a clear preference for retouch at the left lateral margin (76.0%) over the right lateral (25.0%) margin. The majority of retouch is direct (76.0%), with much smaller proportions of mixed direct/crossed (12.0%) and mixed direct/inverse (4.0%), and notably smaller frequencies of crossed (8.0%) examples than in the overlying deposits. There is only one microlith with Ouchtata retouch (4.0%).

There is only one microlith with unmodified ends; the majority have single points (72.0%), and a strong proportion have double points (24.0%). Of the single points (n=18) most are found at the distal (94.4%) and there is only one at the proximal (5.6%). Of all of the microliths the butt is retained on a high proportion (43.5%). Those microliths with basal truncations are found in quite low frequencies (12.0%); each acute, one inverse, two direct. There is one microlith with additional basal retouch, which is also the only example with additional retouch at the tip.

In addition to the La Mouillah points, evidence for the microburin facet is retained on both the scalene bladelets (type 68) and one of the segments (type 82), which together account for a relatively

high proportion of the microliths (28.0%). As a group, the microliths have median values for length, width, and thickness, of respectively, 21.3 mm (range 16.3-27.2 mm, n=11), 5.9 mm (range 5.0-9.6 mm, n=25), and 3.4 mm (range 2.4-4.7 mm, n=25).

Microlith fragments

There are 16 microlith fragments, including four distal, four mesial, seven proximal, and one indeterminate end fragment. All of them are made on chert; the majority are burnt (68.8%). There are more with retouch at the left lateral edge (50.0%) than at the right lateral edge (31.3%); the remaining cases were indeterminate (18.8%). Most of the retouch is direct (87.5%), with two cases crossed (12.5%). The butt is retained in one case. There is also a fragment with an inverse basal truncation. The fragments have median values for width and thickness, respectively of, 6.5 mm (range 4.8-10.1 mm, n=16) and 3.1 mm (range 1.8-5.2 mm, n=16).

Truncations

There are two artefacts from this class, both are truncated pieces (type 80), but are very distinct from one another. The first is burnt and on chert. It has truncation at the distal end, with additional fine retouch at the right lateral margin. It has a small break at the proximal, is narrow, and very thin (12.9 x 8.1 x 1.88 mm) (Fig. 6.10t). The second is burnt and on chert. It has a well-defined truncation at both ends. It is short, wide, and especially thick (19.8 x 21.4 x 9.9 mm)(Fig. 6.10u).

Miscellaneous tools

The group consists of three atypical pieces with continuous retouch (type 105); all indeterminate fragments. Each is on chert; one greyish brown, one pale brown/yellowish brown, and one burnt. The retouch is direct in two cases, and inverse in a single case; at the left edge in two cases, and indeterminate on the other.

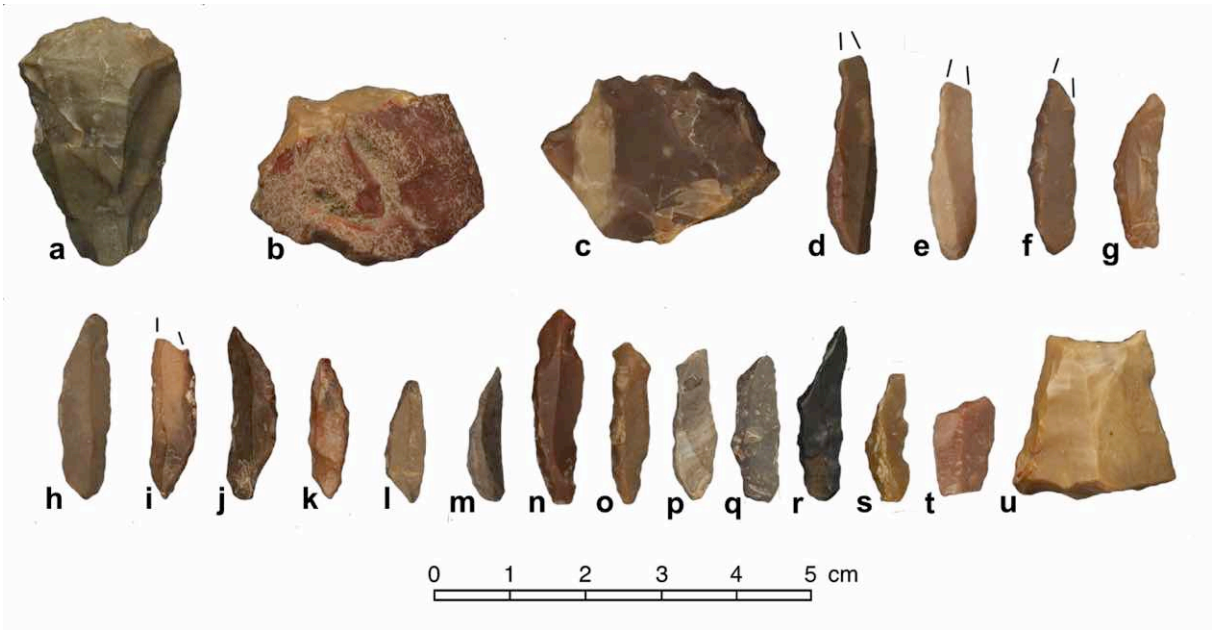


Figure 6.10. Grotte des Pigeons (Taforalt), Sector 8, L28-29: Retouched Tools
a-b) single end-scraper on a flake; c) denticulated end-scarper; d-e) pointed straight backed bladelets; f-j) convex backed bladelets; k) convex backed bladelet with truncated base; l-m) convex backed bladelets leadings to segments; n-q) La Mouillah points; r-s) scalene bladelets; t-u) truncations

6.2.5. Y1

There are 1695 artefacts from Y1 (including associated context L30). The absolute frequencies of artefacts according to excavation unit, along with the totals and relative frequencies for the group, are given in Table 6.13.

Table 6.13. Grotte des Pigeons (Taforalt), Sector 8, Y1:
Number of artefacts in each class by deposit

	Blades	Flakes	CTE	MB	TP	KMB	Cores	SP	Tools	Subtotal	Chips	Chunks	Total
L30	63	189	12	58		1	11	1	61	396	594	34	1024
Y1	61	154	5	40			17	1	50	307	307	35	670
Total	124 17.1%	343 47.3%	17 2.3%	98 13.5%	1 0.1%	1 0.1%	28 3.9%	2 0.3%	111 14.3%	775 99.8%	901 (53.2%)	69 (4.1%)	1695

Cores

There are 28 cores from Unit Y1, accounting for 3.9% of artefacts (excluding chips and chunks). These are most often single platform cores (39.3%), with fewer opposed platform cores (17.9%), two multiple platform cores (7.1%), one discoidal (3.6%), and one core-on-flake (3.6%). There are also six core fragments (21.4%) and one tested nodule (7.1%). The cores are exclusively of chert; pale brown/yellowish brown (21.4%), brown/strong brown (14.3%), greyish brown (3.4%), red/reddish brown (7.1%), dark red/dark reddish (7.1%), light grey (3.4%), dark grey (7.1%), white (7.1%), and

burnt (28.6%). Excluding fragments, there are few that do not retain cortex (13.6%). Where preserved, it appears to be most often pebble/cobble cortex (69.6%) and in one instance tabular (4.3%). There are also two core-on-flake (8.7%) examples. Overall, the cores are quite restricted in size, as seen in the median length, width, and thickness values, which are respectively, 26.8 mm (range 18.0-34.1 mm, n=22), 20.3 mm (range 11.4-38.5 mm, n=22), and 13.1 mm (range 8.7-24.6 mm, n=22).

Of the single platform cores most are flake cores (81.8%)(Fig. 6.11a), with fewer blade cores (27.3%)(Fig. 6.11b), of which one is sub-pyramidal (Fig. 6.11c). Judging from the scars on the dorsal surface these do not appear to have been rotated during reduction. Most cores appear to heavily exploited, with a high proportion (72.7%) having as a last removal a hinged termination. The single platform cores are all restricted in size, with small median values for length, width, and thickness, respectively of, 26.3 mm (range 18.0-31.3 mm, n=11), 19.6 mm (range 11.8-38.5 mm, n=11), and 14.8 mm (range 10.5-24.6 mm, n=11).

The opposed platform cores include one flake (20.0%), one mixed (20.0%), and three blade (60.0%) cores. There are two more regular blade cores, both sub-prismatic (Fig. 6.11d). The others are not well-made and three have only a minimal exploitation on the second platform (Fig. 6.11e-f). All are single face cores. The median dimensions are small, length 20.2 mm (range 19.0-32.9 mm, n=5), width 18.7 mm (range 11.4-21.0 mm, n=5), and thickness 13.1 (range 9.3-16.2 mm, n=5).

There is a discoidal core has flake removals (Fig. 6.11g). The flaking is on the same face, but it is not regular. It is 31.3 x 26.9 x 13.1 mm. The multiple platform cores have flake removals (Fig. 6.11h). Each is lacking clear patterning, one is globular, and one has three faces exploited via three platforms. These are also small cores, 18.9-19.9 mm long, 11.4-23.1 mm wide, 9.3-16.2 mm thick. The two core-on-flakes, including one with a single flake removal, and one with a single blade removal (Fig. 6.11i). These measure, 26.8-27.1 mm long, 18.7-21.1 mm wide, 8.7-9.8 mm thick. There are also six fragments; two flake, two blade, and two indeterminate. And, one tested core on an unusual red tabular chert with a single blade removal measuring 32.5 x 30.5 x 11.8 mm (Fig. 6.11j).

In addition to the cores, two pieces were classified as splintered pieces, which accounts for 0.3% of the artefacts (excluding chips and chunks) from Y1. There are both on chert; one white, one greyish brown. There appears to be a number of clear removals of blank size on the latter (Fig. 6.11k).

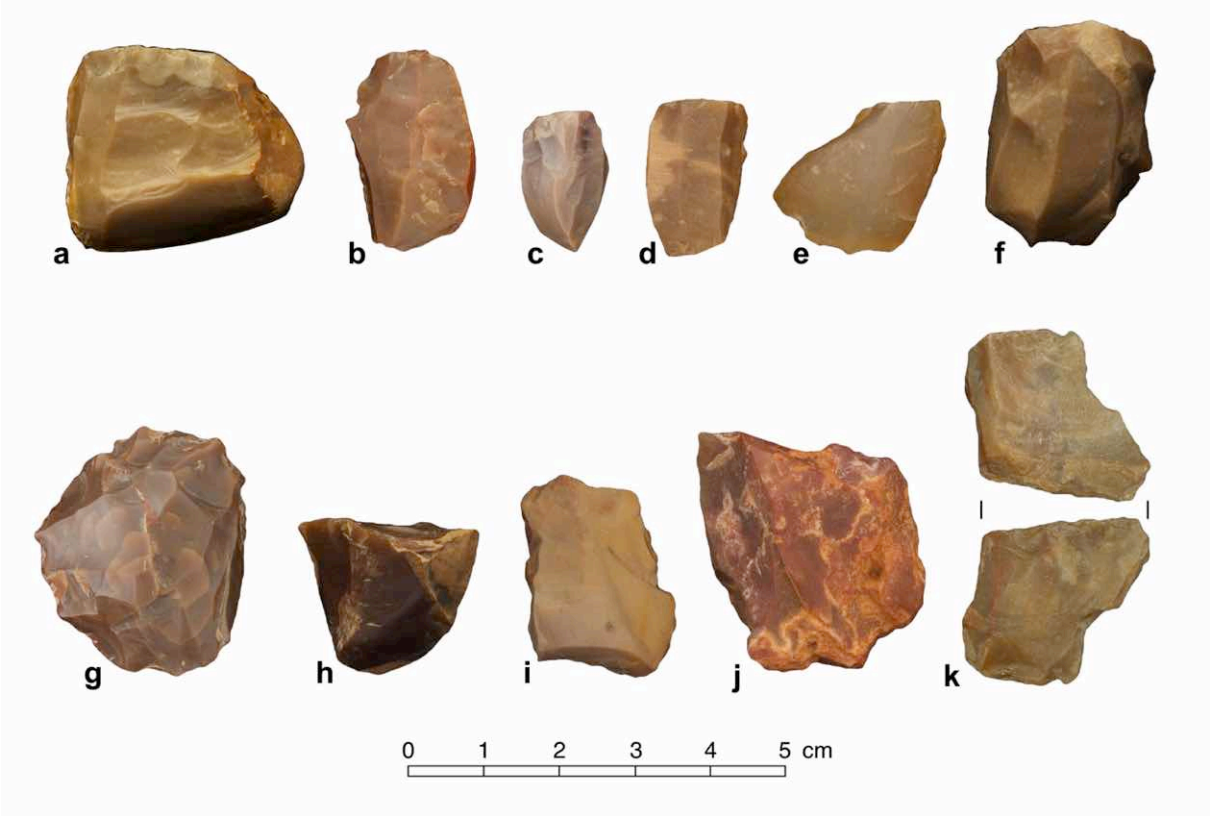


Figure 6.11. Grotte des Pigeons (Taforalt), Sector 8, Y1: Cores
a-c) single platform cores; d-f) opposed platform cores; g) discoidal core; h) multiple platform core; i) core-on-flake; j) tested core; k) splintered piece

Debitage

There are 343 flakes, accounting for 47.3% of the diagnostic artefacts, from Unit Y1. The vast majority flakes are on chert (97.7%), largely to the exclusion of limestone (2.3%). Of the complete flakes (≥20 mm maximum dimensions)(n=81) most are on chert; black (2.5%), dark grey (1.2%), grey/light grey (6.2%), greyish brown (11.1%), pale brown/yellowish brown (12.4%), brown/strong brown (24.7%), dusky/weak red (4.9%), reddish brown (3.7%), white (3.7%), and burnt (28.4%). There are only a couple of flakes of limestone; each burnt (2.5%).

The flakes tend to retain some cortex, divided between those with less than 25% cortex (28.9%), between 25-50% cortex (19.3%), more than 50% cortex (18.1%), and 100% cortex (18.1%).

Less than a third have no cortex (28.9%). The striking platforms are predominately plain (48.0%), whilst cortical (22.7%) examples are also quite common. There are fewer dihedral (10.7%), faceted (13.3%), and punctiform (5.3%) butts. Abrasion of the platform edge is relatively common (18.7%). Of the flakes, unidirectional (56.9%) dorsal scars predominate, followed by multidirectional (33.3%) patterns, whilst opposed (5.9%) or crossed (3.9%) varieties are infrequent. The flakes are generally short, squat, and thick, with median length, width, and thickness, of 22.3 mm (range 15.1-52.7 mm, n=81), 19.1 mm (range 10.1-34.5 mm, n=81), and 5.6 mm (range 1.3-16.8 mm, n=81), respectively.

In total, there are 55 blades and 69 blade fragments, accounting for 17.1% of the diagnostic artefacts, from Unit Y1. The blades are made exclusively on chert; black (1.8%), grey/light grey (5.5%), greyish brown (7.3%), pale brown/yellowish brown (20.0%), brown/strong brown (20.0%), dusky red/weak red (5.5%), white (7.3%), and burnt (32.7%). The majority of blades have no cortex (61.8%). Of the blades retaining dorsal cortex, those retaining less than 25% cortex (21.8%) most important, there are few with between 25-50% cortex (9.1%), more than 50% cortex (7.3%), and none with 100% cortex. There is a high proportion of crushed butts (34.5%), with plain (27.3%) and punctiform (25.4%) varieties being the next most important, there are also five cortical (9.1%), and one of each dihedral (1.8%) and faceted (1.8%) forms. There are a high proportion (45.5%) with abraded edges. Of the identifiable dorsal scars (n=45) the most common are unidirectional (62.2%), followed by opposed (15.6%) and crossed (15.6%), and thereafter multidirectional (6.7%) patterns. The blades are small in size, with median length, width, and thickness values, respectively of, 23.9 mm (range 14.9-40.7 mm, n=55), 9.0 mm (range 4.5-16.2 mm, n=55), and 3.1 mm (range 1.2-7.4 mm, n=55). All are of bladelet size, none being blades *sensu stricto* (after Tixier, 1963, p. 38).

All of the blade fragments (P: 26; M: 26; D:17)(n=69) are on chert; black (1.5%), grey/light grey (4.4%), greyish brown (5.8%), pale brown/yellowish brown (21.7%), brown/strong brown (11.6%), reddish brown (10.1%), dusky red/weak red (1.5%), white (1.5%), and burnt (42.0%). There are a third (33.3%) that retain cortex. The proximal ends (n=23) tend to be have plain (39.1%) or punctiform 52.2%), there is also one crushed (4.3%) and one cortical (4.3%). Of the fragments with identifiable dorsal scars (n=51) these are mostly unidirectional (64.7%), with strong proportion of

opposed (19.6%), fewer multidirectional (11.8%), and a couple of crossed (3.9%) patterns. The fragments have a width and thickness values, respectively of, 8.8 mm (range 4.1-18.7 mm, n=69) and 2.7 mm (range 1.2-6.0 mm, n=69).

There are 17 core-trimming elements from Unit Y1, which account for 2.3% of the artefacts from these deposits (excluding chips and chunks). These are most often crested blades (n=13), which tend to be first removals with a single prepared versant (n=7), there is also a first removal with two prepared versants (n=1), and a number of fragments (n=5). These are all on chert; greyish brown (n=1), pale brown/yellowish brown (n=3), brown/strong brown (n=3), red/reddish brown (n=1), and the remaining burnt (n=5). The crested blades have median values length, width, and thickness, respectively of, 29.0 mm (range 26.3-37.5 mm, n=6), 7.9 (range 3.9-16.7 mm, n=8), and 5.5 mm (range 3.3-7.2, n=8). There are two platform rejuvenations. Each is on chert; one pale brown/yellowish brown, and the other burnt. These measure 16.0-16.3 mm long, 18.9-19.0 mm wide, and 4.3-5.3 mm thick. There are also two *flanc de nucleus.* Both on chert; one black, one brown/strong brown. The former has a hinged termination, and appears to be a failed attempt at producing a *flanc de nucleus*. It is 15.7 x 20.2 x 6.8 mm. The latter removed the front of the core in its entirety, and is 31.4 x 20.2 x 11.1 mm.

Microburins and related products

There are 100 microburin products, accounting for 13.7% of the diagnostic artefacts, from Unit Y1. They are overwhelming true microburins, with 98 artefacts classified as such. Each of these is on chert. The microburins are dominated by distal examples (77.1%), with much lower frequencies removing the proximal end (22.9%). Notching is always direct, usually quite regular, and forms a distinct and deep notch in most cases. The notch is overwhelming applied to the left edge (76.0%) and less frequently at the right lateral margin (24.0%). The distal microburins are almost exclusively notched at the left edge (94.5%) and, in contrast, the proximal microburins have a strong tendency to be notched at the right edge (78.3%). The median values of length, width, and thickness, are respectively, 17.2 mm (range 8.1-31.4 mm, n=98), 10.4 mm (range 4.1-18.8 mm, n=98), and 3.7 mm (range 1.5-7.8 mm, n=98). There is a single Kruskowksi microburin. It is on chert. There is also a

trihedral point, which has the distal end removed and remnants of the notch can be seen on the left edge. It is complete, measuring 21.2 x 10.7 x 3.6 mm. The microburin index is 54.8. In addition, 23 of the microliths and microlith fragments retain visible remnants of microburins scars.

Table 6.14. Grotte des Pigeons (Taforalt), Sector 8, Y1: Absolute and relative frequencies of tool types

	N	%
End-scrapers	**1**	**0.9**
5. Denticulated end-scraper	1	100.0%
Microliths	**60**	**54.1**
56. Convex backed bladelet		
a. typical	10	16.7
b. leading to segment	11	18.3
57. Convex backed bladelet with rounded base	2	3.3
58. Convex backed bladelet with truncated base	3	5.0
59. Convex backed bladelet with retouched base	1	1.7
60. Backed bladelet with gibbousity	1	1.7
62. La Mouillah point	21	35.0
63. Partially backed bladelet		
b. with unmodified ends	2	3.3
65. Shouldered point	1	1.7
67. Obtuse ended backed bladelet		
a. natural end	2	3.3
68. Scalene bladelet	1	1.7
70. Ouchtata bladelet		
a. retouched along entire lateral	1	1.7
71. Bladelet with Ouchtata retouch	3	5.0
112. Pointed denticulated backed bladelet	1	1.7
Microlith fragments	**40**	**36.0**
66. Fragment of a backed bladelet	38	95.0
72. Fragment of a bladelet with Ouchata retouch	2	5.0
Notches and denticulates	**1**	**0.9**
75, Denticulated flake	1	100.0
Truncations	**2**	**1.8**
80. Truncated piece	2	100.0
Miscellaneous	**7**	**6.3**
105. Piece with continuous retouch	5	71.4
112. Utilised piece	2	28.6
Total	**111**	

Tools

There are 111 tools from Unit Y1, accounting for 14.3% of the diagnostic material. The microliths (54.1%) and microlith fragments (36.0%) dominate the assemblage, with end-scrapers (0.9%), notches and denticulates (0.9%), truncations (1.8%), and miscellaneous tools (6.3%), contributing little to the overall frequencies (Table 6.14).

End-scrapers

There is a single artefact belonging to this class. It is a denticulated end-scraper (type 5) on a burnt chert flake. The scraper retouch is at the distal end with fairly regular and evenly spaced contiguous notches. It is complete (39.6 x 30.5 x 13.4 mm)(Fig. 6.12a).

Microliths

There are 60 microliths (Figs 6.12b-x). These are dominated by convex backed bladelet *sensu lato* (Types 56-59)(45.0%) and La Mouillah points (type 62)(35.0%). There are also five other types in small frequencies ranging from 1.7% to 5.0%. These include, one microlith that could not be classified using the existing types as defined by Tixier (1963) and was therefore assigned as various (type 112). It is a pointed denticulated backed bladelet. It is atypical in comparison to the other points from the site. It has a back that consists of a series of clearly defined contiguous notches that are evenly spaced. There are no 'geometric' microlith forms.

All of the microliths are on chert; black (8.3%), dark grey (1.7%), grey/light grey (5.0%), greyish brown (6.7%), pale brown/yellowish brown (32.7%), brown/strong brown (13.3%), reddish brown (6.7%), dusky red/weak red (1.7%), and burnt (21.7%). Just under half of the microliths are broken (48.3%). There is a strong preference for retouch on the left lateral (78.3%) over the right lateral (13.3%) edge; the remaining cases were indeterminate (8.3%). An overwhelming proportion of the retouch is direct (83.3%), with only a few mixed direct/crossed (5.0%), crossed (8.3%), and alternating (1.7%) examples; one was indeterminate (1.7%). There are a small proportion with marginal Ouchtata retouch (5.0%).

The microliths are most often single pointed forms (75.0%), but there are also double pointed examples (21.7%). Only a couple of microliths have unmodified ends (3.3%). Of the single points (n=45) most are modified at the distal (77.8%) with fewer proximal examples (15.6%); three cases were indeterminate (6.7%). Of all the microliths the butt is retained in a third of the cases (33.3%). There are 16.7% with basal truncations, with equal numbers of acute (n=5) and rounded (n=5) forms. The basal truncations are mostly directly retouched (n=6), although there are also a few inverse (n=3) examples; another was indeterminate. The basal truncations are not only restricted to the convex backed bladelets, which have formal type numbers to reflect the presence of basal modification, but are also present on the La Mouillah points. There are a few microliths with addition basal retouch (6.7%); these too are present on the La Mouillah points. There are no microliths with additional retouch at the tip. In addition to the La Mouillah points, evidence for the microburin facet is retained on two convex backed bladelets, which together account for a high proportion (38.3%) of the microliths. As a group the microliths have median values of length, width, and thickness, respectively of, 21.2 mm (range 16.6-31.3 mm, n=31), 6.6 mm (range 4.6-9.0 mm, n=60), and 3.4 mm (range 1.4-6.0 mm, n=60).

Microlith fragments

There are 40 microlith fragments, including eight distal (20.0%), 12 mesial (30.0%), 16 proximal (40.0%), two partial (5.0%), and two indeterminate ends (5.0%). All of these are made on chert; just less than half with evidence of burning (45.0%). There is a strong preference for retouch at the left lateral (57.5%) over the right lateral (30.0%) edge; the remaining cases were indeterminate (12.5%). The overwhelming majority of retouch is direct (82.5%), with only two mixed direct/crossed (5.0%), and four crossed (10.0%); one was indeterminate (2.5%). The butt is retained on a number of the fragments (20.0%). The fragments have median width and thickness values, respectively of, 5.9 mm (range 1.5-10.8 mm, n=40) and 3.4 mm (range 1.3-5.7mm, n=40).

Notches and denticulates

One artefact was assigned to this class. It is a denticulated flake (type 75) produced on chert. It is burnt. It has direct contiguous notches along the entire left lateral margin and at the distal proportion of the right lateral margin (29.9 x 15.4 x 4.9 mm)(Fig. 6.13a).

Truncations

This tool class consists of two truncated pieces (type 80) made on chert. Each is complete with a truncation at the distal end made by direct abrupt retouch. Both are quite small and of bladelet *sensu stricto* size (17.7 x 8.8 x 2.1 mm and 19.3 x 9.7 x 4.8 mm)(Figs 16.3b-c).

Miscellaneous

There are six tools in this class. Five of these are atypical pieces with continuous retouch (type 105); one flake (Fig. 6.13d), one platform rejuvenation flake (Figure 6.13e), and three indeterminate fragments. These are all on chert; one greyish brown, one pale brown/yellowish brown, and three burnt. The flake has marginal retouch along a straight distal end (27.0 x 21.1 x 9.2 mm). The platform rejuvenation flake has direct marginal retouch along irregular distal end, which is the long axis of the piece (13.5 x 25.4 x 5.4 mm). The others are extremely fragmentary and have direct retouch. In addition, there are two utilised pieces. The first is a red/reddish brown chert bladelet *sensu stricto*. It has discontinuous fine damage on both lateral margins (39.4 x 12.1 x 5.6 mm). There is a microburin on brown/strong brown chert (Fig. 6.13f). It is from the distal end of a blade with a notch at the left margin. There is damage along the microburin facet, converging with the notch to form a tip, there are no signs of intentional retouch beyond the original notch. The damage appears consist with its use as a perforator. The utilised microburin is quite large (25.0 x 17.5 x 7.9 mm).

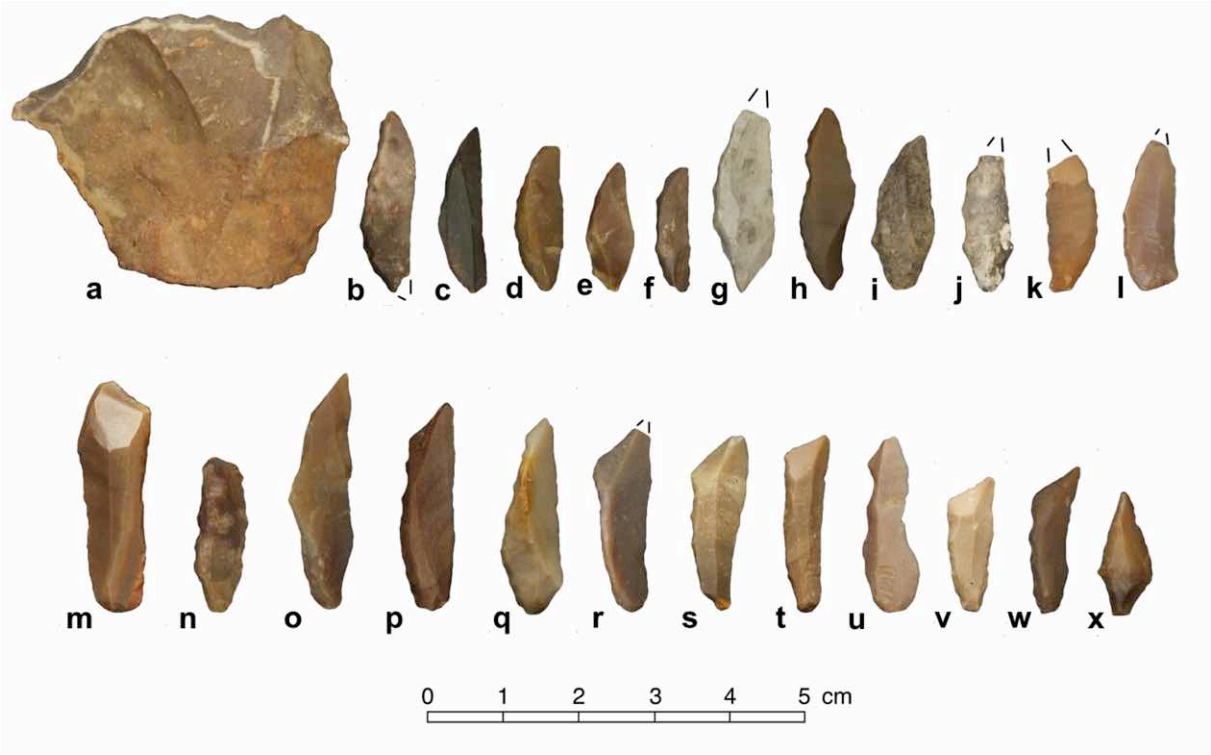


Figure 6.12. Grotte des Pigeons (Taforalt), Sector 8, Y1: Retouched Tools – Part A
a) dentilculated end-scraper; b-d) convex backed bladelets leading to segments;
e-f, k-l) convex backed bladelets; g-h) convex backed bladelets with truncated bases;
i-j) convex backed bladelets with rounded bases; m) Ouchtata bladelet; n) obtuse ended backed bladelet; o-w) La Mouillah points; x) shouldered point

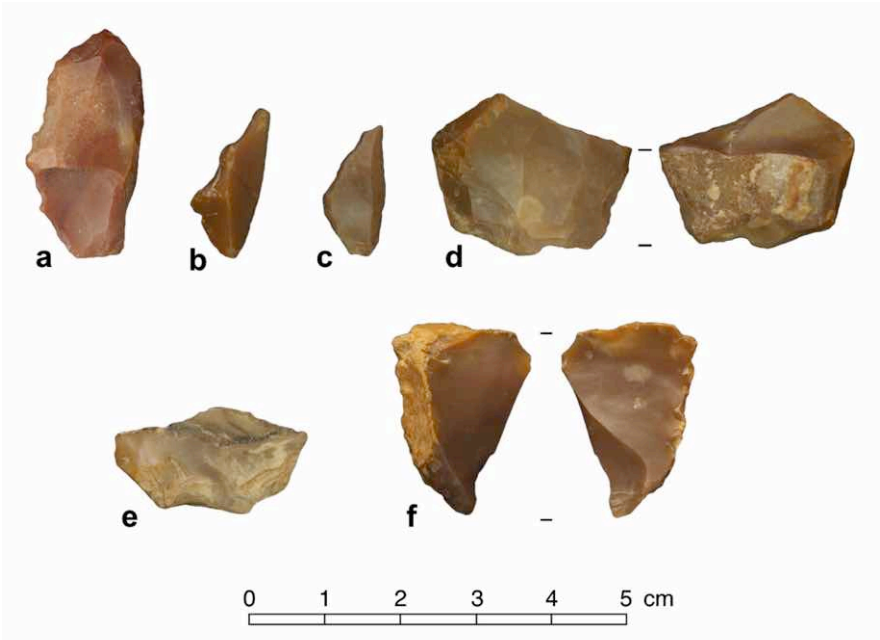


Figure 6.13. Grotte des Pigeons (Taforalt), Sector 8, Y1: Retouched Tools – Part B
a) denticulated flake; b-c) truncations; d-f) pieces with continuous retouch

6.2.6. Y2 sp1

There are 447 lithic artefacts from Y2 sp1 (including associated contexts L31-32). The absolute frequencies of artefacts according to excavation unit, along with the totals and relative frequencies for the group, are given in Table 6.15.

Table 6.15. Grotte des Pigeons (Taforalt), Sector 8, Y2 sp1: Number of artefacts in each class by deposit

	Blades	Flakes	CTE	MB	TP	KMB	Cores	SP	Tools	Subtotal	Chips	Chunks	Total
L31	11	28		11					4	54	151	10	
L32	4	3					2		21	30	32	1	
Y2 sp1	23	57	2	7			3		24	117	41	11	
Subtotal	38 19.0%	88 44.0%	2 1.0%	18 9.0%			5 2.5%		49 24.5%	200 100.0%	224 (50.1%)	23 (5.2%)	447

Cores

There are only five cores from Unit Y2 sp1, which account for 2.5% of the artefacts (excluding chips and chunks). There is one single platform core, two opposed platform cores, one prepared core, and one fragment. Overall, the cores are quite restricted in size, as seen in the median length, width, and thickness values, which are respectively, 26.8 mm (range 18.0-34.1 mm, n=4), 21.8 mm (range 14.5-27.9 mm, n=4), and 12.8 mm (range 10.5-17.5 mm, n=4).

The single platform core has flake removals (Fig. 6.14a). It is on a reddish brown chert with a pebble cortex. Blanks have been removed from a single flaking-surface. There is splintering at the edge of the platform, and also at the opposite end to a much lesser extent, consistent with using a bipolar technique. This appears to have been enacted in order remove a blank along the central arris, which has failed. The core appears to be exhausted and is small measuring 26.1 x 27.9 x 10.5 mm.

The two opposed platform cores both have flake removals (Figs 6.14b-c). These are both on chert, one grey/light grey without cortex, and the other burnt with cobble cortex. Each has only a minimal amount of exploitation on the second platform and there are negatives from hinged/stepped terminating removals at the end of the sequence. Each is heavily reduced or exhausted, with small values between, 23.0-26.1 mm long, 14.5-24.1 mm wide, and 12.1-13.6 mm thick.

The single tested/prepared core on a small elongated cobble of greyish brown chert (Fig. 6.14d). It has been split and a platform prepared at one end. It measures 49.6 x 19.5 x 17.5 mm. In addition, there is one indeterminate core fragment.

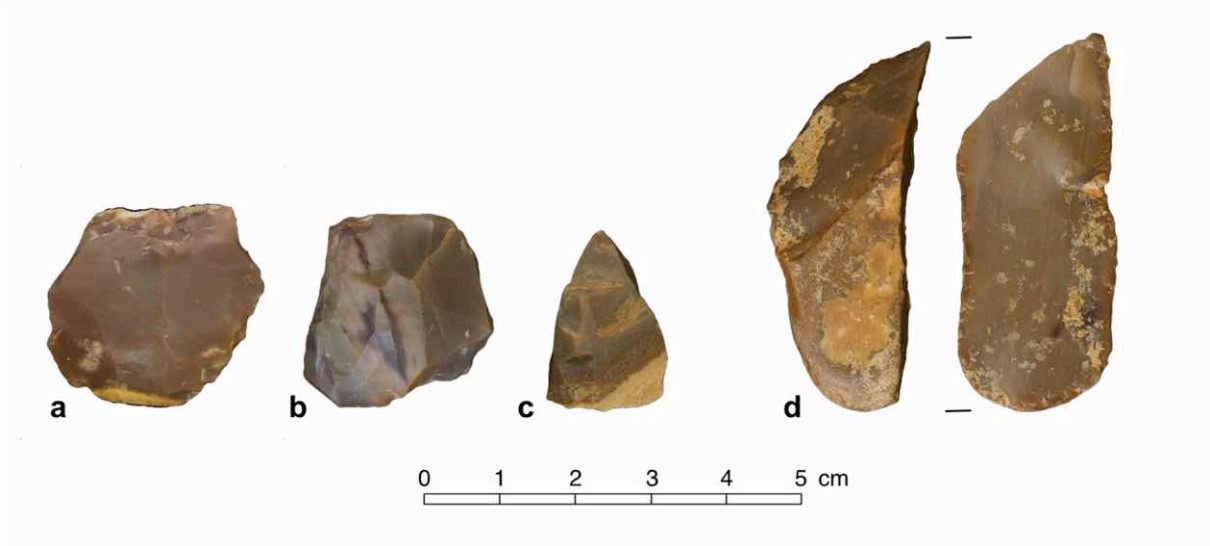


Figure 6.14. Grotte des Pigeons (Taforalt), Sector 8, Y2 sp1: Cores
a) single platform core; b-c) opposed platform cores; d) tested/prepared core

Debitage

The flakes number 88 in Unit Y2 sp1 and account for 44.0% of the diagnostic artefacts. The vast majority (96.6%) of the flakes are on chert and only two are on limestone. The complete flakes (≥20mm maximum dimension)(n=29) are overwhelmingly on chert; black (3.5%), grey/light grey (6.9%), greyish brown (3.5%), pale brown/yellowish brown (17.2%), brown/strong brown (27.6%), and burnt (34.5%). There are a couple of limestone; dark grey (3.5%), and burnt (3.5%). The flakes most often retain cortex, divided between those with less than 25% cortex (20.7%), between 25-50% cortex (20.7%), more than 50% cortex (20.7%), and 100% cortex (10.3%). Less than a third have no cortex (27.6%). The striking platforms are predominantly plain (45.5%), followed by cortical (18.2%), dihedral (22.7%), faceted (9.1%) and punctiform (4.6%). The edge of the platform is often abraded (18.1%); very similar to the frequencies observed in Unit Y1. On the flakes, unidirectional (50.0%) and multidirectional (45.0%) dorsal scar patterns are predominant, whilst there is only one crossed (6.3%) and no opposed patterns. The flakes are generally small is short, squat, and thick, with median

values for length, width, thickness values of 24.6 mm (range 15.9-41.4 mm, n=29), 18.4 mm (range 10.6-41.2 mm, n=29), and 4.8 (range 1.7-15.1 mm, n=29), respectively.

Only a small number of blades and blade fragments were recovered, although these account for 19.0% of the diagnostic artefacts, from Unit Y2 sp1. The blades (n=21) are made exclusively on chert; grey/light grey (4.8%), greyish brown (4.8%), pale brown/yellowish brown (23.8%), brown/strong brown (28.6%), and burnt (38.1%). The majority of these have no cortex (71.4%), with the remainder all showing less than 25% cortex (28.6%). The butts are mostly punctiform (52.3%), with strong proportion of plain (19.1%), and many crushed (28.6%) examples. Abrasion at the platform edge is common (42.9%). Of the identifiable dorsal scars (n=16) the most common are unidirectional (68.8%), followed by opposed (18.8%) and multidirectional (12.5%) in smaller frequencies. None are crossed. The blades are generally small in size, with median length, width, and thickness values, of respectively, 24.3 mm (range 16.9-66.8 mm, n=21), 8.0 mm (range 4.7-31.0 mm, n=21), and 2.9 (range 1.4-10.9 mm, n=21). Of the sample, most are bladelet size, with only one being a blade *sensu stricto* (after Tixier, 1963, p.38).

Of the blade fragments (P:5; M:10; D:3) (n=18) all are on chert; pale brown/yellowish brown (11.1%), greyish brown (5.6%), brown/strong brown (27.8%), reddish brown (11.1%), and burnt (44.4%). Less than half (38.9%) retain any cortex. The proximal ends (n=5) include, one punctiform, one dihedral, and three crushed examples; with signs of abrasion in two cases. Of the fragments with identifiable dorsal scars (n=12) these are predominantly unidirectional (75.0%), with only one opposed (8.3%), and two multidirectional (16.7%) patterns. The fragments have median width and thickness values, respectively of, 8.7 mm (range 5.1-14.7 mm, n=18) and 2.2 mm (range 1.4-4.1 mm, n=18).

There are only two core-trimming elements from Unit Y2 sp1, which account for only a relatively small proportion (1.0%) of the artefacts (excluding chips and chunks) from these layers. These are both crested blades; first removals with a single prepared versant (n=2). There is one on brown/strong brown chert that is 41.3 x 10.2 x 6.1 mm. The other is burnt and on chert with the butt missing, retaining a width and thickness, respectively of, 8.2 and 5.0 mm.

Microburins and related products

There are 18 microburins, accounting for 9.0% of the diagnostic artefacts, from Unit Y2 sp1. No trihedral points or Krukowski microburins were recovered. All of the microburins are on chert. They most often distal examples (66.7%), with much lower frequencies of proximal examples (33.3%). Notching is always direct, usually quite regular, and forms a distinct and deep notch in most cases. The notch is applied most frequenctly to the left edge (61.1%) and less often at the right lateral margin (38.9%). The distal microburins are exclusively notched at the left edge (100.0%) and, in contrast, the proximal microburins overwhelmingly notched on the right edge (85.7%). The median values of length, width, and thickness, are respectively, 17.6 mm (range 5.7-32.9 mm, n=18), 10.3 mm (3.7-22.6 mm, n=18), and 3.6 mm (range 1.2-8.1 mm, n=18). The microburin index is 44.4. In addition, two of the microliths and microlith fragments retain visible remnants of microburins scars.

Tools

There is a small collection of 29 tools from Unit Y2 sp1, although in relative terms they account for 24.5% of the diagnostic material. The microliths (56.7%) and microlith fragments (30.0%) dominate the assemblage largely to the exclusion of the other tool classes, which are end-scrapers (3.3%) and a notched and denticulates (3.3%)(Table 6.16).

End-scrapers

The tool class if represented by a single artefact. It is a denticulated end-scraper (type 5) on a grey/light grey chert flake. The scraper end is located distally. It is relatively large (37.2 x 30.3 x 10.2 mm)(Fig. 6.15a).

Microliths

There are 16 microliths (Figures 6.15b-l). These include, three convex-backed bladelet *sensu lato* (types 56-59)(17.7%), two La Mouillah points (type 62)(11.8%), one scalene bladelets (type 68)(5.6%), three obtuse ended backed bladelets (type 67)(17.7%), and eight Ouchtata bladelets (type 70)(47.1%). There is no clear dominance of a single type (Table 6.16). All of the microliths are made on chert; dark grey (5.9%), pale brown/yellowish brown (17.7%), brown/strong brown (35.3%), and

burnt (41.2%). There are eight that are broken (47.1%). In contrast to the overlying deposits, there is a preference for retouch at the right lateral edge (76.5%) over the left lateral edge (23.5%). The majority of the retouch is direct (88.2%), with two crossed (11.8%). There is a much greater proportion (47.5%) of examples with marginal Ouchtata retouch than in the overlying deposits.

Table 6.16. Grotte des Pigeons (Taforalt), Sector 8, Y2 sp1: Absolute and relative frequencies of tool types

	N	%
End-scrapers	**1**	**3.3**
5. Denticulated end-scraper	1	100.0%
Microliths	**17**	**56.7**
56. Convex backed bladelet		
a. typical	1	5.6
b. leading to segment	1	5.6
58. Convex backed bladelet with truncated base	1	5.6
62. La Mouillah point	2	11.8
67. Obtuse ended backed bladelet		
a. natural end	3	17.7
68. Scalene bladelet	1	5.6
70. Ouchtata bladelet		
a. retouched along entire lateral	6	35.3
b. retouched at proximal	2	11.8
Microlith fragments	**10**	**30.0**
66. Fragment of a backed bladelet	6	
72. Fragment of a bladelet with Ouchata retouch	4	
Notches and denticulates	**1**	**3.3**
79. Notched or denticulated piece with continuous retouch	1	100.0
Total	**30**	

The microliths with unmodified ends dominate (64.7%), whereas single points (29.4%) and double points (5.9%) are comparatively rare. Of the single points (n=5) three are found at the distal and two at the proximal. Of all the microliths the butt is retain in just over a third of cases (35.3%). There is one convex backed bladelet with an inverse acutely truncated base. None of the microliths have additional basal or tip retouch. Evidence of a microburin facet is found on the two La Mouillah points (type 62). As a group the microliths have median values of length, width, and thickness,

respectively of, 27.5 mm (range 19.9-33.9 mm, n=9), 7.6 mm (range 5.8-9.7 mm, n=17), and 2.6 mm (range 1.8-4.5 mm, n=17).

Microlith fragments

There are only 10 microlith fragments, including two distal, three mesial, three proximal, and two indeterminate ends. All of these are on chert; most with evidence of burning (n=7). Most of the retouch is at the right lateral (n=7) over the left lateral (n=1) edge; the remaining cases were indeterminate (n=2). The retouch is typically direct (n=8); there are single examples with mixed direct/crossed (n=1) and inverse (n=1) retouch. There is one fragment retaining the butt. The fragments together have a median width and thickness, of 7.2 mm (range 4.2-9.8 mm, n=10) and 2.3 mm (range 1.4-4.3 mm, n=10), respectively.

Notches and denticulates

There is a single artefact in this class; a notched indeterminate fragment with continuous retouch (type 79) on grey/light grey chert. It is left-distal corner fragment with a direct single-blow notch (9.0 x 1.6 mm) to the left edge, with additional low inverse sub-parallel retouch along the right lateral margin.

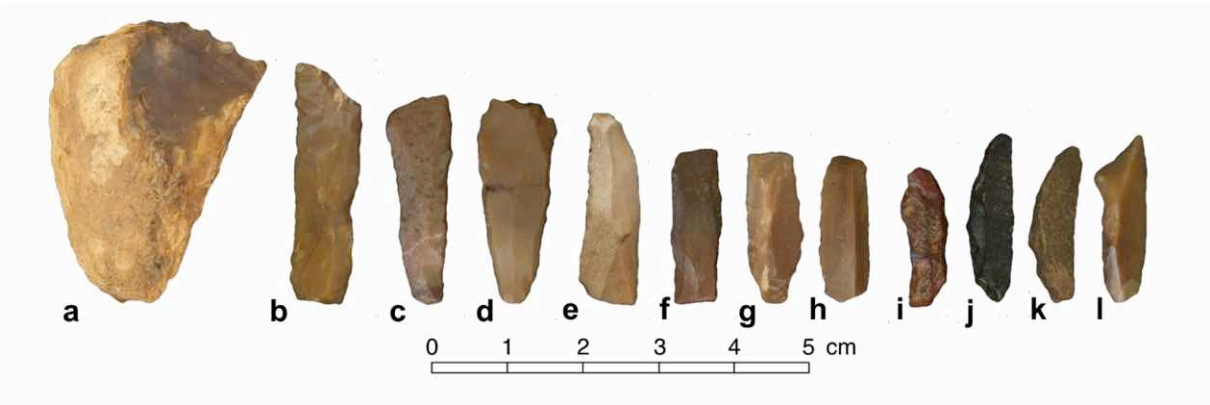


Figure 6.15. Grotte des Pigeons (Taforalt), Sector 8, Y2 sp1: Retouched Tools
a) denticulated end-scraper b-d) obtuse ended backed bladelets; e-h) Ouchtata bladelets;
i) convex backed bladelet; j) convex backed bladelet leading to segment; k-l) La Mouillah points

6.2.7. Y2 sp2-5

There are only 340 lithic artefacts from Units Y2 sp2-5. The absolute frequencies of artefacts according to excavation unit, along with the totals and relative frequencies for the group, are given in Table 6.17.

Table 6.17. Grotte des Pigeons (Taforalt), Sector 8, Y2 sp2-5: Number of artefacts in each class by deposit

	Blades	**Flakes**	**CTE**	**MB**	**TP**	**KMB**	**Cores**	**SP**	**Tools**	**Subtotal**	**Chips**	**Chunks**	**Total**
Y2 sp2	7	28	2				2		7	46	28	2	76
Y2 sp3	24	59	2						12	97	87	5	189
Y2 sp4									13	13			13
Y2 sp5	15	27	1				2	1	7	53	33	6	92
Total	46 22.0%	114 54.5%	5 2.4%				4 1.9%	1 0.5%	39 18.7%	209 100.0%	148 (40.0%)	13 (3.5%)	370

Cores

There are only four cores, accounting for 1.9% of the diagnostic artefacts, from Unit Y2 sp2-5. There are two single platform cores and two opposed platform cores. The single platform cores include one with flake removals (Fig.6.16a) and one with blade removals (Fig. 6.16b); the latter is sub-pyramidal. Each is on chert with pebble cortex; one burnt, the other brown/strong brown. Each is heavily worked, with small metrical values between, 18.0-21.3 mm long, 14.6-15.6 mm wide, and 8.1-12.5 mm thick.

The opposed platform cores both have flake removals. One is on brown/strong brown chert with pebble cortex. It has a single face. It measures 36.6 x 30.3 x 21.0 mm. The other is burnt on chert with pebble cortex (Fig. 6.16c). It has a single face. There are stacked hinged/stepped terminating removals from the main platform; the other platform has only a minimal amount of exploitation on the second platform; it appears that the exploitation of an additional platform was an attempt to regular the production of blanks. It is 24.5 x 15.7 x 14.3 mm.

In addition, there is one splintered piece, which accounts for only 0.5% of the diagnostic artefacts from Unit Y2 sp2-5. It is on a burnt chert flake. There is characteristic bifacial splinted removals at opposite extremities. There are no clear removals (Fig. 6.16d).

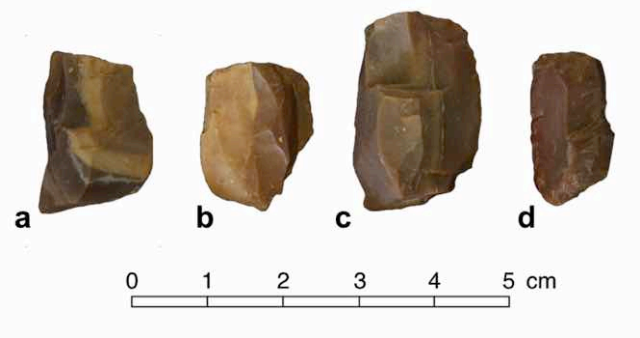


Figure 6.16. Grotte des Pigeons (Taforalt), Sector 8, Y2 sp2-5: Cores
a-b) single platform cores; c) opposed platform core; d) splintered piece

Debitage

There are 114 flakes, which account for 54.5% of the diagnostic artefacts, from Units Y2 sp2-5. The flakes are dominantly on chert (93.9%) with only a small number on limestone (6.1%). The complete flakes (≥20mm maximum dimension)(n=34) include, black (2.9%), grey/light greyish (5.9%), greyish brown (2.9%), pale brown/yellowish brown (14.7%), brown/strong brown (23.5%), heavily patinated (2.9%), and burnt (26.5%), examples on chert. There are only a couple on limestone; dark grey (2.9%), and burnt (2.9%). The flakes most often retain cortex, divided between those with less than 25% cortex (17.7%), between 25-50% cortex (14.7%), more than 50% cortex (20.6%), and 100% cortex (14.7%). There is approximately a third that have no cortex (32.4%). The butts tend to be plain (40.7%), followed by cortical (25.9%), faceted (18.5%), punctiform (11.1%), and dihedral (3.7%) varieties. The abrasion of the platform edge is still common (18.1%) and in similar frequencies to that observed throughout the Yellow Series. Of the flakes, multidirectional (65.2%) dorsal scars are most common, followed by strong proportions of unidirectional (30.4%) patterns. There is only one opposed (4.4%) and none with crossed patterns. The flakes are generally short, broad, and thick, with median length, width, and thickness values, of 25.3 mm (range 11.4-37.6 mm, n=34), 20.3 mm (range 9.3-38.7 mm, n=34), 5.6 mm (range 1.6-11.3, n=34), respectively.

There are 22 blades and 24 blade fragments, accounting for 22.0% of the diagnostic artefacts, from Unit Y2 sp2-5. The blades are made exclusively on chert; dark grey (9.1%), grey/light grey (13.6%), greyish brown (4.6%), pale brown/yellowish brown (4.6%), brown/strong brown (18.2%), reddish brown (4.6%), heavily patinated (4.6%), and burnt (40.9%). The majority of the blades have no cortex (77.3%), whereas the blades with less than 25% cortex (9.1%), between 25-50% cortex (4.6%), and more than 50% cortex (9.1%), are less frequent. The majority of butts are punctiform (45.5%), followed by plain (13.6%), and two cortical (9.1%) and one dihedral (4.5%). There are also a high proportion of butts that have been crushed (27.3%). Butt abrasion is present on slightly less than a third (27.2%) of cases. Of the identifiable dorsal scars (n=22) the most common type are unidirectional (54.6%), followed by strong proportions of both opposed (18.2%) plus multidirectional (18.2%), and two with crossed (9.1%) patterns. The blades are generally small in size, with median length, width, and thickness values, of respectively, of 27.3 mm (range 15.0-45.8 mm, n=22), 9.3 mm (range 4.9-14.2 mm, n=22), and 3.0 mm (range 1.4-5.5 mm, n=22). All are of bladelet size, none being blades *sensu stricto* (after Tixier, 1963, p. 38).

Of the blade fragments (P:9 M:7 D:8) (n=24) all are on chert; black (8.3%), grey/light grey (8.3%), greyish brown (13.6%), pale brown/yellowish brown (16.7%), brown/strong brown (8.3%), reddish brown (8.3%), heavily patinated (8.3%), and burnt (29.2%). There are just less than a third (29.2%) that retain cortex. The proximal fragments (n=9) have plain (n=1) and punctiform (n=8) butts. There is abrasion on most (n=7) of the edges. Of the fragments with identifiable dorsal scars (n=12) they are predominately unidirectional (83.3%), with one count of each, opposed (8.3%) and crossed (8.3%). The fragments have median width and thickness values, of respectively, 7.8 mm (range 2.8-16.1 mm, n=24) and 2.1 (range 1.2-5.4 mm, n=24).

There are five core-trimming elements, accounting for 2.4% of the diagnostic artefacts, from Unit Y2 sp2-5. These include four crested blades; two first removals with one prepared versant and two fragments. All are on chert; one pale brown/yellowish brown, and three burnt. The median values for length, width, and thickness, are respectively, 19.9 mm (n=1), 9.4 mm (range 7.9-10.9 mm, n=2),

and 3.7 mm (range 3.6-3.8 mm, n=2). There is also one small platform rejuvenation on pale brown/yellowish brown chert. It is 14.7 x 8.1 x 2.7 mm.

Microburins and related products

There are no microburin products from Unit Y2 sp2-5. In addition, none of the tools retained visible remnants of microburin scars. Therefore the microburin index is zero.

Retouched tools

There are 39 tools from Unit Y2 sp2-5. They account for 18.7% of the diagnostic material. Microliths (38.5%) and microlith fragments (46.2%) dominate largely to the exclusion of the other class, which include notches and denticulates (5.1%) and miscellaneous tools (2.6%)(Table 6.18).

Microliths

There are 15 microliths, of which seven types have been identified; one pointed straight backed bladelet (type 45)(6.7%), three convex backed bladelets *sensu lato* (types 56-59)(20.0%), two scalene bladelets (type 68)(13.3%), three partially backed bladelets (type 63)(20.0%), two obtuse ended backed bladelets (type 67)(13.3%), and four Ouchtata bladelets (type 70)(26.7%)(Fig. 6.17a-k).

All of the microliths are on chert; black (6.7%), dark grey (6.7%), greyish brown (13.3%), pale brown/yellowish brown (26.7%), brown/strong brown (13.3%), white (6.7%), and burnt (20.0%). There five broken microliths (33.5%). There is a preference for retouch on the right lateral edge (73.3%) over the left lateral edge (26.7%). The retouch is direct on each microlith, excluding one indeterminate case. There is a high proportion of marginal Ouchtata retouch (26.7%).

Many of the microliths have unmodified ends (53.3%), single points are also important (46.7%), and there are no double points. The single points (n=7) are most often at the distal (n=6) and there is only one at the proximal (n=1), which is on a partially backed bladelet (type 63). The butt is retained on a high proportion of the microliths (67.7%). There are two with basal truncations; both convex-backed bladelet with rounded bases (type 57) formed by direct retouch. None of the microliths have additional tip retouch and there is an absence of microliths that retain evidence of a

microburin facet. As a group, the microliths have median values of length, width, and thickness, of respectively, 27.8 mm (range 20.8-36.6 mm, n=10), 9.7 mm (range 7.0-11.2 mm, n=15), and 3.1 mm (range 1.8-5.1 mm, n=15).

Table 6.18. Grotte des Pigeons (Taforalt), Sector 8, Y2 sp2-5: Absolute and relative frequencies of tool types

	N	%
Microliths	**15**	**38.5**
45. Pointed straight backed bladelet	1	6.7
56. Convex backed bladelet		
a. typical	1	6.7
57. Convex backed bladelet with rounded base	2	13.3
63. Partially backed bladelet		
a. with pointed end	1	6.7
b. with unmodified ends	2	13.3
67. Obtuse ended backed bladelet		
a. natural end	2	13.3
68. Scalene bladelet	2	13.3
70. Ouchtata bladelet		
a. retouched along entire lateral	2	13.3
b. retouched at proximal	2	13.3
Microlith fragments	**18**	**46.2**
66. Fragment of a backed bladelet	6	33.3
72. Fragment of a bladelet with Ouchata retouch	12	66.7
Notches and denticulates	**2**	**5.1**
74. Notched flake	1	50.0
79. Notched or denticulated piece with continuous retouch	1	50.0
Truncations	**3**	**7.7**
80. Truncated piece	3	100.0
Miscellaneous	**1**	**2.6**
105. Piece with continuous retouch	1	100.0
Total	**39**	

Microlith fragments

There are 18 microlith fragments, including five distal (27.8%), five mesial (27.8%), seven proximal (38.9%), and one partial (5.6%). These are all on chert; just less than half with clear evidence of burning (44.4%). There is one more microlith fragment with retouch at the right lateral edge (50.0%) than at the left lateral edge (44.4%); one was indeterminate (5.6%). The butt is retained on a third of the microlith fragments (33.3%). The median width and thickness values are respectively, 10.2 mm (range 6.0-15.9 mm, n=17) and 2.6 mm (range 1.5-4.5 mm, n=17).

Truncations

Three truncated pieces (type 80) have been recorded. One is complete (Fig. 6.17l). It has a straight truncation at the distal end formed by direct abrupt retouch. There is also additional, fine inverse retouch restricted to the proximal portion of the left margin. The butt is not retained. It measures 25.9 x 16.0 x 3.23 mm. There are also two fragments with more or less straight truncations at the distal end.

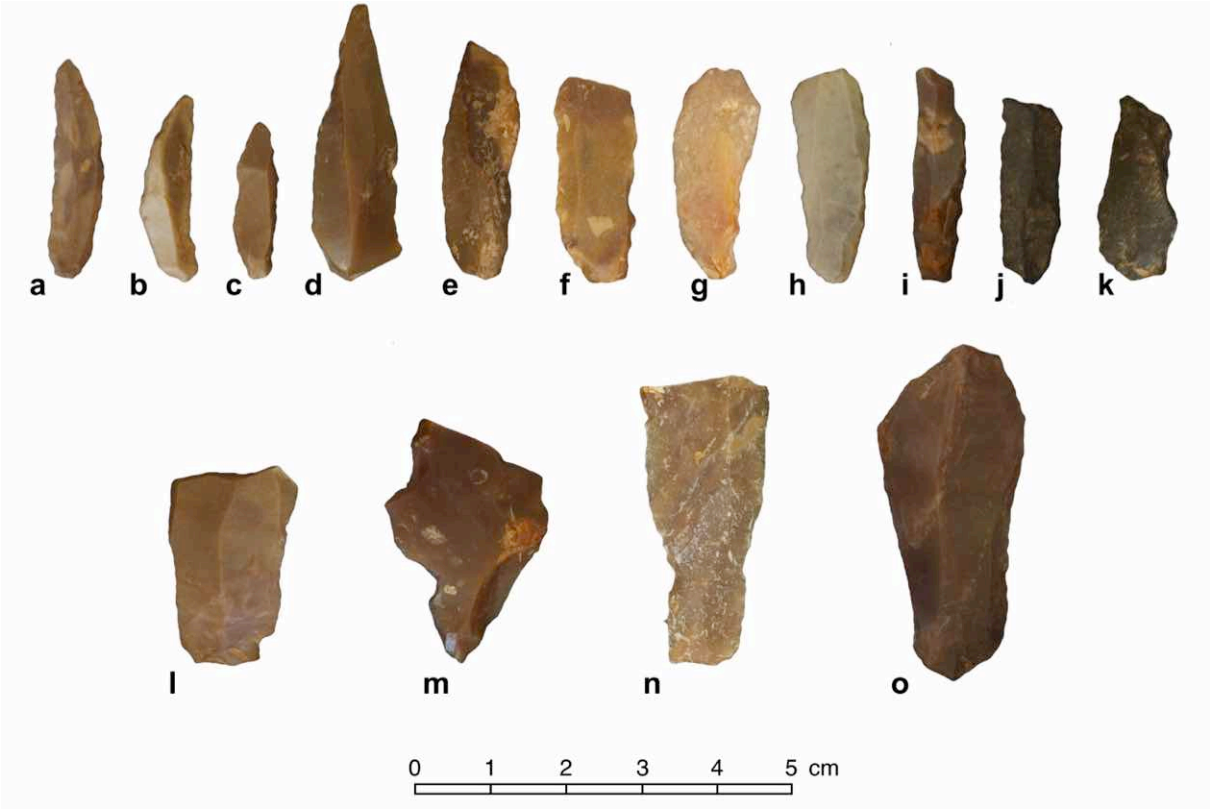


Figure 6.17. Grotte des Pigeons (Taforalt), Sector 8, Y2 sp2-5: Retouched tools
a) convex backed bladelet; b) convex backed bladelet with rounded base; c) pointed straight backed bladelet; d) partially backed bladelet with pointed end; e, g) partially backed bladelet with unmodified end; f) obtuse ended backed bladelet; h) Ouchtata bladelet retouched along entire lateral; i) Ouchtata bladelet retouched at proximal; j-k) scalene bladelets; l) truncation; m) notched flake; n) denticulated blade with continuous retouch; o) piece with continuous retouch

Notches and denticulates

There are two artefacts in this class; a notched flake (type 74), and a denticulated blade with continuous retouch (type 79). The former is a fragment on brown/strong brown chert. It has a well-defined notch (6.5 x 2.2 mm) at the left edge with a break at the distal (32.4 x 21.2 x 2.8 mm) (Fig. 6.17m). The latter is a blade on chert denticulated in the central portion of the left margin and additional marginal inverse retouch along the right edge (38.1 x 17.0 x 4.6 mm)(Fig. 6.18n).

Miscellaneous tools

There is a single piece in this category. It is an atypical piece with continuous retouch (type 105) and is made on a brown/strong brown chert blade. There is marginal retouch along the left edge and damage on the right edge. It is on a relatively large blade compared to others from the site (46.5 x 20.1 x 6.4 mm)(Fig. 6.17o).

6.2.8. Y3-4

There is only a small collection of 118 lithic artefacts from Y3-4. The absolute frequencies of artefacts according to excavation unit, along with the totals and relative frequencies for the group, are given in Table 6.19.

Table 6.19. Grotte des Pigeons (Taforalt), Sector 8, Y3-4: Number of artefacts in each class by deposit

	Blades	Flakes	CTE	MB	TP	KMB	Cores	SP	Tools	Subtotal	Chips	Chunks	Total
Y3		1							9	10		1	11
Y4 sp1	10	18					3		5	36	16	2	54
Y4 sp2	3	4	1				2		4	14	10	3	27
Y4 sp3	4	7					2		0	13	11	3	27
Total	17 23.3%	30 41.1%	1 1.4%				7 9.6%		18 24.7%	73 100.1%	37 (31.4%)	8 (6.8%)	118

Cores

There are seven cores, accounting for a relatively high proportion (9.6%) of the diagnostic artefacts, from Units Y3-4. These are mostly single platform cores (n=5), with the only a single opposed platform core (n=1) and core fragment (n=1). All the cores are on chert. None are burnt, although more than half (n=4) are heavily patinated. Of those where the colour could be clearly established, one is pale brown/yellowish brown, and two are brown/strong brown. Excluding the fragment, the cores all retain pebble/cobble cortex (n=6). Overall, the cores are quite restricted in size, although somewhat larger than those from the overlying deposits, as indicated by the median length, width, and thickness, which are respectively, 30.7 mm (range 26.4-37.1 mm, n=6), 19.5 mm (range 16.1-30.5 mm, n=6), and 15.5 mm (range 12.4-25.5 mm, n=6).

The single platforms cores all have blade removals (Fig. 6.18a-c) and include one that is sub-pyramidal (Fig. 6.18d). None of these have evidence that they have been rotated during reduction or

show characteristics of bipolar reduction. The single platform cores are heavily reduced, with small median values for length, width, and thickness, respectively of, 29.6 mm (range 26.4-37.1 mm, n=5), 17.9 mm (range 16.1-30.5 mm, n=5), and 15.5 mm (range 12.4-20.9 mm, n=5). The opposed platform core has mixed blade and flake removals (Fig. 6.18e). It has a series of stacked hinged/stepped terminating removals initiating from the primary platform, at the opposite end a removal with a hinged termination has been struck, which appears to be a failed attempt at refreshing the core face. It is 34.2 x 29.6 x 25.5 mm. There is also an indeterminate core fragment.

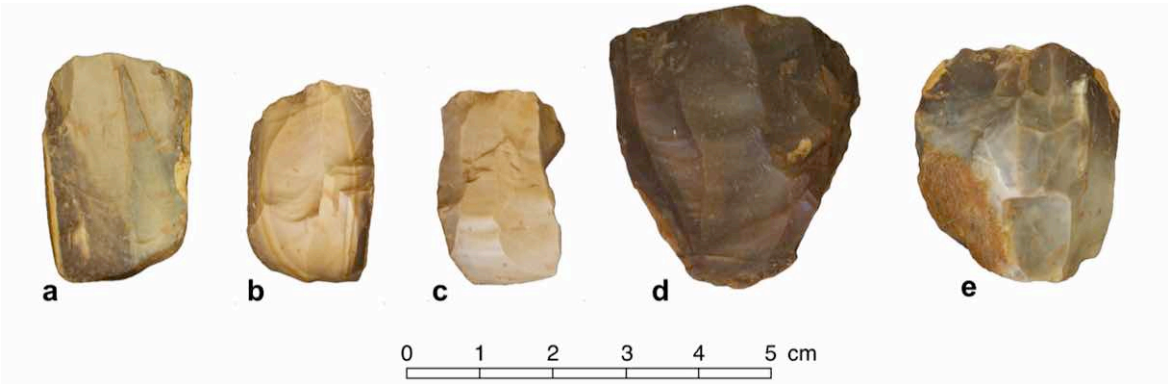


Figure 6.18. Grotte des Pigeons (Taforalt), Sector 8, Y3-4: Cores
a-d) single platform cores; e) opposed platform core

Debitage

Only 30 flakes were recovered from Units Y3-4. These account for 41.1% of the diagnostic artefacts. The flakes are predominantly on chert (83.3%), with a much smaller proportion of limestone (16.7%). Of the complete flakes (≥20mm maximum dimensions)(n=15) most are on chert; grey/light grey (6.7%), greyish brown (6.7%), brown/strong brown (20.0%), heavily patinated (46.7%), and burnt (6.7%). There are a couple on limestone; dark grey (6.7%), and burnt (6.7%). The flakes most often retain cortex, divided between those with less than 25% cortex (26.7%), between 25-50% cortex (20.0%), more than 50% cortex (20.0%), and 100.0% cortex (13.3%). The remaining few have no cortex (20.0%). The striking platforms are mainly plain (60.0%), followed by cortical (20.0%), faceted (13.3%), and crushed (6.7%) varieties. The edge of the platform is rarely abraded (13.3%). Of the flakes with identifiable dorsal scar patterns (n=9), these include equal numbers of unidirectional (n=4) and multidirectional (n=4), and one opposed (n=1), pattern. The flakes are generally small, with

median values of length, width, and thickness, of respectively, 26.5 mm (range 16.7-40.5 mm, n=15), 19.6 mm (range 11.6-33.9 mm, n=15), and 6.1 mm (range 2.1-12.7 mm, n=15).

In total there are 10 blades and 7 blade fragments, which together account for 23.3% of the artefacts (excluding chips and chunks). The blades are made exclusively on chert; black (n=1), brown/strong brown (n=1), heavily patinated (n=7), and burnt (n=1). Most of the blades retain cortex, divided between those with less than 25% (n=4), between 25-50% (n=2), and more than 50% (n=1). There are three with no cortex (n=3). The butts are generally punctiform (n=7), with individual instances of, cortical (n=1), plain (n=1), and crushed (n=1) varieties. There is abrasion at the edge in four cases. Of the identifiable dorsal scars (n=8), there are unidirectional (n=4), opposed (n=1), crossed (n=2), and multidirectional (n=1) patterns. The blades are all small, with median length, width, and thickness values, respectively of 28.6 mm (range 23.1-38.5 mm, n=10), 9.2 mm (range 6.9-16.6 mm, n=10), and 4.1 (range 2.7-5.7 mm, n=10). These are all of bladelet size, none being blades *sensu stricto* (after Tixier, 1963, p. 38).

Of the blade fragments (P:4, M:1, D:2)(n=7) each is on chert; black (n=2), greyish brown (n=1), heavily patinated (n=3), and burnt (n=1). There are two blade fragments retaining cortex. The proximal fragments, include plain (n=1) and punctiform (n=3) examples, of which only one has abrasion. Of the fragments with identifiable dorsal scars these are most often unidirectional (n=5), with a single multidirectional pattern (n=1). The fragments have median width and thickness values, of respectively, 8.4 mm (range 4.7-16.9 mm, n=7) and 3.1 (range 1.5-5.8 mm, n=7).

There is only a single core-trimming element from Units Y3-4, which accounts for 1.4% of the artefacts (excluding chips and chunks). It is a crested blade first removal with one prepared versant. It is 34.7 x 8.6 x 3.9 mm.

Microburins and related products

There are no microburin products from Units Y3-4. In addition, none of the tools retained visible remnants of microburins scars. Thus, the microburin index is zero.

Tools

This is the smallest collection of tools from Sector 8 consisting of only 18 artefacts. In relative terms, the tools account for 24.7% of diagnostic artefacts from Units Y3-4. The majority of tools are microliths (66.7%) or microlith fragments (8.3%), whilst end-scrapers (11.1%), notches and denticulates (11.1%), and miscellaneous tools (11.1%) are found in smaller frequencies (Table 6.20).

Table 6.20. Grotte des Pigeons (Taforalt), Sector 8, Y3-4: Absolute and relative frequencies of tool types

	N	%
End-scrapers	**2**	**11.1**
5. Denticulated end-scraper	1	50.0
112. Fragment of an end-scraper	1	50.0
Microliths	**11**	
45. Pointed straight backed bladelet	4	36.4
a. with pointed end	3	27.3
67. Obtuse ended backed bladelet		
a. natural end	1	9.1
70. Ouchtata bladelet		
b. retouched at proximal	1	9.1
71. Bladelet with Ouchtata retouch	1	9.1
90. Scalene triangle	1	9.1
Microlith fragments	**1**	**5.6**
72. Fragment of a bladelet with Ouchata retouch	1	100.0
Notches and denticulates	**2**	**11.1**
73. Large notched on strangulated piece	1	50.0
76. Notched blade or bladelet	1	50.0
Miscellaneous	**2**	**11.1**
105. Piece with continuous retouch	2	100.0
Total	**18**	

End-scrapers

There are two artefacts in this class. One is an end-scraper on a retouched flake (type 2) made on chert and heavily patinated. It has a well-defined convex scraper at the distal and contiguous notches at the right lateral margin. It is quite large (40.5 x 29.5 x 6.7 mm)(Fig. 6.19a). The other is a fragment of an end-scraper on limestone. It is has a well-formed convex scraper edge at the proximal end. It has a remaining width and thickness, of respectively, 26.0 and 10.9 mm (Fig. 6.19b).

Microliths

There are 11 microliths (Figs 6.19c-l). These include, four pointed straight backed bladelets (type 45), three partially backed bladelets forming a points (type 63a), one obtuse ended backed bladelet (type 67), one Ouchtata bladelet with retouch at proximal (type 70b), bladelet with Ouchtata retouch (type 71), and one scalene triangle (type 95). All of the microliths are made on chert; black (18.2%), dark grey (18.2%), pale brown/yellowish brown (26.7%), brown/strong brown (18.2%), and burnt (9.1%). The microliths all have direct retouch (90.9%), with the exception of one that is mixed direct/crossed (9.1%). There are two with Ouchtata retouch (18.2%).

Of all the microliths a couple have unmodified ends (18.2%), whilst single points are most frequent (63.7%), and there are also a couple with double points (18.2%). Of the single points (n=7) there is one more modified at the distal end (n=4) than at the proximal end (n=3). Of all the microliths the butt is retained in over a third of cases (36.4%). None of the microliths have a basal truncation. One of the partially backed bladelets (type 63) has additional inverse basal retouch. None of the other microliths have retouch. There are no examples with additional tip retouch. None of the microliths have evidence of a microburin facet. As a group, the microliths have median values of length, width, and thickness, of respectively, 24.8 mm (range 14.8-35.6 mm, n=6), 6.7 mm (range 4.8-12.3 mm, n=11), and 3.0 mm (range 1.3-3.6 mm, n=11).

Microlith fragments

There is only a single microlith fragment. It is a proximal fragment on chert. There is no evidence of burning. It has direct marginal retouch at the right lateral edge. The butt is retained. It might be a fragment of an Ouchtata bladelet (type 70). It has a width and thickness, of 4.8 mm and 2.0 mm, respectively.

Notches and denticulates

There are two artefacts in this class; a large notched or strangulated piece (type 73), and a notched fragment (type 76?). These are distinct from each other. The former is on a distal fragment of cortical limestone flake. There is a notch at both the left (18.2 x 1.9 mm) and right (9.7 x 2.1 mm) lateral

margins. It is 62.6 x 44.4 x 17.1 mm (Fig. 6.19m). The latter is a small partial fragment on chert with a direct notch on the right lateral edge.

Miscellaneous tools

This group consists of two atypical pieces with continuous retouch (type 105). Both are partial fragments on chert retouched at the left margin; one grey/light grey, one pale brown/yellowish brown.

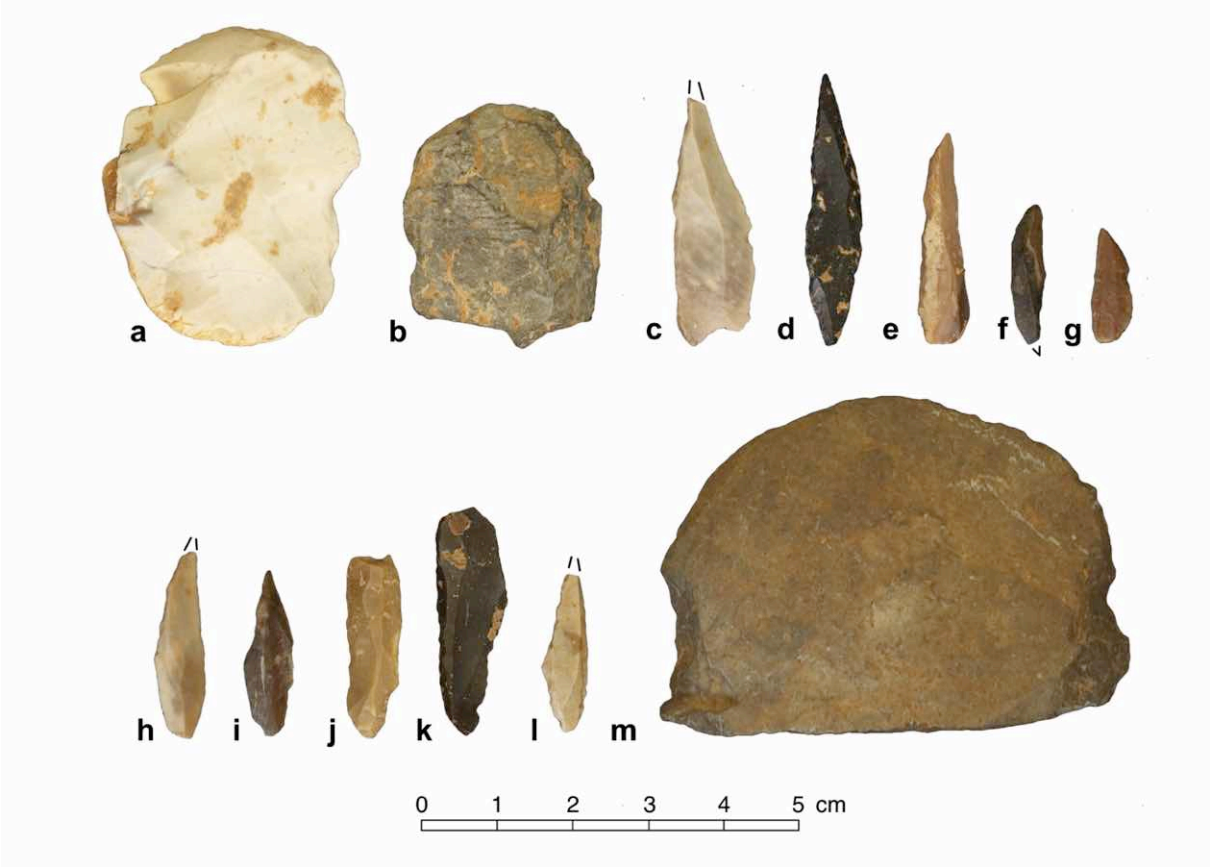


Figure 6.19. Grotte des Pigeons (Taforalt), Sector 8, Y3-4: Retouched tools
a) end-scraper on a retouched flake; b) fragment of an end-scraper; c-f) pointed straight backed bladelets; g-i) partially backed bladelet with pointed end; j) obtuse ended backed bladelet; k) Ouchtata bladelet; l) scalene triangle; m) notched or strangulated piece

6.3. Sector 9

A collection of 1263 lithic artefacts were analysed from Sector 9. The artefacts were excavated from three stratigraphic contexts, with Layers 1-2 providing the earliest dates for the upper LSA at the Grotte des Pigeons (Taforalt). Given the lack of stratigraphic information available, the lithic artefacts from each unit were described separately in case.

6.3.1. Layer 1

There are 434 lithic artefacts from Layer 1. Absolute and relative frequencies according to artefact class are given in Table 6.21. Each of the major artefact classes is represented with the exception of trihedral points and Krukowski microburins.

Table 6.21. Grotte des Pigeons (Taforalt), Sector 9, Layer 1: Absolute and relative frequencies of artefacts

Blades	Flakes	CTE	MB	TP	KMB	Cores	SP	Tools	Subtotal	Chips	Chunks	Total
24 13.0%	126 68.5%	1 0.5%	7 3.8%			1 0.5%	1 0.5%	24 13.0%	184 99.8%	247 (56.9%)	3 (0.7%)	434

Cores

There is only one core, accounting for 0.5% of the diagnostic artefacts, from Layer 1. It is an opposed platform blade core. It is on a split pebble of brown chert. There is splintering at both ends; indicating that the core has been reduced on an anvil. It is exhausted and small measuring only 23.8 x 10.9 x 12.3 mm.

In addition to the core, there is a single splintered piece. It is on a pale brown chert. There is bipolar splintering at each edge and the negatives of number of small flake removals. It is not very different from the few pieces classified as core-on-flakes recovered from elsewhere at the site. It measures 22.3 x 18.9 x 5.8 mm.

Debitage

In total 126 flakes were recovered from Layer 1. These account for 68.5% of the diagnostic artefacts. The flakes from Layer 1 are overwhelmingly on chert (98.4%), with there being only two on limestone. The complete flakes (≥20mm maximum dimensions)(n=21) are all on chert; black (4.8%), pale brown/yellowish brown (14.3%), brown/strong brown (47.6%), heavily patinated (4.8%), and burnt (19.1%). These flakes tend to retain cortex, divided between those with less than 25% cortex (38.1%), between 25-50% cortex (9.5%), more than 50% cortex (9.5%), and 100% cortex (9.5%). A third of the flakes have no cortex (33.3%). The butts include, plain (28.6%), dihedral (23.8%), crushed (19.1%), cortical (14.3%), punctiform (9.5%), and faceted (4.8%) varieties, in depreciating frequencies. There is abrasion at the platform edge in a limit number of cases (9.5%). Of the

identifiable dorsal scars (n=12) most are unidirectional (66.7%), with only a couple counts of opposed (16.7%), and single counts of crossed (8.3%) and multidirectional (8.3%) patterns. The flakes are generally short, squat, and thick, with median length, width, and thickness values of, 21.1 mm (range 14.2-33.3, n=21), 18.9 mm (range 10.0-39.6 mm, n=21), and 4.1 mm (range 2.1-11.2 mm, n=21).

In total there are 16 blades and 8 blade fragments, which together account for 13.0% of the diagnostic artefacts. The blades are all on chert; black (6.3%), greyish brown (6.3%), pale brown/yellowish brown (25.0%), brown/strong brown (43.8%), heavily patinated (6.3%), and burnt (12.5%). The majority of blades have no cortex (87.5%), with only single count with less than 25% (6.3%) and single count with between 25-50% (6.3%). The butts are predominantly punctiform (56.3%), followed by crushed (31.3%) and plain (6.3%), there is only a single cortical example (6.3%). The abrasion at the platform edge is common (50.0%). Of the identifiable dorsal scars (n=13) the most common are unidirectional (69.2%), followed by opposed (15.4%), crossed (7.7%), and multidirectional (7.7%) patterns. The blades are generally small in size, with median length, width, and thickness, of respectively, 22.1 mm (range 13.2-36.7 mm, n=16), 7.3 mm (range 4.6 – 12.2 mm, n=16), and 2.2 mm (range 1.4 – 4.1 mm, n=16). The complete pieces are all of bladelet size, none being blades *sensu stricto* (after Tixier, 1963, p. 38).

Of the blade fragments (P:2; M:4; D:2)(n=8) all are on chert; black (n=1), pale brown/yellowish brown (n=2), brown/strong brown (n=1), heavily patinated (n=1), and burnt (n=3). There are few blade fragments that retain some cortex (n=3). The proximal ends (n=2) both have plain butts with signs of abrasion at the edge. Of the fragments with identifiable dorsal scars (n=5) they are predominately unidirectional (n=4), with only a one with opposed (n=1) patterns. The fragments have a median width and thickness values, of respectively, 8.7 mm (range 6.5 – 12.7 mm, n=8) and 2.7 mm (range 1.4 – 4.2 mm, n=8).

There is a single core-trimming element from Layer 1. It accounts for only 0.5% of the diagnostic artefacts. It is a crested blade with a single prepared versant made on black chert. The distal

termination is hinged; presumably the removal to propagate along the length of the core. It is complete, with a length of 25.6 mm, width of 8.4 mm, and thickness of 4.6 mm.

Microburins and related products

There are seven microburin products, accounting for 3.8% of the diagnostic artefacts, from Layer 1. Each is a true microburin; there are no Krukowski microburins or trihedral points. The microburins most often remove the proximal end of the bladelet (71.4%), with much lower frequencies removing the distal end (28.6%). Notching is always direct, quite regular and not very deep. The notch is most often at right edge (71.4%) and only at the right edge in two cases (28.6%). The distal microburins are exclusively notched at the left edge, and, in contrast, the proximal microburins are entirely notched at the right edge. The median length, width, and thickness values, are respectively, 9.9 mm (range 5.5-12.9 mm, n=7), 6.4 mm (range 4.3-9.4 mm, n=7), and 2.1 mm (range 1.2-3.4 mm, n=7). The microburin index is 25.0. None of the backed bladelets retain visible remnants of microburins scars.

Retouched tools

In total there are 24 retouched tools from this context. They account for 13.0% of the diagnostic artefacts. The microliths (20.8%) and microlith fragments (66.7%) are overwhelming the most common tool class in the sample, whilst notches and denticulates (4.2%) and miscellaneous tools (8.3%) account for much smaller frequencies (Table 6.22).

Table 6.22. Grotte des Pigeons (Taforalt), Sector 9, Layer 1: Absolute and relative frequencies of tool types

	N	%
Microliths	**5**	**20.8**
45. Pointed straight backed bladelet	1	20.0
63. Partially backed bladelet		
b. retouched ends	1	20.0
64. Shouldered bladelet	1	20.0
68. Scalene bladelet	1	20.0
70. Ouchtata bladelet		
a. retouched along entire edge	1	20.0
Microlith fragments	**16**	**66.7**
66. Fragment of a backed bladelet	13	81.3
72. Fragment of a bladelet with Ouchata retouch	3	18.8
Notches and denticulates	**1**	**4.2**
76. Notched blade or bladelet	1	100.0
Miscellaneous	**2**	**8.3**
105. Piece with continuous retouch	2	100.0
Total	**24**	

Microliths

There are five microliths . These include, one pointed straight backed bladelet (type 45), one partially backed bladelet (type 63), one shouldered bladelet (type 64), one scalene bladelet (type 68), and one Ouchtata bladelet (type 70)(Figs 6.20a-d). All are made on chert. One of the microliths is broken. There are three counts of retouch at the left lateral edge and two at the right lateral edge. In each case the retouch is direct, typically semi-abrupt, but in one case marginal Ouchtata retouch was used. There is one microlith with an unmodified end, and four single points. Of the single points most are at the distal end (n=3) and one is at the proximal end (n=1). Of all the microliths the butt is retained in just over half of cases (n=3). None of the microliths have basal truncations. None of the microliths retain microburin scars. As a class, these tools have median values of length, width, and thickness, respectively of, 28.6 mm (range 17.2-39.5 mm, n=4), 7.3 mm (range 5.3-12.7 mm, n=5), and 2.2 mm (range 1.4-4.4 mm, n=5).

Microlith fragments

There are 16 microlith fragments. These include, two distal (12.5%), seven mesial (43.8%), three proximal (18.8%), and four indeterminate ends (25.0%). All of these are made on chert. There is a

preference for retouching the right lateral edge (43.8%), over the left lateral edge (18.8%), and a high proportion of pieces could not be orientated (37.5%). Retouch is almost exclusively direct (93.8%), with only a single inverse example (6.3%). The backing is typically semi-abrupt, although marginal Ouchtata retouch is relatively common (18.8%). The microlith fragments have median values for width and thickness, of respectively, 6.6 mm (range 3.7-10.0, n=15) and 2.7 mm (range 1.7-4.6 mm, n=16).

Notches and denticulates

This class consists of a single notched bladelet (type 76) fragment. It is on dark grey chert. It is a proximal fragment with a direct single unretouched notch (3.3 x 1.2 mm) at the proximal portion of the right lateral edge It is retains a width of 7.4 mm and thickness of 3.6 mm (Fig. 6.20e).

Miscellaneous

The group includes two rather uncharacteristic pieces with continuous retouch (type 105). The first is a chert flake with direct Ouchtata retouch along the distal end. It measures 23.6 x 18.2 x 4.0 mm (Fig. 6.20f). The second is a crested blade on chert, with direct Ouchtata retouch along the entirety of the right edge. It is 35.0 x 11.3 x 3.3 mm (Fig. 6.20g).

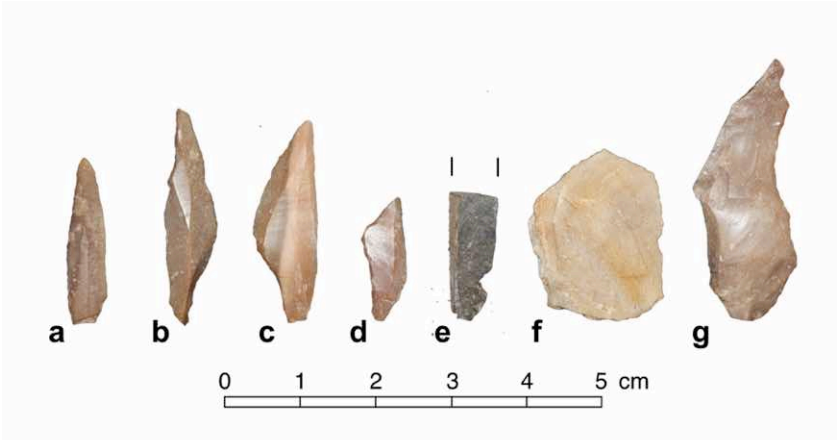


Figure 6.20. Grotte des Pigeons (Taforalt), Sector 9, Layer 1: Retouched tools
a) pointed straight bladelet bladelet; b) partially backed bladelet with pointed end; c) shouldered bladelet; d) scalene bladelet; e) notched bladelet; f-g) piece with continuous retouch

6.3.2. Layer 2

There are 275 lithic artefacts from Layer 2. Absolute and relative frequencies according to artefact class are given in Table 6.23. The assemblage consists of blades, flakes, a core, and a number of tools. There are no core-trimming elements, microburin products, or splintered pieces.

Table 6.23. Grotte des Pigeons (Taforalt), Sector 9, Layer 2: Absolute and relative frequencies of artefacts

Blades	Flakes	CTE	MB	TP	KMB	Cores	SP	Tools	Subtotal	Chips	Chunks	Total
41 29.7%	83 60.1%					1 0.7%		13 9.4%	138 99.9%	131 (47.6%)	6 (2.2%)	275

Cores

There is a single core, accounting for 0.7% of the diagnostic artefacts, from Layer 2. It is an opposed platform flake core on a splint brown chert pebble. The main platform has a few preparatory removals and the scar of an elongated flake that terminates in a hinge fracture; this appears to be a failed attempt producing a small blade. The opposite platform is faceted, but has not been utilised for the production of blanks. The core appears to be exhausted. It measures 25.1 x 22.1 x 13.2 mm.

Debitage

In total 83 flakes were recovered, accounting for 60.1% of the diagnostic artefacts, from Layer 2. The majority are on chert (90.4%) with many fewer on limestone (9.6%). Of the complete flakes (≥20mm maximum dimension)(n=17) most on chert; greyish brown (5.9%), pale brown/yellowish brown (35.3%), brown/strong brown (29.4%), heavily patinated (5.9%), and burnt (5.9%). There are also three on limestone; dark grey (5.9%), and burnt (11.8%). These flakes tend to retain the cortex, divided between those with less than 25% cortex (17.7%), between 25-50% cortex (17.7%), more than 50% cortex (11.7%), and 100% cortex (23.5%). Just less than a third of the flakes have no cortex (29.4%). The butts include, cortical (35.3%), plain (23.5%), punctiform (17.7%), dihedral (11.8%), and crushed (5.9%) varieties, in depreciating frequencies. There is abrasion at the platform edge in a limit number of cases (11.8%). Of the identifiable dorsal scars (n=11) most are unidirectional (45.5%), followed by crossed (27.3%), multidirectional (18.2%), and opposed (9.1%) patterns. The flakes are generally short, squat, and thick, with median length, width, and thickness values, of respectively, 22.7

mm (range 17.8-50.8, n=17), 17.0 mm (range 12.3-34.9 mm, n=17), and 5.7 mm (range 2.1-14.1 mm, n=17).

It total, 3 blades and 38 blade fragments were recovered, which together account for 29.7% of the diagnostic debitage, from Layer 2. The blades are each on chert; greyish brown (n=1), pale brown/yellowish brown (n=1), and brown/strong brown (n=1). Of these three blades, there is one with no cortex, one with less than 25% cortex, and one with between 25-50% cortex. In respects of the butt and dorsal scars each is similar, with a punctiform striking platforms with an abraded edge and unidirectional dorsal scar patterns. They are also similar in size, with median dimensions, of respectively, 28.1 mm (range 27.7-33.9 mm, n=3), 6.3 mm (range 6.1-7.9 mm, n=3), and 2.7 mm (range 2.3-3.9 mm, n=3). Each of these is bladelet size, none being blades *sensu stricto* (after Tixier, 1963, p. 38).

The blade fragments (P:16; M:13; D:9) (n=38) are all on chert; black (2.6%), greyish brown (10.5%), pale brown/yellowish brown (39.5%), brown/strong brown (18.4%), white (2.6%), and burnt (26.3%). There are only a couple that retain cortex (5.3%). The majority of proximal ends (n=16) are punctiform (68.8%), with many fewer crushed (18.8%) and plain (12.5%) examples. Abrasion of the platform edge is typical (68.8%). Of the fragments with identifiable dorsal scars (n=26) the most are unidirectional (80.8%), with only a few counts of opposed (11.5%), and single counts of crossed (3.8%) and multidirectional (3.8%) patterns. The fragments have a median width and thickness values, of respectively, 8.3 mm (range 5.6 – 13.0 mm, n=38) and 2.6 mm (range 1.2 – 4.6 mm, n=38).

Tools

In total 13 retouch tools were recovered, accounting for 9.4% of the diagnostic artefacts, from Layer 2. The microliths (38.5%) and microlithic fragments (46.2%) dominate, with only two other artefacts, both truncations (15.4%)(Table 6.24).

Table 6.24. Grotte des Pigeons (Taforalt), Sector 9, Layer 2: Absolute and relative frequencies of tool types

	N	%
Microliths	**5**	**38.5**
68. Scalene bladelet	(1)	(20.0)
70. Ouchtata bladelet		
a. retouched along entire edge	(3)	(60.0)
b. retouched at proximal	(1)	(20.0)
Microlith fragments	**6**	**46.2**
66. Fragment of a backed bladelet	(3)	(50.0)
72. Fragment of a bladelet with Ouchata retouch	(3)	(50.0)
Truncations	**2**	**15.4**
80. Truncated piece	(2)	(100.0)
Total	**13**	

Microliths

There are five microliths (Fig. 6.21a-d). These include, one scalene (type 68) and four Ouchtata bladelets (type 70). All of these are made on chert. One is retouched on the left lateral edge and four on the right lateral edge (including one with partial retouch restricted to the proximal portion of the margin). All have direct retouch; one semi-abrupt and four Ouchtata. The scalene has a flat oblique truncation at the distal end. The other microliths have unmodified distals. None of the microliths retain microburin scars. As a class, these tools have median values of length, width, and thickness, of respectively, 26.6 mm (range 22.1-29.3 mm, n=4), 7.6 mm (range 6.6-11.7 mm, n=5), and 2.7 mm (range 2.1-4.5 mm, n=5).

Microlith fragments

There are six microlith fragments from Layer 2 (Fig. 6.21e-f). These include, two distal, two mesial, and two proximal fragments. All of these are made on chert. Each is retouched at the right lateral edge, including one with retouch restricted to the proximal aspect of the margin. All have direct retouch, three semi-abrupt and three Ouchtata. The distal fragments both have unmodified ends. The proximal fragments both retain the butt. The median width and thickness values, are respectively, 8.6 mm (range 6.1-9.2 mm, n=6) and 2.7 mm (range 0.8-3.0 mm, n=6).

Truncations

Two truncated pieces (type 80) were recovered from this context. Each is a bladelet fragment on chert with a direct straight truncation at the distal end. The widths are 7.8 and 10.6 mm, and thicknesses, 2.2 and 2.3 mm (Fig. 6.21g)

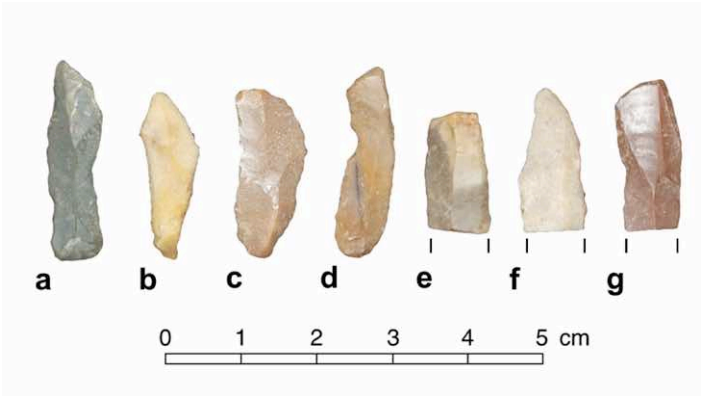


Figure 6.21. Grotte des Pigeons (Taforalt), Sector 9, Layer 2: Retouched tools
a) scalene bladelet; b-d) Ouchtata bladelets; e-f) fragments of bladelets with Ouchtata retouch; g) truncation

6.3.3. Layer 3

There are 554 lithic artefacts from Layer 3. Absolute and relative frequencies according to artefact class are given in Table 6.25. The assemblage consists of blades, flakes, core-trimming elements, and a number of tools. There are no microburin products, cores, or splintered pieces.

Table 6.25. Grotte des Pigeons (Taforalt), Sector 9, Layer 3:
Absolute and relative frequencies of artefacts

Blades	Flakes	CTE	MB	TP	KMB	Cores	SP	Tools	Subtotal	Chips	Chunks	Total
56 24.4%	132 57.4%	3 1.3%						39 17.0%	230 100.1%	321 (57.9%)	3 (0.5%)	554

Debitage

In total 132 flakes were recovered, accounting for 57.4% of diagnostic artefacts, from Layer 3. The flakes are overwhelming on chert (98.5%), only a single flake is on limestone (0.8%), and one is on basalt (0.8%). The basalt artefact is a small flake (<20mm maximum dimension). This raw material is found in small frequencies in the lowermost LSA contexts in Sector 3 (see above), but is common in the pre-LSA deposits, where it is associated with bifacial technology. It is almost certain that the small basalt flake is residual. Of the whole flakes (≥20 mm)(n=24) most are on chert; pale brown/yellowish brown (50.0%), brown/strong brown (25.0%), white (4.2%), and burnt (16.7%). There is also one

burnt flake on limestone (4.2%). The majority of these flakes retain cortex, divided between those with less than 25% cortex (25.0%), between 25-50% cortex (12.5%), more than 50% cortex (4.2%), and 100% cortex (16.7%). Over a third of the flakes have no cortex (41.7%). The butts are mostly plain (41.7%) or punctiform (20.8%), with fewer crushed (16.7%) and cortical (12.5%) forms, and only singles counts of dihedral (4.2%) and faceted (4.2%), varieties. Abrasion at the platform edge is found in a small number of cases (12.5%). Of the identifiable dorsal scars (n=20) most are unidirectional (65.0%), followed by opposed (25.0%). There are only a couple with multidirectional (10.0%), but none with crossed, patterns. The flakes are generally short, squat, and thick, with median length, width, and thickness values of, 20.7 mm (range 14.1-44.0 mm, n=24), 18.5 mm (range 7.1-29.6 mm, n=24), and 4.0 mm (range 1.8-9.8 mm, n=24).

There are 13 blades and 43 blade fragments, accounting for 24.4% of diagnostic artefacts, from Layer 3. The blades are all on chert; pale brown/yellowish brown (69.2%), brown/strong brown (23.1%), and burnt (7.7%). None of the blades retain cortex. All butts are punctiform with an abraded platform edge, with the exception of one piece that is not abraded. Of the blades with identifiable dorsal scars (n=11), most are unidirectional (72.7%), a couple are opposed (18.2%), and one is crossed (9.1%). The blades are generally small, with median length, width, and thickness, of respectively, 18.4 mm (range 16.0-37.4 mm, n=13), 7.0 mm (range 5.1-11.7 mm, n=13), and 2.0 mm (range 1.2-2.7 mm, n=13). Each is bladelet size, none being blades *sensu stricto* (after Tixier, 1963, p. 38).

All of the blade fragments (P:19; M:16; D:8)(n=43) are on chert; pale brown/yellowish brown (46.5%), brown/strong brown (30.2%), white (2.3%), heavily patinated (2.3%), and burnt (18.6%). There couple retaining cortex (7.0%). The proximal ends (n=19) are most often punctiform (83.5%), few much smaller frequencies of plain (16.7%), and only one crushed (5.3%) variety. The abrasion of the platform edge is typical (63.2%). Of the fragments with identifiable dorsal scars (n=32), the vast majority are unidirectional (87.5%), with only a couple of opposed (6.3%), and single counts of crossed (3.1%) and multidirectional (3.1%) patterns. The fragments have a median width and thickness values, of respectively, 8.7 mm (range 5.4 – 12.6 mm, n=43) and thickness of 2.2 mm (range 1.1 – 3.7 mm, n=43).

There are three core-trimming elements, which account for 1.3% of the diagnostic artefacts, from Layer 3. Each is a crested blade on chert. There is a broken piece with a single prepared versant, nonetheless much of the original length of the piece is retained, and it measures 42.0 x 9.0 x 5.5 mm.. Each of the other crested blades is complete and has a single versant. They are broadly of similar size measuring 26.0 x 10.1 x 3.5 mm and 30.6 x 7.6 x 2.6 mm.

Tools

There are 39 tools from this context. They account for 17.0% of the diagnostic artefacts. The microliths (12.8%) and microliths fragments (76.9%) are the most common tools, with fewer counts of notches and denticulates (1.7%) and miscellaneous tools (7.7%)(Table 6.26).

Table 6.26. Grotte des Pigeons (Taforalt), Sector 9, Layer 3: Absolute and relative frequencies of tool types

	N	%
Microliths	**5**	**12.8**
45. Pointed straight backed bladelet	1	20.0
46. Pointed straight backed bladelet with rounded base	1	20.0
63. Partially backed bladelet		
b. retouched ends	1	20.0
67. Obtuse ended backed bladelet		
a. natural end	2	40.0
Microlith fragments	**30**	**76.9**
66. Fragment of a backed bladelet	9	30.0
72. Fragment of a bladelet with Ouchata retouch	21	70.0
Notches and denticulates	**1**	**1.7**
76. Notched blade or bladelet	1	100.0
Miscellaneous	**3**	**7.7**
112. Utilised Piece	3	100.0
Total	**39**	

Microliths

Five microliths were recovered from Layer 3 (Fig. 6.22a-e). These include, two pointed straight backed bladelets *sensu lato* (types 45 & 46), one partially backed bladelet (type 63), and two obtuse ended backed bladelets (type 70). All of the microliths are made on chert. Three of the microliths are broken. They include five retouched at the right lateral side and one retouched at the left lateral side (with retouch restricted to the distal portion of the margin). In each case the retouch is direct. None of

the pieces have marginal Ouchtata retouch. One has an additional rounded basal truncation. None of the microliths retain microburin scars. The median values of length, width, and thickness, are 27.0 mm (range 25.6-31.8 mm, n=2), 9.2 mm (range 8.2-10.3 mm, n=5), and 2.7 mm (range 2.2-4.3 mm, n=5).

Microlith fragments

There are 30 microlith fragments; five distal (16.7%), 12 mesial (40.0%), 12 proximal (40.0%), and one partial (0.3%). All of these are made on chert. There is a preference for retouch at the right lateral edge (83.3%) over left lateral edge (16.7%). In each case the retouch is direct. The majority of pieces have marginal Ouchtata retouch (n=21, 70.0%). The butt is retained on a high proportion of the microlith fragments (36.7%). The distal end fragments are unmodified, with the exception of one piece with an acute truncation. The median values for width and thickness, are respectively, 7.8 mm (range 5.5-10.1, n=29) and 2.4 mm (range 1.5-4.2 mm, n=30).

Notches and denticulates

There is a single mesial fragment of a notched bladelet (type 76) belonging to this class. It is on chert. The notch is at the right lateral margin and is formed by direct retouch. The piece has a width of 9.2 mm and thickness of 2.5 mm.

Miscellaneous

There are three artefacts in this class. One is a bladelet, with light direct retouch at the proximal proportion of the left lateral edge, which does not appear to be intentional. It is complete measuring 33.3 x 7.3 x 2.7 mm (Fig. 6.22g). It is tempting to speculate that this piece was used in a similar fashion to the Ouchtata bladelets (type 70), as these often have retouch restricted to the proximal proportion of one lateral edge, with damage possibly occurring during similar hafting procedures. In addition, there are two fragments with irregular shallow inverse retouch, most likely resulting from use, at the left margin.

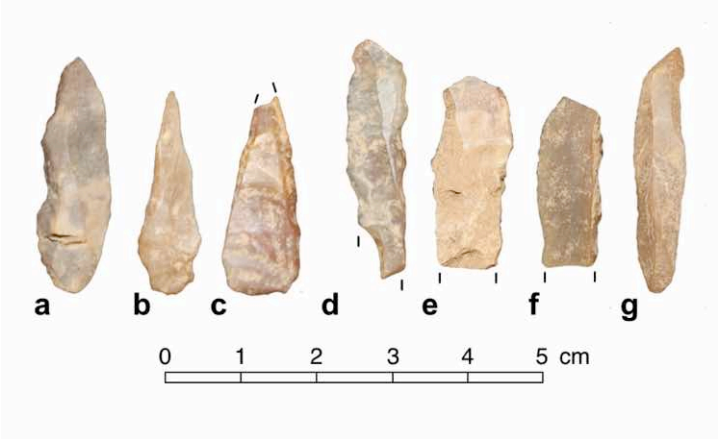


Figure 6.22. Grotte des Pigeons (Taforalt), Sector 9, Layer 3: Retouched tools
a) pointed straight bladelet bladelet; b) pointed straight bladelet bladelet with rounded base; c) partially backed bladelet; d-e) obtuse ended backed bladelets; f) fragment of a bladelet with Ouchtata retouch; g) utilised piece

6.4. Sector 10

There are 2526 lithic artefacts from Sector 10. The absolute and relative frequencies of artefacts according to class are given in Table 6.27. The assemblages recovered from each season are grouped for description as no clear stratigraphic divisions were recognised and it was unclear if any of the lithic artefacts remained *in situ* within area.

Table 6.27. Grotte des Pigeons (Taforalt), Sector 10:
Number of artefacts in each class by excavation season

	Blades	Flakes	CTE	MB	TP	KMB	Cores	SP	Tools	Subtotal	Chips	Chunks	Total
2005	108	330	18	11			25	8	78	578	300	104	982
2006	44	128	8	4			5	3	32	224	159	55	438
2008	50	158	11	5			16	5	44	289	115	49	453
2009	23	63	4	-			6	1	20	117	54	18	189
2010	70	165	9	5			22	3	41	315	85	64	464
Total	295 19.4%	844 55.4%	50 3.3%	25 1.6%			74 4.9%	20 1.3%	215 14.1%	1523 100.0%	713 (28.2%)	290 (11.5%)	2526

Cores

Sector 10 includes 74 cores, which account for 4.9% of the diagnostic artefacts. These are most often single platform cores (29.7%), followed closely by opposed platform cores (25.7%), then in much smaller frequencies, core-on-flakes (10.8%), multiple platform (8.1%), 90º degree (2.7%), discoidal (1.4%), and tested/prepared (1.4%) cores. There is also a strong proportion of core fragments (20.3%). These are most often on chert; black (2.7%), grey/light grey (8.1%), pale brown/yellowish brown

(5.4%), greyish brown (5.4%), brown/strong brown (14.9%), white (1.4%), and burnt (59.5%). There are only two cores on other raw materials; one on limestone (1.4%), and other on dark grey and olive banded mudstone (1.4%). Overall, the cores are generally quite restricted in size, with median dimensions of length, width, and thickness, of respectively, 33.1 mm (range 19.6-69.3 mm, n=59), 22.5 mm (range 15.2-68.8 mm, n=59), 15.9 mm (range 8.4-58.0 mm, n=59).

The single platform cores (n=22) most often have flake removals (45.5%), with blade removals only slightly less important (36.3%), and mixed removals making up the remainder (18.2%)(Figs 6.23a-f). The flaking surface tends to have unidirectional scars in accordance with the platform (86.3%). However, in one case (4.6%) there are negatives of previous removals opposite to the retained platform, and in a couple (9.1%) of cases there are negatives of previous removals orthogonal to the retained platform. The latter scar patterns indicate that at some point during the sequence these cores were rotated or attempts were made to from alternative directions to regulate the core. The single platform cores include one on mudstone that is relatively large, the widest, thickest, and one of the longest, cores (46.1 x 47.9 x 27.8 mm)(Fig.6.23e). There is also an usual core on light grey/grey chert with an inclusion of 'chalcedony', which is also quite large (46.8 x 30.6 x 20.3 mm)(Fig. 6.23f). Overall, the single platform cores have median length, width, and thickness, of respectively, 32.1 mm (range 19.6-46.8 mm), 22.4 mm (16.6-47.9 mm), and 15.2 mm (range 9.8-27.8 mm).

The opposed platform cores (n=19) most often have flake removals (42.1%), with blade removals only slightly less important (31.6%), and mixed removals making up the remainder (26.3%)(Figs 6.23g-j). These tend to be single face cores (n=17) most often with only a minimal amount of exploitation of the second platform although more intensively work examples are present. There are two cores where adjacent faces are worked from opposite directions. The opposed platform cores have length, width, and thickness values, of respectively, 33.5 mm (range 25.6-41.6 mm, n=19), 20.3 mm (range 16.0-30.0 mm, n=19), and 15.9 mm (range 9.0-24.8 mm, n=19).



Figure 6.23. Grotte des Pigeons (Taforalt), Sector 10: Cores a-f) single platform cores; g-j) opposed platform cores; k-m) multiple platform cores; n) discoidal core; o) core-on-flake

The 90º degree platform cores (n=2), include a flake and mixed example. Each has platforms exploiting a single face. The former is irregular and has a series of stepped terminating removals on the flaking surface, which appear to be an attempt to remove inclusions within the material. Each appears to be exhausted. The median values for length, width, and thickness, are respectively, 32.8 mm (range 28.4 -37.3 mm, n=2), 25.1 mm (range 20.5-29.6 mm, n=2), and 23.0 mm (range 18.7-27.3 mm, n=2).

The multiple platform cores (n=6) each have flake removals. Each is lacking clear patterning, one with two faces exploited via three platforms, and five globular. The former is on a distinctive tabular black chert (Fig. 6.23k), which is rare throughout the site. Of the globular examples, most all on common cherts (Fig. 6.23l), and another is on limestone that is unusually large (69.3 x 68.8 x 58.0 mm)(Fig. 6.23m). The median values for length, width, and thickness, are respectively, 40.7 mm (range 35.6 -69.3 mm, n=6), 32.0 mm (range 22.1-68.8 mm, n=6), and 22.9 mm (range 11.0-58.0 mm, n=6). The discoidal core (n=1) is a flake core (Fig. 6.23n). It is not very regular, there is a series of smaller removals around the perimeter. It is 24.3 x 29.1 x 13.2 mm.

The core-on-flakes (n=8) include, one with burin-like removals (Fig. 6.23o), and the another seven have flake removals (Figures 6.23p) It appears that larger, especially thicker, flakes were selected for exploitation, with the removals often struck from the butt or off a stepped termination. The core-on-flakes have median values of length, width, and thickness, of respectively, 28.9 mm (range 22.7-43.1 mm, n=8), 21.7 mm (range 15.2-31.5 mm, n=8), and 10.7 mm (range 8.4-18.4 mm, n=8).

There is a single tested/prepared core. It is on an elongated cobble that has been prepared in a simple manner. First, the cobble was split to create a plain striking platform, then a single flake struck down the front of the cobble to create an arris, the arris was then used to shape the core by means of a crest with a single prepared versant, although the crest was not detached. The tested/prepared core measures 43.2 x 33.8 x 23.1 mm.

In addition to the cores, there are 20 splintered pieces, which account for 1.3% of the diagnostic artefacts, from sector 10. These are all on chert; black (5.0%), grey/light grey (5.0%), pale

brown/yellowish brown (10.0%), brown/strong brown (20.0%), white (5.0%), and burnt (55.0%). Most of the pieces retain some cortex (75.0%). These are united in having bifacial splintering characteristic of the use of the anvil technique, but nonetheless these are quite heterogenous as a group. There are 15 that do not have removals that seem of sufficient size to be utilised although might be failed attempts to produce suitable blanks or occurred during the initial phases of the reduction sequence with splitting the pebble/cobble (Figs. 6.24a-c). There are only three that appear to have blanks of useable size (Figs. 6.24d). In addition, two examples are wedge shaped and quite typical of *pieces esquillées* (type 104), as defined by Tixier (1963, pp.146-9)(Fig. 6.24e). The median values of length, width, and thickness, are respectively, 30.2 mm (range 18.8-40.9 mm, n=20), 23.7 mm (range 12.6-31.6 mm, n=20), and 8.6 mm (range 4.6-15.8 mm, n=20).

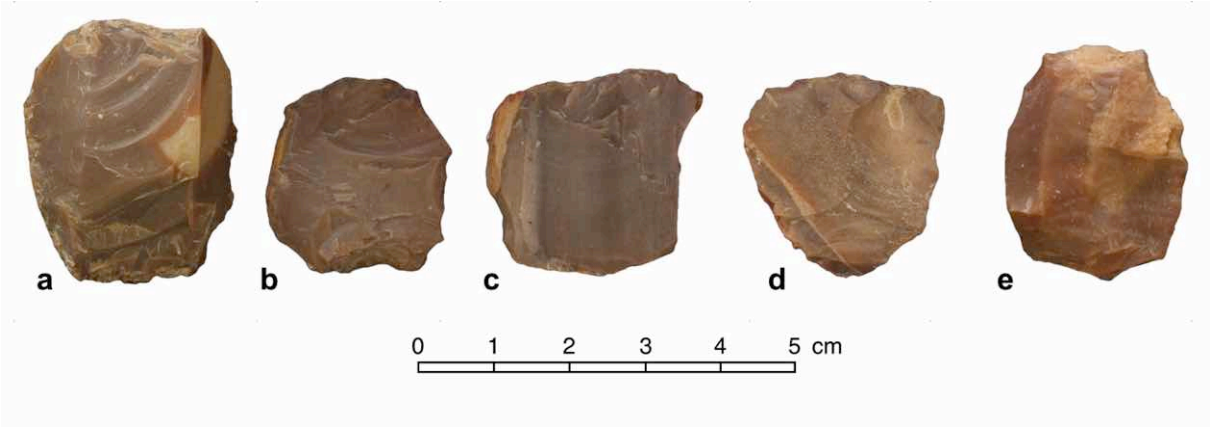


Figure 6.24. Grotte des Pigeons (Taforalt), Sector 10: Splintered pieces

Debitage

There are 844 flakes, accounting for 55.4% of the diagnostic artefacts, from sector 10. The vast majority of these are on chert (93.0%), with the remainder on limestone (7.0%). Of the complete flakes (≥20mm maximum dimension)(n=398) the vast majority are on chert; black (0.3%), dark grey (1.8%), grey/light grey (2.0%), greyish brown (5.0%), pale brown/yellowish brown (4.8%), brown/strong brown (9.5%), red/reddish brown (1.3%), dusky red/weak red (0.3%), white (3.5%), heavily patinated (3.5%), and burnt (59.0%). There are much smaller frequencies on limestone; grey/light grey (0.8%), dark grey (1.3%), and burnt (6.8%). In addition, there is one on distinctive opaque milky white quartz (0.3%).

The vast majority of these flakes retain cortex, divided between those with less than 25% (30.4%), between 25-50% (15.1%), above 50% (15.1%), and 100% cortex (11.1%). There is a little less than a third (29.4%) with no cortex. The butts tend to be plain (44.7%), cortical (23.1%) are well represented, and there are fewer punctiform (7.5%), dihedral (5.5%), and faceted (6.8%) butts; the remaining butts are crushed (12.3%). The proportion of flakes with abrasion at edge of the striking platform is relatively low (7.0%). Of the identifiable dorsal scars (n=251) these are most often unidirectional (44.2%), with strong proportions of multidirectional (35.5%) patterns, and fewer opposed (9.6%) and crossed (10.6%) examples. The flakes are somewhat greater in size than those from the other sectors, but are nonetheless, in absolute terms, generally, short, squat, and thick. The median length, width, and thickness values, are respectively, 26.3 mm (range 11.6-74.4 mm, n=398), 20.7 mm (range 10.1-78.4 mm, n=398), and 6.0 mm (range 1.3-27.8 mm, n=398). There are only 12 flakes greater than 50 mm in length; only a couple on chert (n=2), one on milky quartz (n=1), and most often limestone (n=9).

There are 158 blades and 137 blade fragments were recovered, accounting 19.4% the diagnostic artefacts, from Sector 10. The blades are exclusively on chert; black (1.3%), grey/light grey (1.3%), greyish brown (4.4%), pale brown/yellowish brown (10.1%), brown/strong brown (16.5%), red/reddish brown (0.6%), white (4.4%), heavily patinated (3.8%), and burnt (57.6%). The majority of blades have no cortex (50.6%); there is a strong proportion with less than 25% cortex (30.4%), and many fewer with between 25-50% cortex (9.5%), above 50% cortex (7.6%), and 100% cortex (1.9%). The butts tend to be plain (38.6%) or punctiform (32.3%), with much smaller frequencies of cortical (4.4%), dihedral (4.4%), and faceted (2.5%). In addition, there are a high proportion of indeterminate butts that are crushed (17.7%). The abrasion of the striking platform edge is quite common (34.2%). Of the identifiable dorsal scars (n=135) these are most often unidirectional (65.2%), with similar proportions of opposed (14.8%) and multidirectional (17.0%), and few crossed (2.2%) patterns. The blades are generally small in size, with median length, width, and thickness values, of respectively, 33.0 mm (range 17.0-62.6 mm, n=158), 12.2 mm (range 5.0-25.9 mm, n=158), and 4.2 mm (range 1.3-11.4 mm). Of these, most are bladelet size, with only five being blades *sensu stricto* (after Tixier,

1963, p. 38). However, the distinction is somewhat arbitrary. There are four blades *sensu stricto* that have reasonably short lengths (range 50.0-51.4 mm), although these are quite wide (range 17.5-25.5 mm). A single blade *sensu stricto* appears most distinct in size (62.6 x 25.9 x 8.9 mm).

Of the blade fragments (P:58, M:38, D:41)(n=137) all are on chert; grey/light grey (1.5%), greyish brown (2.9%), pale brown/yellowish brown (5.8%), brown/strong brown (8.8%), red/reddish brown (2.9%), white (3.6%), heavily patinated (0.7%), and burnt (73.7%). There is over a third (37.2%) retaining cortex. The butts (n=58) tend to be punctiform (55.3%), with a strong proportion of plain (34.5%), there are few cortical (3.5%), no dihedral, and only a single faceted (1.7%) example. In addition, there are a small proportion (5.2%) that are crushed. Of the identifiable dorsal scars (n=93) the majority are unidirectional (66.7%), followed by strong proportions of opposed (22.6%), and fewer crossed (5.4%) and multidirectional (5.4%) patterns. The fragments have median width and thickness values, of respectively, 11.1 mm (range 6.8-18.4 mm, n=137) and 3.6 mm (range 1.4-8.3 mm).

In total, 50 core-trimming elements, accounting for 3.3% of the diagnostic artefacts, were recovered from Sector 10. The overwhelming majority are crested blades (n=37). These tend to be first removals with a single prepared versant (62.2%), first removals with both versants prepared are less common (27.0%), and second removals rare (5.4%). There are also a couple (5.4%) of fragments. These are all on chert; grey/light grey (5.4%), greyish brown (5.4%), brown/strong brown (18.9%), pale brown/yellowish brown (2.7%), white (8.1%), and burnt (59.5%). The median values for length, width, and thickness, are respectively, 41.6 mm (range 26.2-60.8 mm, n=26), 13.4 mm (range 7.6-24.4 mm, n=35), and 7.2 mm (range 3.9-12.6 mm, n=35).

There are fewer platform rejuvenation flakes (n=6). Each is on chert and burnt. Excluding a fragment, the median values for length, width, and thickness, are respectively, 19.6 mm (range 16.4-38.4 mm, n=5), 21.4 mm (range 11.2-31.2 mm, n=5), and 6.2 mm (range 3.3-8.5 mm, n=5). There are also few *flanc de nucleus* (n=7). These are struck back from the edge of the primary striking platform (n=4), from opposite the primary striking platform (n=1), and orthogonal to the primary striking platform (n=2). Each is on chert; white (n=1), brown/strong brown (n=1), and burnt (n=4). The median

values for length, width, and thickness, are respectively, 26.4 mm (range 16.6-32.2 mm, n=7), 24.4 mm (range 12.8-42.2 mm, n=7), and 9.8 mm (range 6.0-12.7 mm, n=7).

Microburins and related products

There are 25 true microburin, which account for 1.6% of the diagnostic artefacts, from Sector 10. No trihedral points or Krukowski microburins were recovered. The microburins are exclusively on chert; mostly burnt (76.0%). These are most often distal microburins (84.0%), with much smaller numbers of proximal varieties (16.0%). Notching is always direct, usually quite regular, and forms a distinct and deep notch in most cases. The notch is overwhelming applied to the left margin (80.0%) and less frequently at the right margin (20.0%). The distal microburins are exclusively notched at the left edge, and, in contrast, the proximal microburins have a strong tendency to be notched at the right edge (80.0%) over the left (20.0%). The microburins have relatively large dimensions, with median length, width, and thickness values, of respectively, 23.8 mm (range 9.3-40.5 mm, n=25), 13.6 mm (range 7.2-21.2 mm, n=25), and 4.6 mm (range 2.0-10.0 mm, n=25). The microburin index is 15.4. In addition, 2.0% of the microliths retain visible remnants of microburin scars.

Tools

In total there are 217 retouched tools, accounting for 14.1 of the diagnostic artefacts, from Sector 10. The microliths (48.8%) and microlith fragments (20.0%) are overwhelming the most common tool class.

Table 6.28. Grotte des Pigeons (Taforalt), Sector 10: Absolute and relative frequencies of tool types

	N	%
End-scrapers	**33**	**15.4**
1. End-scraper on a flake	13	39.3
2. End-scraper on a retouch flake	1	3.0
3. Circular scraper	1	3.0
5. Denticulated end-scraper	7	21.2
6. Nosed or shouldered end-scraper	2	6.1
8. Single end-scraper on a blade or bladelet	1	3.0
11. Double end-scraper	1	3.0
112. Fragment of an end-scraper	7	21.2
Perforators	**1**	**0.5**
12. Single perforator	1	100.0
Backed flakes and blades	**11**	**5.2**
34. Backed flake	2	18.2
35. Straight backed blade	1	9.1
36. Blade with convex backed end	1	9.1
37. Convex backed blade	2	18.2
40. Obtuse backed blade	2	18.2
42. Fragment of a backed blade	3	27.3
Composite tools	**1**	**0.5%**
43. End-scraper/backed blade	1	100.0
Microliths	**105**	**48.8**
45. Pointed straight backed bladelet	11	10.5
47. Pointed straight backed bladelet with truncated base	13	12.4
48. Mechta el-Abri point	1	1.0
51. Pointed straight backed bladelet with retouched base	1	1.0
52. Aïn Kéda point	1	1.0
55. Bladelet with convex backed end	1	1.0
56. Convex backed bladelet		
a. typical	24	22.9
b. leading to segment	13	12.4
57. Convex backed bladelet with rounded base	4	3.8
58. Convex backed bladelet with truncated base	22	21.0
59. Convex backed bladelet with retouched base	1	1.0
61 Backed bladelet with narrowed base	2	1.9
62. La Mouillah point	2	1.9
63. Partially backed bladelet		
b. with unmodified ends	2	1.9

	N	%
Microliths (continued)		
68. Scalene bladelet	2	1.9
70. Ouchtata bladelet		
b. retouched at proximal	1	1.0
71. Bladelet with Ouchtata retouch	1	1.0
95. Elongated scalene triangle with one short truncation	1	1.0
97. Elongated scalene triangle with one short concave truncation	1	1.0
Microlith fragments	**43**	**20.0**
66. Fragment of a backed bladelet	37	86.1
72. Fragment of a bladelet with Ouchata retouch	6	14.0
Notches and denticulates	**17**	**7.9**
74. Notched flake	2	11.8
75. Denticulated flake	4	23.5
76. Notched blade or bladelet	2	11.8
77. Denticulated blade or bladelet	7	41.2
79. Notched or denticulated piece with continuous retouch	2	11.8
Truncations	**1**	**0.5**
80. Truncated piece	1	100.0
Miscellaneous	**5**	**2.3**
105. Piece with continuous retouch	4	80.0
106. Side-scraper	1	20.0
Total	**217**	

End-scrapers

There are 33 artefacts in this tool category. There are 13 end-scrapers on flakes (type 1), which are the most common type accounting for 39.3% of the artefacts in this class. These are all made on chert; black (7.7%), greyish brown (7.7%), pale brown/yellowish brown (23.1%), and burnt (61.5%). There are over half with cortex (61.5%). The scrapers are most often formed at the distal (69.2%) rather than the proximal (23.1%); one was indeterminate (7.7%). The scraper ends tend not to be extensively fashioned and are quite crude, although two are more well-formed (Fig. 6.25a). The single end-scrapers have length, width, and thickness values, of respectively, 30.8 mm (range 24.9-41.1 mm, n=13), 24.0 mm (range 15.8-35.4 mm, n=13), and 9.1 mm (range 5.9-13.5 mm, n=13).

There is one end-scraper on a retouched flake (type 2), which is made on chert and extremely burnt. It does not retain any cortex. There is a well-made convex scraper at the distal end. In addition, there is semi-abrupt retouch at the left edge. It is 40.0 x 23.1 x 8.0 (Fi. 6.25b). There is also a circular scraper (type 3) made on a cortical flake on brown/strong brown chert. It is well-made with retouch around the entire perimeter, although it does not extend onto the centre of the butt. It has a length, width, and thickness, of respectively 23.7 x 27.7 x 11.4 mm (Fig. 6.25c).

There are seven denticulated end-scrapers (type 5), which are the second most common end-scraper type, accounting for 21.2% of the class. These are all made on chert; pale brown/yellowish brown (n=2), brown/strong brown (n=3), and burnt (n=2). These tend to retain cortex (4 out of 7 cases). The scraper end is located at the distal in four cases (including one applied inversely) and at the proximal in two cases. Three of the former have retouch that extends down both margins, including one that is well-made with fairly regularly spaced notches (Fig. 6.25d). One has retouch around the entire perimeter, which might be described as a denticulated circular scraper (Fig. 6.25e). Overall, the denticulated end-scrapers have median length, width, and thickness values, of respectively, 23.7 mm (range 22.7-31.6 mm, n=7), 26.7 mm (range 20.8-31.3 mm, n=7), and 9.6 mm (range 7.1-13.1 mm, n=7).

There are two nosed end-scrapers (type 6), both made at the distal end on cortical chert flakes; one brown/strong brown, and one burnt. Each is of respectively similar size, measuring 37.8 x 20.2 x 6.3 mm, and 44.9 x 23.5 x 7.7 mm, respectively (Fig. 6.25f). There is only one end-scraper on a blade (type 8). It is made on translucent white chert. It does not retain cortex. The blank is well-made with regular margins. It has a well-formed convex scraper at the distal end. It is 50.5 x 15.9 x 8.0 mm (Fig. 6.25g). The rarity of translucent white chert (i.e. 'chalcedony') across the site and fine craftsmanship may indicate the object had more then simply a utilitarian purpose. There is a double end-scraper (type 11) on an extremely burnt chert flake retaining some cortex. The debitage axis is unknown due to burning. There is a well-made convex scraper at each end. It is 32.5 x 17.3 x 6.6 mm (Fig. 6.25h).

In addition to the formal types there are seven fragments of end-scrapers, which make up a strong proportion (21.2%) of all the end-scrapers combined. These are all on chert; pale brown/yellowish brown (n=1), brown/strong brown (n=1), white (n=1), and burnt (n=4). The majority retain cortex (5 out of 7). The scraper edge is at the distal in six cases; five convex, and one denticulated. The remaining end-scraper fragment is a partial fragment with denticulated retouch at the proximal.

Perforators

There is only one artefact in this class. It is a single perforator (type 12) that is formed on the left margin of a small flake. It is on chert and burnt. The butt is retained. It is 13.1 x 23.6 x 4.1 mm (Fig. 6.25i).

Composite tools

This is a rare tool class throughout the site and here consists of a single end-scraper/backed blade (type 43). It is on a non-cortical pale brown/yellowish brown chert blade. It has direct backing along the entirety of the left edge. It has the outline of a convex backed blade (type 37). The point is at the distal. It has a well-formed convex scraper at the proximal, removing the butt. There are no traces of microburin scars. It is complete, measuring 47.3 x 15.7 x 4.9 mm.

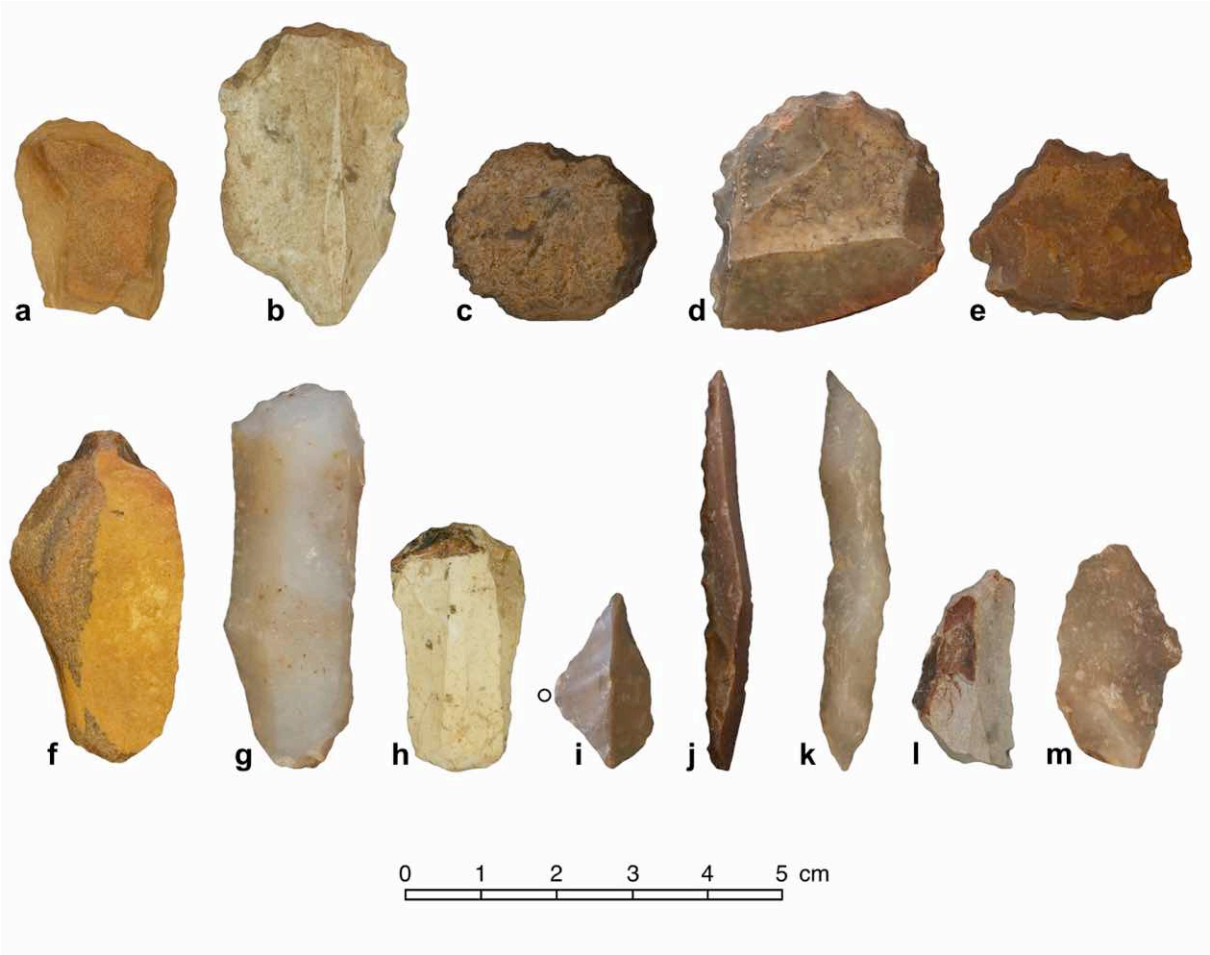


Figure 6.25. Grotte des Pigeons (Taforalt), Sector 10: End-scrapers, Perforators, Backed Blades & Flakes a) single end-scraper on a flake; b) single end-scraper on a flake with retouch; c) circular end-scraper; d-e) denticulated end-scrapers; f) nosed end-scraper; g) end-scraper on a blade; h) double end-scraper; i) single perforator; j) straight backed blade; k) convex backed bladelet; l-m) backed flakes

Backed blades and flakes

There are eleven artefacts in this category. There are two artefacts that are particularly distinctive. These are a straight backed blade (type 35) and convex backed blades (type 37)(Figs. 6.25j-k). The former is made on brown/strong brown chert. It has mixed direct/crossed retouch at the right lateral margin, which has an extremely regular and straight delineation, and is bi-pointed. The length, width, and thickness, are respectively, 55.7 mm, 6.4 mm, and 4.7 mm. The latter is on translucent white chert (i.e. 'chalcedony'). It is has mixed direct/crossed retouch at an indeterminate margin, which is slightly convex. It has an inverse basal truncation. It is a similar size. The length, width, and thickness, are respectively, 53.9 x 9.0 x 5.7 mm. Each of the aforementioned examples seemingly required an exception level of skill in order to attain a suitable blank and subsequently form the back without

breakage occurring. It is tempting to speculate due to the associated context that these might have been burial goods.

The other nine artefacts in this category are less distinctive. These include another convex backed blade (type 37) distinct from the previously describe find. It is on chert. It has evidence of burning. There is direct retouch at an indeterminate margin that modifies a natural cortical 'back'. It is 26.1 x 14.1 x 4.6 mm. There is a blade with a convex backed end (type 36). It is on chert. It has evidence of burning. There is direct retouch at the left lateral edge forming truncating the proximal. It retains a width and thickness, of respectively, 12.8 and 4.4 mm. There are two obtuse backed blades (type 40) both on chert. Each has direct retouch restricted to the proximal portion of one lateral margin; in one case at the left lateral margin, and the other at the right lateral margin. These measure 41.0 x 15.0 x 6.3 mm and 40.4 x 12.2 x 6.5 mm, respectively. There two backed flakes (type 34) that are both on chert. Each has evidence of burning. One has direct left lateral retouch that truncates both ends (Fig. 6.25l). It measures 21.1 x 14.1 x 4.6 mm. And the other, has direct left lateral retouch, but the butt and distal end are retained (Fig. 6.25m). It measures, 26.1 x 14.1 x 6.9 mm. In addition, three pieces were classified at fragments of backed blades (type 42). These are all on chert and are burnt. The retouch is direct in each case; one left; one right; and one at an indeterminate margin. The widths range from 15.2-19.9 mm and thicknesses from 2.9-7.9 mm.

Microliths

There are 105 microliths (Figs. 6.26a-as). These are dominated by convex backed bladelets *sensu lato* (types 56-59)(61.0%) and pointed straight backed bladelets *sensu lato* (types 45-52)(25.7%). An additional 10 types are also present in frequencies from 1.9% to 1.0% (Table 6.28). These include, three 'geometrics' accounting for 2.9% of the microliths. All of the microliths are made on chert; black (1.0%), grey/light grey (1.0%), greyish brown (1.0%), pale brown/yellowish brown (16.2%), brown/strong brown (10.5%), red/reddish brown (1.9%), dusky red/weak red (1.0%), white (1.0%), and overwhelmingly burnt (65.7%) varieties. Most of the microliths are broken (53.3%). There is a preference for retouch at the left lateral edge (53.3%) over the right lateral edge(40.0%); the remaining cases were indeterminate (6.7%). The majority of the retouch is direct (61.0%), with high proportions

of mixed direct/crossed (21.0%) and crossed (17.1%). There is also one inverse example (1.0%). There are only a couple with marginal Ouchtata retouch (1.9%).

Only a couple of the microliths have unmodified ends (1.9%), with the overwhelming majority being single points (82.9%), and a strong proportion double points (15.2%). Of the single points (n=87) most are found at the distal (73.6%) with the proximal utilised less often (17.2%); eight cases were indeterminate (7.7%). Of all the microliths the butt is retained in less than a quarter of cases (22.9%). There is a relatively high frequency of microliths with basal truncations (38.1%), which tend to be acute (n=36) over rounded (n=4). The basal truncations are most often with direct retouch (n=38), with strong proportions of inverse (n=10), and one bifacial, which is on a Mechta el-Abri point (type 58). There are only a couple of microliths with additional basal retouch (1.9%). There is one microlith with addition retouch at the tip(s)(1.0%); fine direct retouch is present at both tips on the Aïn Kéda point (type 52). As a group the microliths vary somewhat in size, the median value for length, width, and thickness, are respectively, 25.1 mm (range 16.4-41.3 mm, n=52), 6.8 mm (range 4.5-13.2 mm, n=105), and 3.5 mm (range 1.8-6.5 mm, n=105).

Microlith fragments

There are 43 microlith fragments, including 14 distal (32.6%), 9 mesial (20.9%), 11 proximal 25.6%), and nine indeterminate ends (20.9%). All of these are made on chert; the majority burnt (74.4%). There is a slightly higher proportion retouched at the left lateral edge (37.2%) over the right lateral edge (30.2%). There was also a single case retouch at both margins (2.3%). The remaining cases were indeterminate (30.2%). Most of the retouch is direct (79.1%), there is a strong proportion that is crossed (14.0%), two alternating (4.7%), and one mixed direct/crossed (2.3%). The butt is retained on only a small proportion of the fragments (7.0%). The fragments have median width and thickness values, of respectively, 8.1 (range 3.9-13.3 mm, n=43), and 3.5 mm (range 1.8-5.6 mm, n=43).

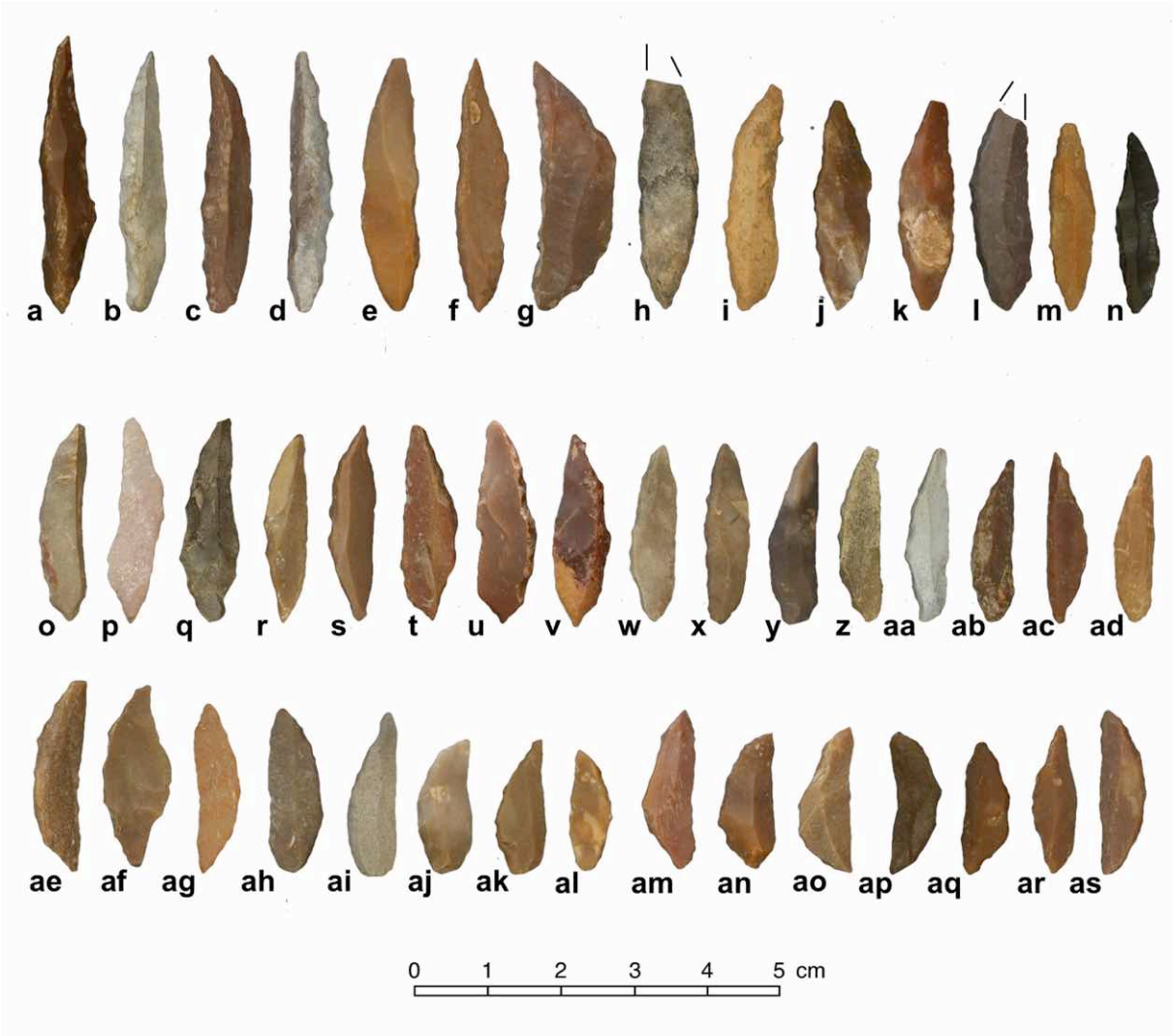


Figure 6.26. Grotte des Pigeons (Taforalt), Sector 10: Microliths
a-n) straight backed bladelet sensu lato; inc, a) Mechta el-abri point, e) Aïn Keda point;
o-ar) convex backed bladelet sensu lato; inc, am-ar) convex backed bladelets leading to segments; as) segment

Notches and denticulates

There are 17 artefacts within this class. These are all on chert; grey/light grey (12.5%), pale brown/yellowish brown (6.3%), brown/strong brown (25.0%). The majority show evidence of burning (62.5%). There is just under half that retain cortex (47.1%). The blanks include, one blade, nine bladelets, and seven flakes. The blade has a single notch at the left lateral edge and additional direct marginal retouch on the same edge. It is 53.9 x 13.9 x 3.8 mm (Fig. 6.27a). There are two blades with single notches; both at the left lateral edge. Each of these is broken and might be failed examples of the microburin technique (Fig. 6.27b). There are also seven bladelets with contiguous notches; one at the left lateral margin, three at the right lateral margin, and three on both margins. These include five

fragmentary examples and two that are unbroken; 40.0 x 17.4 x 6.7 mm and 41.9 x 17.9 x 4.9 mm (Fig. 6.27c), respectively. There are two flakes with a signal notch at the left lateral edge. Both are complete measuring 31.6 x 14.9 x 4.1 mm, and 32.2 x 17.3 x 4.1 mm (Fig. 6.27d), respectively. In addition, there is a flake with a single notch at the distal end and with additional marginal retouch along the left margin. It is 34.8 x 17.9 x 4.2 mm (Fig. 6.27e). There are also four flakes with contiguous notches; one at the left lateral, and three on both margins. These include three complete examples; 18.5 x 17.0 x 4.2 mm (Fig. 6.27f), 29.4 x 14.9 x 7.2 (Fig. 6.27g), and 24.3 x 12.6 x 4.0 mm. Overall, median length, width, and thickness values, are respectively, 32.2 mm (range 18.5-53.9 mm, n=9), 17.0 mm (range 12.6-17.9 mm, n=9), and 4.2 mm (3.8-7.2 mm, n=9).

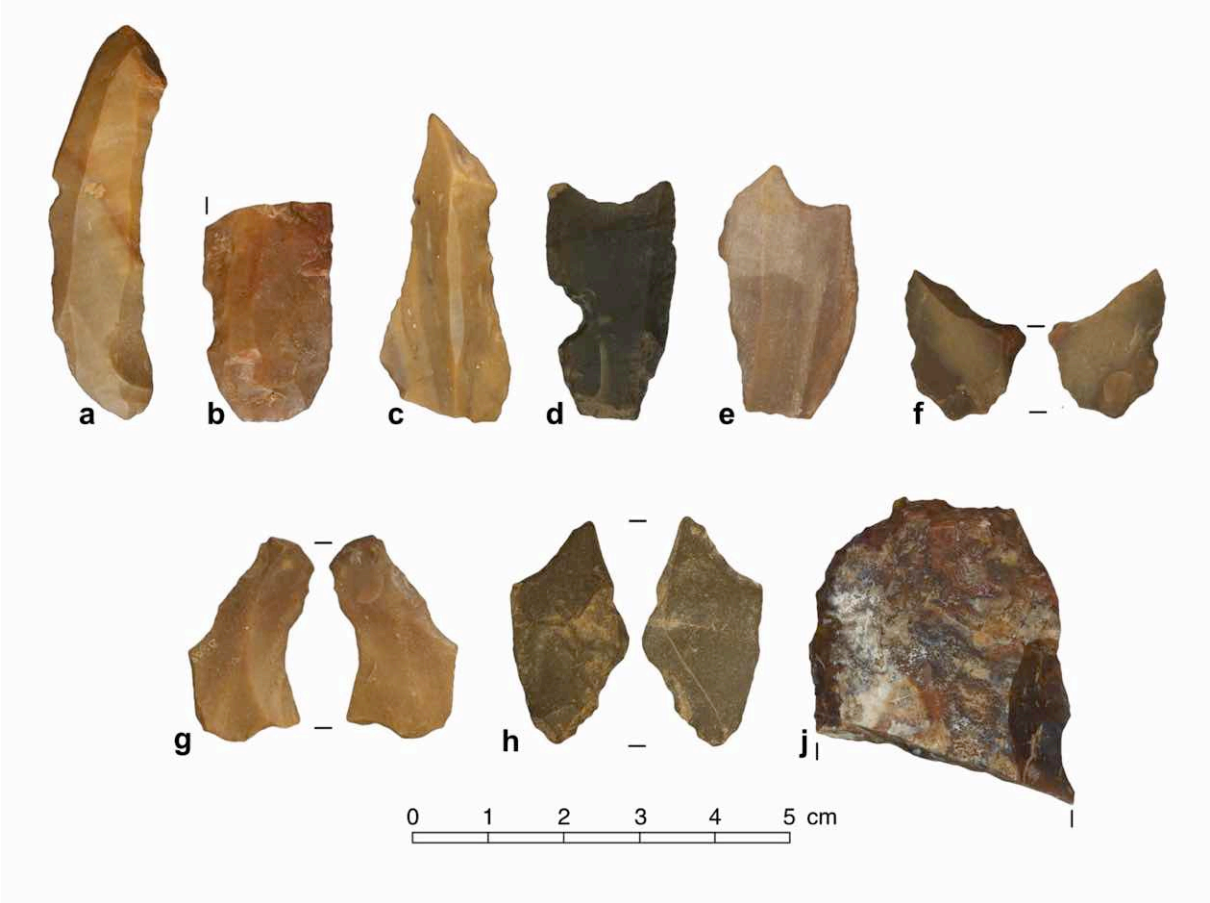


Figure 6.27. Grotte des Pigeons (Taforalt), Sector 10: Notches & Denticulates, Truncations, and Miscellanous
a-b) notched blades; c) denticulated blade; d-e) notched flakes;
f-g) denticulated pieces with continuous retouch; h) truncation; j) fragment of a side-scraper

Truncations

There is only one artefact assigned to this class. It is a truncated piece (type 80) on dark grey chert (Fig.27h). It has an inverse slightly concave truncation at the distal. The angle of truncation is 126º. It is 28.4 x 15.0 x 5.6 mm.

Miscellaneous tools

There are five tools in his class. Four of these are atypical pieces with continuous retouch (type 105). These are all on chert; each burnt. Each is extremely fragmentary and have direct retouch; three at the right lateral margin, and one at both lateral margins. In addition, there is one formal tool, a fragment of a side-scraper (type 106)(Fig. 27i). It made on brown/strong brown chert. It has scraper retouch along the left edge and at the distal end. It is relatively wide and thick, 34.1 mm and 10.4 mm, respectively. It does not appear consistent with the upper LSA and is much more typical of the forms observed in the MSA at the site.

Chapter 7

Grotte des Pigeons, Taforalt (Morocco): Statistical Analysis of Cultural Phases

7.1. Overview of Cultural Phases

A major question relates to whether the lithic assemblages described in Chapter 6 are sufficiently different from each other to be separated into distinct cultural facies. In order to establish whether the collections could be divided into separate groups, systematic pairwise comparisons were used to examine variation in the attribute and metrical data (see Chapter 4 for details). The groups were developed through systematically collapsing those groups where differences were not shown to be significant. Each lithic assemblage was grouped only with the adjacent stratigraphic contexts, respecting basic stratigraphic principles. In total, three groups emerged from these analyses, which were most different from each other, whilst minimising within group variation.

Here the three groups are referred as the Upper Phase, a Middle Phase, and a Lower Phase. The Upper Phase includes contexts L2 through L27 in Sector 8. These are Grey Series deposits associated with midden activity and the so-called *escargotière.* The radiocarbon ages for this phase lie between ~14.6 – 12.5 ka cal BP. The Middle Phase includes L28-29 and Unit Y1 in Sector 8. These are the lowermost Grey Series and uppermost Yellow Series deposits. The associated contexts give radiocarbon ages between ~15.7 – 14.4 ka cal BP. The Lower Phase of occupation is Y2 sp 2-5 and Y3-4, as well as stratigraphic equivalents in Sector 3, Sector 9, also associated with the Yellow Series. These contexts give radiocarbon ages of between ~22.1 – 16.9 ka cal BP. The results of the comparative statistical analyses between the groups are discussed below.

In should be noted, that a number of assemblages were excluded *a priori* from the comparisons, because the stratigraphic units from which these were derived showed signs of mixing of non-contemporary deposits. Unit Y2 sp1 was excluded as the sediments indicate some unusual geological phenomena, specifically plastic deformation of the sediments that is consistent of wetness and possible transient ground freezing (Barton et al. 2013, p. 277), which could lead to the vertical

displacement of material. This would explain the apparent mixed nature of the assemblage with distinct similarities to adjacent Unit Y1 and Unit Y2 sp2-5. However, it is conceivable (yet considered very unlikely) that it represents a genuine transition between these stratigraphic units. Likewise, the presence of numerous burials in Sector 10 could have led to significance disturbance and mixing of stratigraphic levels and was therefore excluded.

A total of 13,689 artefacts could be assigned to a specific phase (Table 7.1). The majority come from the Upper Phase (66.6%), with less from the Middle Phase (19.3%) and Lower Phase (14.2%). When the relative frequencies of different artefact classes from each phase (excluding those from the indeterminate/mixed phase) are contrasted several patterns emerge (Figure 7.1). Overall, 29.4% of the assemblage could be classified according to artefact class, with the remaining 70.7% consisting of debris (i.e. chips and chunks). The relative frequencies of diagnostic artefacts vary dramatically between the phases, with 21.7% in the Upper Phase, 41.3% in the Middle Phase, and 49.4% in the Lower Phase. It appears that the proportion of diagnostic artefacts is inversely related to the levels of burning amongst the assemblages.

In total, 48.2% of the chipped-stone assemblage (n=13,689) shows evidence of burning, which included, pot-lids, discolouration, fusing, and fracturing. There are significantly higher levels of burning associated with the artefacts from the Upper Phase (74.0%), than in the Middle Phase (37.4%) and Lower Phase (23.4%)(Fisher's exact, $p < .001$). There are also high levels of burning of the faunal, molluscan, and botanical remains, and of the sediments, which occurred as a result of subsistence activities (Barton et al., 2013; Humphreys et al., 2014; Taylor et al., 2009; Taylor, 2014; S. Collcutt, pers. comm.). Most of the lithic artefacts must have been burnt during the course of these activities. There is no evidence to indicate burning occurred as the result of the specific use of heat treatment as a knapping technique. In fact, the burning is less often associated with the cores than the other artefact classes. It seems most probably that the much higher levels of burning account for the high proportion of debris in the Upper Phase (78.3%), than in the Middle (58.7%), and Lower Phases (50.6%). Whilst the high levels of burning somewhat obscures evidence of the reduction sequence, a number of prominent changes in the nature of the lithic technology were recorded across the sequence.

Table 7.1. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of artefacts according to phase

	Blades	**Flakes**	**CTE**	**MB**	**TP**	**KMB**	**Cores**	**SP**	**Tools**	**Subtotal**	**Chips**	**Chunks**	**Total**
Upper Phase	251 12.7%	1196 60.6%	43 2.2%	5 0.3%	-	6 0.3%	46 2.3%	4 0.2%	423 21.4%	1974 100.0%	6731 (73.9%)	405 (4.4%)	9110
Middle Phase	181 16.7%	519 47.7%	28 2.6%	143 13.2	1 0.1%	1 0.1%	47 4.3%	3 0.3%	164 15.1%	1087 100.0%	1424 (54.0%)	125 (4.7%)	2636
Lower Phase	199 20.7%	554 57.6%	11 1.1%	10 1.0%	-	-	16 1.7%	4 0.4%	167 17.4%	961 100.0%	942 (48.5%)	40 (2.1%)	1943
Total	631 %	2269 56.4%	82 2.0%	158 3.9%	1 0.0%	7 0.2%	109 2.7%	11 0.3%	754 18.7%	4022 100.0%	9097 (66.5%)	570 (4.2%)	13689

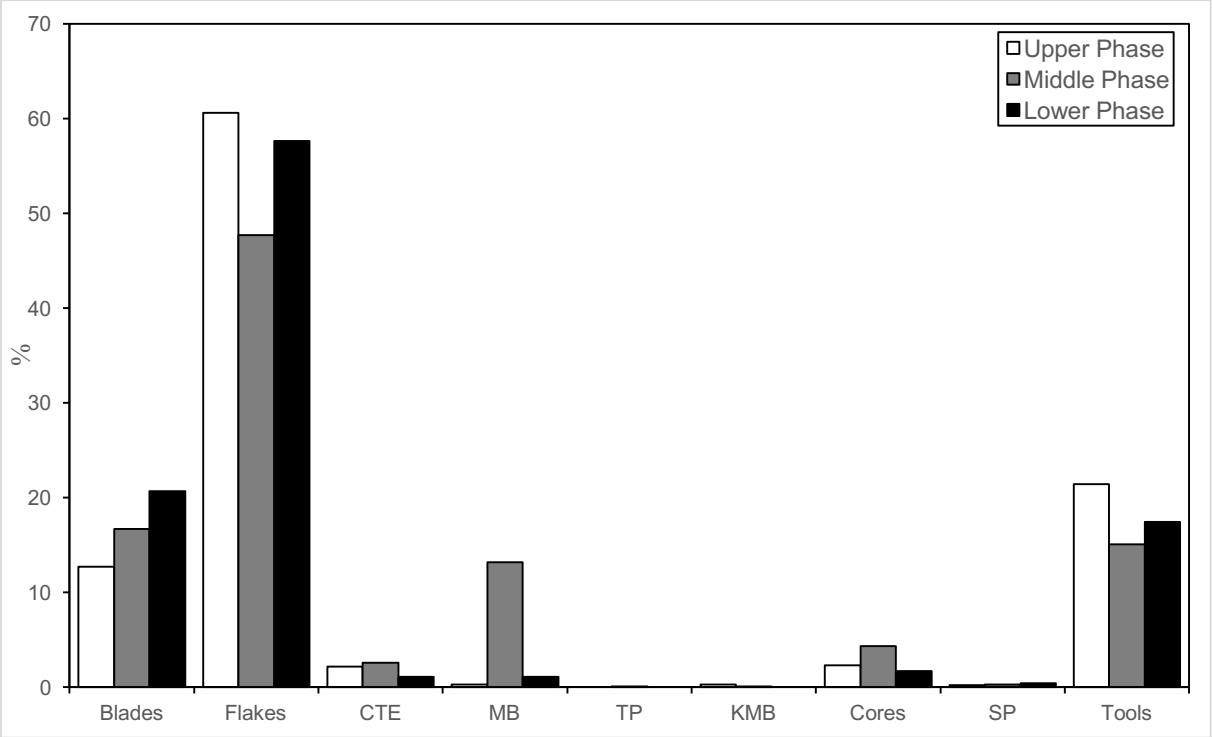


Figure 7.1. Grotte des Pigeons (Taforalt):
Relative frequencies of diagnostic artefacts by phase

7.2. Raw Material

All of the assemblages from the different phases were dominated by chipped-stone artefacts on fine-grained chert. It was the principal raw material exploited by the occupants of the site during the LSA (Table 7.2). The majority of the fine-grained cherts had a waxy lustre and are translucent. In each horizon brownish hues dominate the assemblage. It should be noted that many of the colours graded into each other. For instance, the greyish brown, pale brown/yellowish brown, and brown/strong, might best be understood as variation along a continuum. Accordingly, there did not appear to be any major differences in colour selection. Judging by the cortical elements the translucent cherts were from well-rounded pebbles and small cobbles with smooth to slightly rough/puckered cortex consistent with being fluvially rolled.

The majority of the fine-grained cherts were believed to derive from the Pleistocene gravels of the Moulouya River. A range of cherts similar to those exploited at the site were identified at three localities. Unfortunately, today the Pleistocene gravels are overlain and largely obscured by ~10 m thick series of fine-grained overbank deposits that formed during the Holocene (Ibouhouten et al., 2010; Zeilhofer et al., 2010). The gravels can be observed primarily due to down cutting of the river through the Holocene deposits and also at one location due to the in-cutting of a road. During the Pleistocene occupation of the site the gravels would have been more widely accessible. In addition to those materials exploited at the site a number of other materials were available at each sample locality, including coarser-grained cherts, quartzites, etc.

As the crow flies the Moulouya River is located ~17 km from Grotte des Pigeons (Taforalt). The site is located on a minor tributary of the River Zegel that is itself a major feeder of the Moulouya River, although less direct the former tributary may have provided a natural route for the LSA inhabitants to sources of raw materials. In fact, the presence of the occasional marine shell-bead indicates that the occupants were travelling or exchanging items over some distance. The current coastline is ~40km from the site and is not believed to be that different from what it was in the past.

There are a few artefacts on opaque black chert that were not identified in the Pleistocene gravels of the Moulouya River. During an intense survey of the River Zegel and surrounding Beni-Snessen Mountains the author was unable to locate the potential source for this black chert and the geological source of this raw material remains unclear.

A couple of other sources of chert were identified closer to the site, but neither provided materials consistent with those found in the archaeological assemblages. These cherts appear as irregular nodules bound tightly in outcropping limestone of the local bedrock and are relatively coarse-grained with fissures interrupting the fracture plane making it difficult to control knapping. There was no evidence to suggest that the LSA inhabitants exploited these materials despite their close proximity to the site.

The second most important raw material selected for knapping was coarser-grained limestone. Whilst fine-grained chert continued to be dominant throughout the sequence there was relatively higher frequencies of limestones in the Upper Phase (17.4%), than in the Middle Phase (6.8%) or Lower Phase (2.6%)(Table 7.2). The only diagnostic artefacts on this material were flakes and a small number of crude tools from the main sequence in Sector 8. The limestone derived from the minor tributary of the River Zegel that is situated less than 100 m from the cave entrance. In addition to the intentionally knapped limestone, there were also numerous naturally and/or heat fractured limestone cobbles that were sometimes hard to differentiate from one another. It is possible that these limestone cobbles also served as pounders, hammer-stones, anvils, boiling stones, and/or hearthstones.

A very small number of the lithic artefacts were also recorded on basalt in the Lower Phase (n=3, 0.2%). This material was absent in both the Middle and Upper Phases. Each were small flakes (<20mm in maximum dimension) and were recovered from bottom of the Lower Phase from contexts in Sector 3 (28-44 cm) and Sector 9 (Layer 3). From comparisons with similar finds below the LSA horizons in Sector 8, it is almost certain that these small basalt flakes were residual and related to earlier activity at the site. Each appeared to be a small thinning flake from biface manufacture, which is commonly associated with the deposits underlying the LSA (Barton et al., 2013). A handful of

retouched tools were made on fine-grained quartz (see Chapter 6 for description). No debitage products were recorded on this material. The source of the material was not immediately apparent.

Table 7.2. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of raw materials according to phase

	Upper Phase	**Middle Phase**	**Lower Phase**
Chert	7516 82.5%	2457 93.2%	1885 97.0%
Limestone	1584 17.4%	178 6.8%	50 2.6%
Fine-grained Quartz	10 0.1%	1 0.0%	5 0.3%
Basalt	-	-	3 0.2%
Total	9110 100.0%	2636 100.0%	1943 100.0%

7.3. Cores

The cores only occurred in low relative frequencies throughout the sequence. They were found in similar proportions in the Upper and Lower Phases (2.3% and 1.7% respectively), but there was a slight peak in their occurrence in the Middle Phase (4.3%)(Table 7.1).

All of the cores were on chert from the Lower, Middle, and Upper Phases. The vast majority were indeterminate in colour as a result of the high proportion of burning. For the remainder, a wide range of colours were represented: black, dark grey, grey/light grey, greyish brown, pale brown/yellowish brown, brown/strong brown, reddish brown, dusky red/weak red, and white. The majority of cores are on pale brown/yellowish brown and brown/strong brown cherts (Table 7.3). There was no significant difference in the colours from phase to phase (Fisher's exact, $p = .635$).

Table 7.3. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of the colour of cores by phase

	Upper Phase	**Middle Phase**	**Lower Phase**
Black	2 16.7%	1 3.4%	-
Dark grey	-	2 6.9%	-
Grey/light grey	-	1 3.4%	-
Greyish brown	-	2 6.9%	-
Pale brown/yellowish brown	2 16.7%	9 31.0%	2 25.0%
Brown/strong brown	4 33.3%	8 27.6%	6 75.0%
Reddish brown	2 16.7%	4 13.8%	-
White	2 16.7%	2 6.9%	-
Subtotal	12 100.1%	29 99.9%	8 100.0%
Indeterminate	(34) (73.9%)	(18) (38.3%)	(8) (50.0%)
Total	46	47	16

The absolute and relative frequencies of core types are shown in Table 7.4. There was only a small number of cores from the Lower Phase (n=16), which somewhat limited comparisons of the relative frequencies with the other phases. In the Lower Phase, single platform cores were most frequent (43.8%). In the overlying phases, single platform cores were also the most important type, with similar frequencies in both the Upper Phase (37.0%) and Middle Phase (38.3%). These were followed by opposed platform cores, which again occur in similar frequencies in both the Upper Phase (17.4%) and Middle Phase (17.0%).

A strict distinction between these types is misleading. Many of the opposed platform cores had one heavily exploited platform and an additional platform that was utilised less intensively. The additional platform most often only had a couple of removals and the core was usually abandoned soon after. Thus, in most cases the opposed platform cores appear to be indicative of a failed effort to regulate the core. There was little evidence to indicate regular rotation of the core and/or concurrent exploitation of two striking surfaces.

A range of cores occured in much smaller proportions. Many of these were not represented at the bottom of the sequence, which could simply be an effect of the small number of cores from the

Lower Phase. There was not a significant difference in the proportions of the different cores across the sequence (Fisher's exact test, p = .613). Nonetheless, there were some changes in the relative frequencies of certain forms that indicate a more intensive use of raw materials in the Upper Phase. For instance, there was a notable increase in the number of core-on-flakes towards the top of the sequence. These were twice as common in the Upper Phase (13.0%), as in the Middle Phase (6.4%), and absent in the Lower Phase. In contrast, the tested/prepared cores were absent in the Upper Phase, but found in stable numbers in the Middle and Lower Phase (6.4% and 6.3%, respectively).

Table 7.4. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of cores according to phase

	Upper Phase	**Middle Phase**	**Lower Phase**
Single platform	17 37.0%	18 38.3%	7 43.8%
Opposed platform	8 17.4%	8 17.0%	5 31.3%
90º platform	2 4.3%	-	-
Discoidal	1 2.2%	1 2.1%	-
Multiple platform	4 8.7%	6 12.8%	-
Core-on-flake	6 13.0%	3 6.4%	-
Core fragment	8 17.4%	8 17.0%	3 18.8%
Tested/prepared	-	3 6.4%	1 6.3%
Total	46 100.0%	47 100.0%	16 100.2%

The absolute and relative frequencies of the removals on the cores are shown in Table 7.5. Fisher's exact test indicates that there was no significant difference in the removals on the cores from across the sequence (p = .179). Overall, the majority of the cores had flake removals (52.0%), followed by strong proportions of blade removals (37.8%), and much lower proportions with mixed removals (10.2%). The distinction between the blade, flake, and mixed cores, was somewhat misleading. In general, the flake cores appeared to be more heavily reduced and might be blade cores where the scars had been obliterated by subsequent removals. Considering this it was interesting that in terms of individual frequencies there were more cores with blade removals in the Lower Phase (53.3%), than in the Middle Phase (39.5%), and in-turn than the Upper Phase (30.0%).

Table 7.5. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of scars on cores according to phase

	Upper Phase	**Middle Phase**	**Lower Phase**
Flake	24 60.0%	23 53.5%	4 26.7%
Blade	12 30.0%	17 39.5%	8 53.3%
Mixed	4 10.0%	3 7.0%	3 20.0%
Subtotal	40 100.0%	43 100.0%	15 100.0%
Indeterminate	(6) (13.0%)	(4) (8.5%)	(1) (6.3%)
Total	46	47	16

The presence of dorsal cortex retained on the cores is shown in Table 7.6. Fisher's exact test indicates that there was no significant difference between the phases (p = .135). The overwhelming majority of the cores retained some cortex within the Upper Phase (82.6%) and Middle Phase (78.7%). Interestingly, all of the cores retained cortex in the Lower Phase. However, there were only a small number of cores from the latter (n=16).

Table 7.6. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of cortex on cores by phase

	Upper Phase	**Middle Phase**	**Lower Phase**
No Cortex	8 17.4%	10 21.3%	-
Cortex	38 82.6%	37 78.7%	16 100.0%
Total	46 100.0%	47 100.0%	16 100.0%

The absolute and relative frequencies of striking platforms on cores are shown in Table 7.7. Fisher's exact test suggests that there was a significant difference in the proportions between the phases (p <.024). Whilst, simple (cortical/plain) striking platform were dominant on cores throughout the sequence, there are strong proportions of complex (dihedral/faceted) striking platforms on the cores from the Upper and Middle Phases (28.9% and 31.9%, respectively), but these were absent in the Lower Phase. The proportion of cores with abrasion is shown in Table 7.8. Fisher's exact test suggests that there was a significant difference between the phases (p < .049). There was a much smaller proportion with abrasion in the Upper Phase (32.6%), than in the Middle Phase (51.1%), and, in turn, than in the Lower Phase (66.7%).

Table 7.8. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of abrasion on cores by phase

	Upper Phase	Middle Phase	Lower Phase
No Abrasion	31 67.4%	23 48.9%	5 33.3%
Abrasion	15 32.6%	24 51.1%	10 66.7%
Total	46 100.0%	47 100.0%	16 100.0%

The metric data on cores is shown in Table 7.9. Kruskal-Wallis tests were used to compare the dimensions of cores across the sequence. There was not a significant difference in terms of length (H=2.459(2), *p*=.292), width (H=1.141(2), *p*=.565), or thickness (H=2.852(2), *p*=.240). Nonetheless, there were notable changes in the dimensions of cores with a subtle shift towards smaller cores in the Upper Phase, which might be considered reflective of a more intensive exploitation of available raw materials. For instance, the median length of cores were slightly greater in the Lower Phase ($\tilde{x}$ = 29.3 mm), than in the Middle Phase ($\tilde{x}$ = 26.8 mm), and in the Upper Phase ($\tilde{x}$ = 27.4 mm). Furthermore, the median thickness was slightly greater in the Lower Phase ($\tilde{x}$ = 14.3 mm), than in the Middle Phase ($\tilde{x}$ = 14.0 mm), and much thicker than in the Upper Phase ($\tilde{x}$ = 12.7 mm).

Table 7.9. Grotte des Pigeons (Taforalt): Dimensions on cores by phase

	N	Mean	S.D	Median	Range	Midrange
Upper Phase						
Length	38	27.02	5.25	27.4	16.5-40.8	22.3-31.1
Width	38	19.49	5.38	18.8	10.4-34.7	16.8-21.3
Thickness	38	13.98	5.31	12.7	7.2-31.3	9.5-18.4
Middle Phase						
Length	39	26.02	5.42	26.8	17.8-43.2	21.4-29.3
Width	39	20.84	5.79	19.6	11.4-38.5	16.4-24.1
Thickness	39	15.08	4.09	14.0	8.7-24.6	12.0-17.5
Lower Phase						
Length	13	29.46	7.48	29.3	18.0-45.3	24.5-34.2
Width	13	20.55	6.60	17.9	10.9-30.5	15.7-25.7
Thickness	13	15.28	4.64	14.3	8.0-25.5	12.5-15.5

In summary, there were a number of similarities between the cores, however some subtle differences indicate changes in the nature of core reduction throughout the sequence. The Lower Phase was characterised by single platform blade cores with abrasion at the edge of the striking platforms, which are slightly larger and less heavily reduced than in the other horizons. The Middle Phase was

also characterised by single platform cores, but the edge of the striking platform was slightly less often abraded and was more often faceted. The size of the cores slightly diminished. The Upper Phase was similar to the latter, although there was less abrasion. There was a reduction in the number of cores with blade removals, which might be related to a more intensive reduction strategy towards the top of the sequence.

7.4. Debitage

7.4.1. Flakes

All of the complete flakes (≥20mm maximum dimension) were analysed from each phase. These were made on variety of different colour fine-grained cherts and on coarser-grained limestone. The proportions of flakes on the different raw materials are shown in Table 7.10 and Figure 7.2. Fisher's exact test indicates there was a significant difference in the raw materials between the phases ($p <$ .001). Whilst, fine-grained cherts dominate in each phase (between 77.9 and 96.4%) there were greater proportions of flakes on coarser-grained limestone in the Upper Phase (22.1%) than in either the Middle or Lower Phase (3.6% and 10.4%, respectively). As there appeared to be differences in the reduction and use of these raw materials each is analysed separately.

Table 7.10. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of raw materials on flakes by phase

	Upper Phase	Middle Phase	Lower Phase
Chert	208 77.9%	132 96.4%	120 89.6%
Limestone	59 22.1%	5 3.6%	14 10.4%
Total	267 100.0%	137 100.0%	134 100.0%

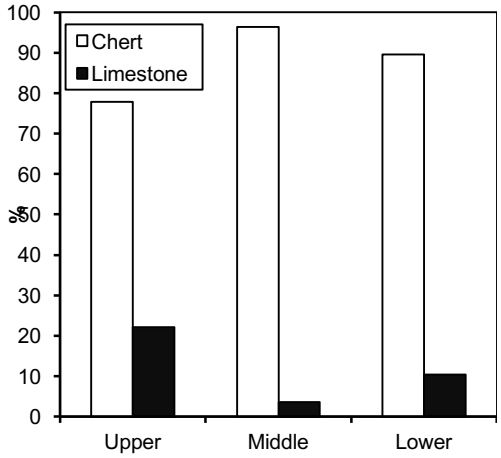


Figure 7.2. Grotte des Pigeons (Taforalt):
Relative frequencies of the raw materials on flakes by phase

In total, across the three phases, there were 460 whole chert flakes (≥20 mm maximum dimension). There were more from the Upper Phase (n=208), with much smaller numbers in the Middle (n=132) and Lower (n=120) Phases. The proportions of the different colour cherts on the flakes are shown in Table 7.11 and Figure 7.3. The vast majority were indeterminate in colour as a result of the high proportions of burning in the assemblage (see below). There is a clear dominance of pale brown/yellowish brown and brown/strong brown cherts, which, excluding those indeterminate in colour, make up the majority of flakes (29.4% and 37.0%, respectively).

Table 7.11. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of colours on chert flakes by phase

	Upper Phase	Middle Phase	Lower Phase
Black	1 1.4%	3 3.7%	1 1.2%
Dark grey	5 6.8%	2 2.5%	
Grey/light grey	8 11.0%	6 7.4%	3 3.6%
Greyish brown	4 5.5%	14 17.3%	3 3.6%
Pale brown/yellowish brown	17 23.3%	13 16.0%	40 47.6%
Brown/strong brown	33 45.2%	28 34.6%	27 32.1%
Reddish brown	4 5.5%	7 8.6%	2 2.4%
Dusky red/weak red		4 4.9%	1 1.2%
White	1 1.4%	4 4.9%	7 8.3%
Subtotal	73 100.0%	81 100.0%	84 100.0%
Indeterminate	(135) (64.9%)	(51) (38.6%)	(36) (30.0%)
Total	208	132	120

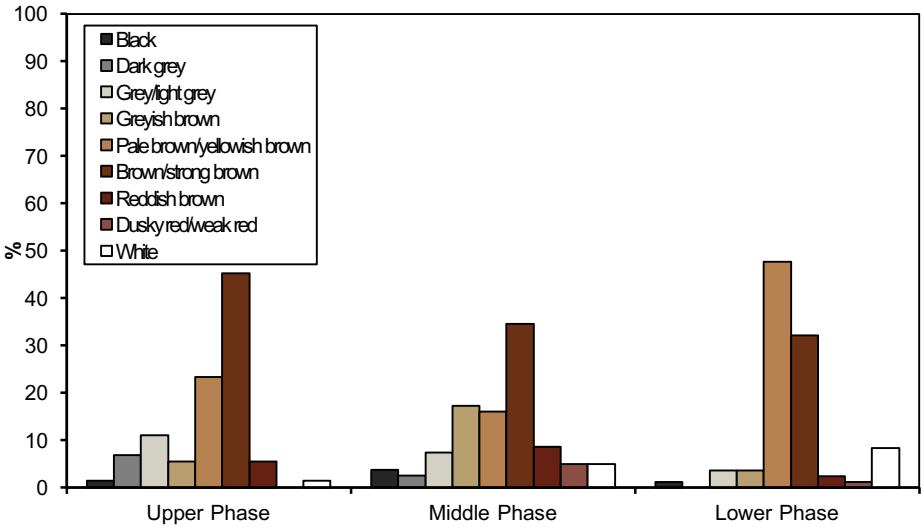


Figure 7.3. Grotte des Pigeons (Taforalt):
Relative frequencies of colours on chert flakes by phase

The proportion of dorsal cortex retained on the chert flakes is shown in Table 7.12 and Figure 7.4. Fisher's exact test indicates that there was no significant difference in the proportion of dorsal cortex retained on the flakes between each phase (p = .792). There was a clear dominance of

cortical flakes within each phase, with only around a third of flakes without cortex in the Upper Phase (30.0%), Middle Phase (28.0%), and Lower Phase (32.5%).

Table 7.12. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of cortex on chert flakes by phase

	Upper Phase	**Middle Phase**	**Lower Phase**
None	62 30.0%	37 28.0%	39 32.5%
Less than 25%	51 24.6%	32 24.2%	32 26.7%
Between 25-50%	30 14.5%	20 15.2%	20 16.7%
More than 50%	46 17.4%	18 13.6%	15 12.5%
100%	28 13.5%	25 18.9%	14 11.7%
Total	207 100.0%	132 100.0%	120 100.0%

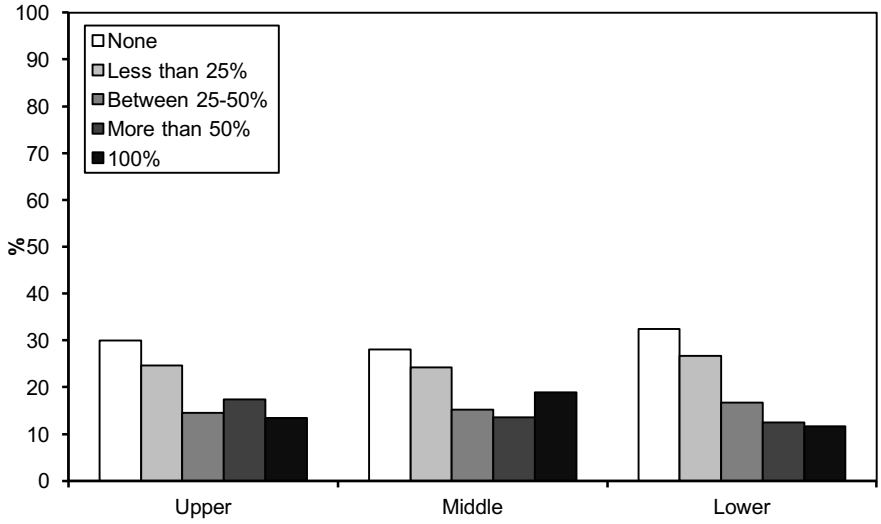


Figure 7.4. Grotte des Pigeons (Taforalt):
Relative frequencies of cortex on chert flakes by phase

The proportion of striking platform types on the chert flakes is shown in Table 7.13 and Figure 7.5. Fisher's exact test indicates that these differed significantly between and across the sequence (p <.001). Pairwise comparisons indicate that the Lower Phase was significantly different from the Middle (p = .001) and Upper Phases (p = .027). However, the Upper Phase and Middle Phase did not differ significantly (p=.068). Throughout the sequence plain and cortical butts were the most important. However, there was a notable increase in the proportion of flakes with punctiform striking platforms, and corresponding decreases in plain and cortical striking platforms, towards the bottom of

the sequence; low proportions of punctiform butts in the Upper (4.8%) and Middle Phases (3.8%), and much higher proportions in the Lower Phase (14.2%).

Table 7.13. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of butt types on chert flakes by phase

	Upper Phase	Middle Phase	Lower Phase
Cortical	41 19.7%	32 24.2%	19 15.8%
Plain	102 49.0%	58 43.9%	44 36.7%
Dihedral	4 1.9%	11 8.3%	12 10.0%
Faceted	20 9.6%	13 9.9%	10 8.3%
Punctiform	10 4.8%	5 3.8%	17 14.2%
Crushed	31 14.9%	13 9.9%	18 15.0%
Total	208 100.1%	132 100.0%	120 100.0%

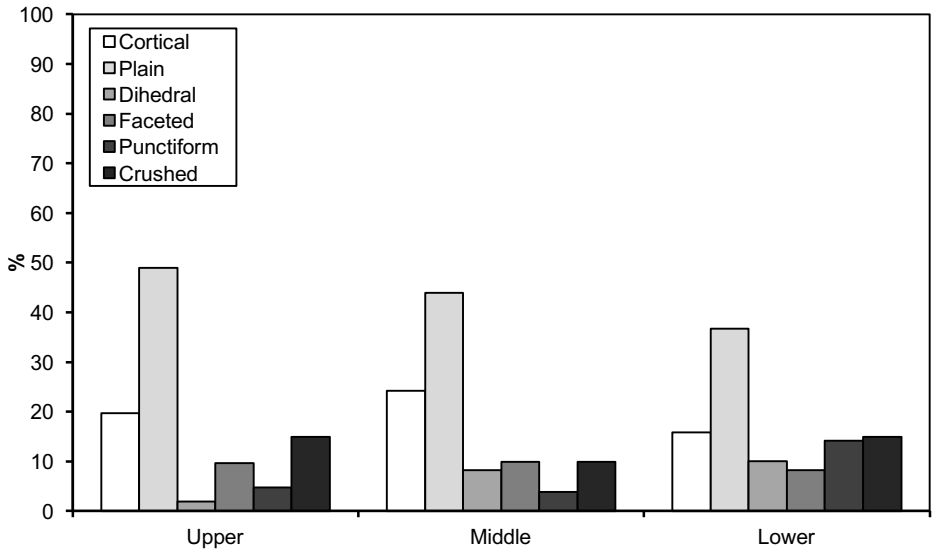


Figure 7.5. Grotte des Pigeons (Taforalt):
Relative frequencies of butt types on chert flakes by phase

The proportion of striking platforms on chert flakes with abrasion are shown in Table 7.14 and Figure 7.6. Fisher's exact test indicates that there was a significant difference in the occurrence of abrasion across the sequence (p = .001). There were relatively low frequencies of abrasion irrespective of the phase, although notably higher frequencies in the Lower and Middle Phases (14.4% and 16.7%, respectively) compared with those from Upper Phase (4.8%).

Table 7.14. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of abrasion on chert flakes by phase

	Upper Phase	Middle Phase	Lower Phase
Abraded	10 4.8%	19 14.4%	20 16.7%
Not Abraded	198 95.2%	113 85.6%	100 83.3%
Total	208 100.0%	132 100.0%	120 100.0%

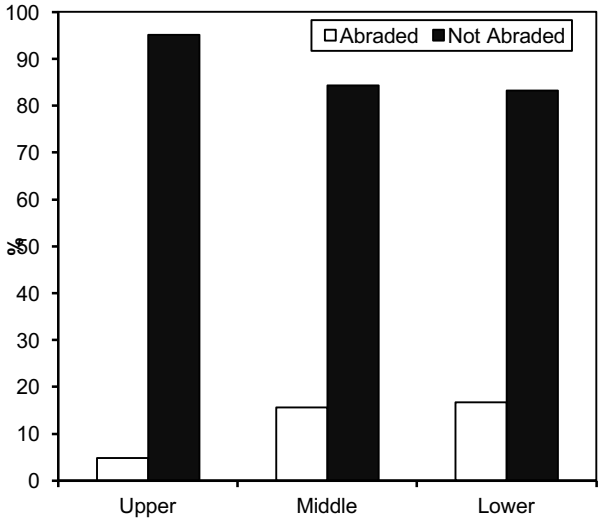


Figure 765. Grotte des Pigeons (Taforalt):
Relative frequencies of abrasion on chert flakes by phase

The proportions of identifiable dorsal scar patterns on chert flakes are shown in Table 7.15 and Figure 7.7. Fisher's exact test indicates that there was no significant difference in the dorsal scar patterns observed across the sequence (p = .610). Overall, unidirectional patterns were the most common (51.4%), followed by multidirectional scars (32.1%), and much lower proportions of opposed (11.2%) and crossed (6.9%) scars.

Table 7.15. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of dorsal scar patterns on chert flakes by phase (excluding indeterminate)

	Upper Phase	Middle Phase	Lower Phase
Unidirectional	57 47.9%	43 52.4%	49 55.1%
Opposed	12 10.1%	6 7.3%	10 11.2%
Crossed	8 6.7%	4 4.9%	8 9.0%
Multidirectional	42 35.3%	29 35.4%	22 24.7%
Total	119 100.0%	82 100.0%	89 100.0%

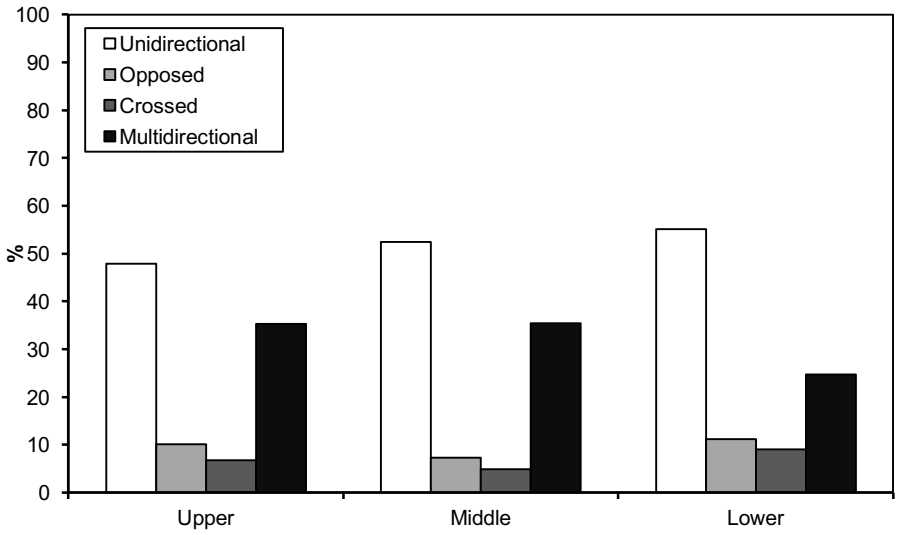


Figure 7.7. Grotte des Pigeons (Taforalt):
Relative frequencies of dorsal scar patterns on chert flakes by phase (excluding indeterminate)

The proportions of terminations on chert flakes are shown in Table 7.16 and Figure 7.8. Fisher's exact test indicates that there was no significant difference in the individual terminations observed across the sequence (p = .079). Overall, flakes with feathered (40.0%) and overshot (40.2%) terminations were dominant, with much smaller proportions of hinged (11.7%) and stepped (8.4%) terminations.

Table 7.16. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of terminations on chert flakes by phase

	Upper Phase	**Middle Phase**	**Lower Phase**
Feathered	88 42.3%	41 31.1%	55 45.8%
Hinged	26 12.5%	12 9.1%	16 13.3%
Overshot	80 38.5%	66 50.0%	39 32.5%
Stepped	14 6.7%	13 9.9%	10 8.3%
Total	208 100.0%	132 100.1%	120 99.9%

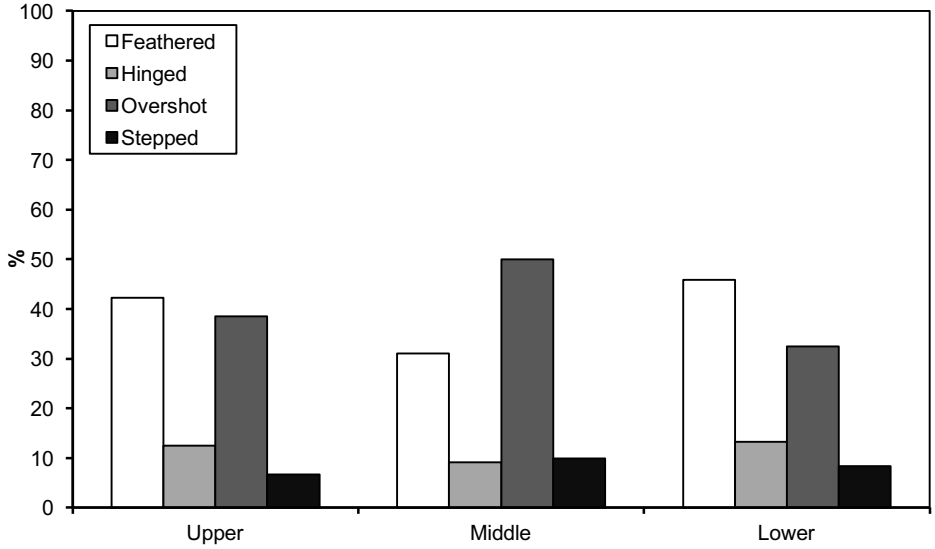


Figure 7.8. Grotte des Pigeons (Taforalt):
Relative frequencies of terminations on chert flakes by phase

The metric data on chert flakes is shown in Table 7.17 and in Figures 7.9-7.11. The flakes were all small, only one being greater than 50 mm in length (from the Upper Phase). Nonetheless, there were some indication of size variation in these flakes between the Upper, Middle, and Lower Phases. Kruskal-Wallis tests were used to compare the dimensions of flakes across the sequence. There was not a significant difference in terms of length (H=0.023(2), p=.988), but there was borderline significance in terms of width (H=5.886(2), p=.053) and significance in terms of thickness (H=6.243(2), p=.044). Post-hoc tests were conducted given the statistically significant results of the Kruskal-Wallis tests. In terms of width, the Lower Phase was found to be significantly different from both the Upper Phase (p=.027) and Middle Phase (p=.037). However, the Upper Phase and Middle Phase did not differ significantly (p=.950). The flakes are narrower from the Lower Phase than in the Middle Phase and Upper Phase. In terms of thickness, the Lower Phase was found to be significantly different from both the Upper Phase (p<.021) and Middle Phase (p=.009). However, the Upper Phase and Middle Phase did not differ significantly (p=.285). The flakes are thinner in the Lower Phase, than in the Middle and Upper Phases.

Table 7.17. Grotte des Pigeons (Taforalt): Dimensions on chert flakes

	N	Mean	S.D	Median	Range	Midrange
Upper Phase						
Length	208	23.06	5.28	22.5	12.4-52.9	19.9-25.6
Width	208	19.90	5.91	19.4	9.3-51.3	15.5-23.5
Thickness	208	5.48	2.28	5.1	1.3-11.4	3.8-6.9
Middle Phase						
Length	132	23.09	5.08	22.3	12.6-41.9	19.0-26.0
Width	132	19.83	5.49	19.4	9.3-34.5	15.7-23.1
Thickness	132	5.65	2.35	5.4	1.3-13.2	3.8-7.0
Lower Phase						
Length	120	22.96	4.95	22.1	11.4-40.5	19.7-25.7
Width	120	18.54	6.01	18.0	7.1-39.6	14.3-21.9
Thickness	120	5.12	2.75	4.6	1.1-12.7	3.1-6.7

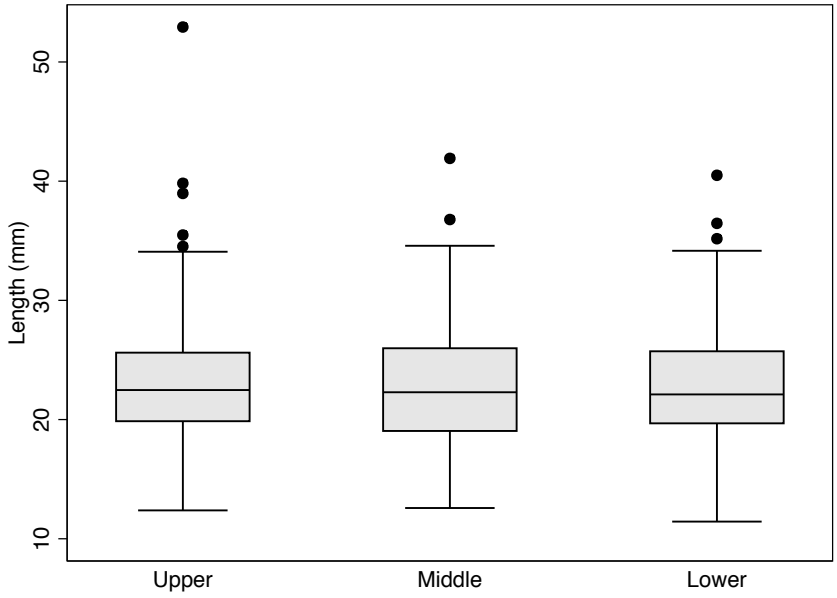


Figure 7.9. Grotte des Pigeons (Taforalt): Boxplot showing length of chert flakes by phase

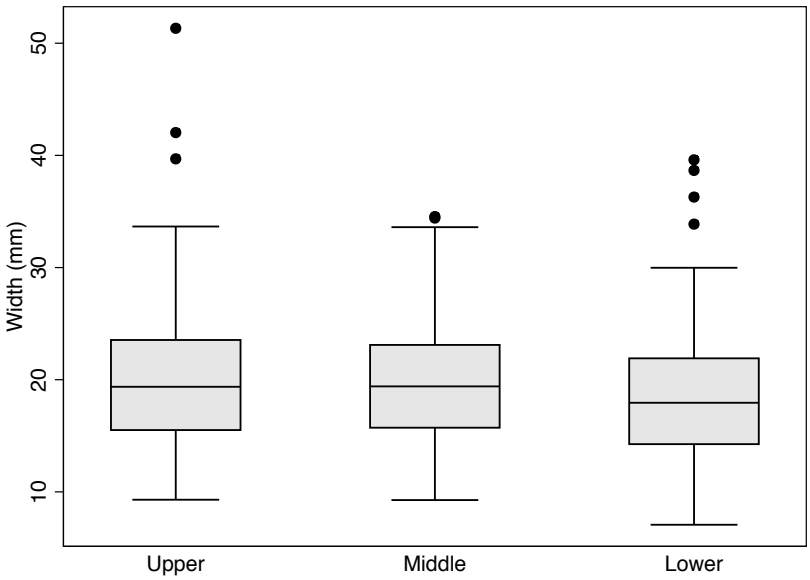


Figure 7.10. Grotte des Pigeons (Taforalt): Boxplot showing width of chert flakes by phase

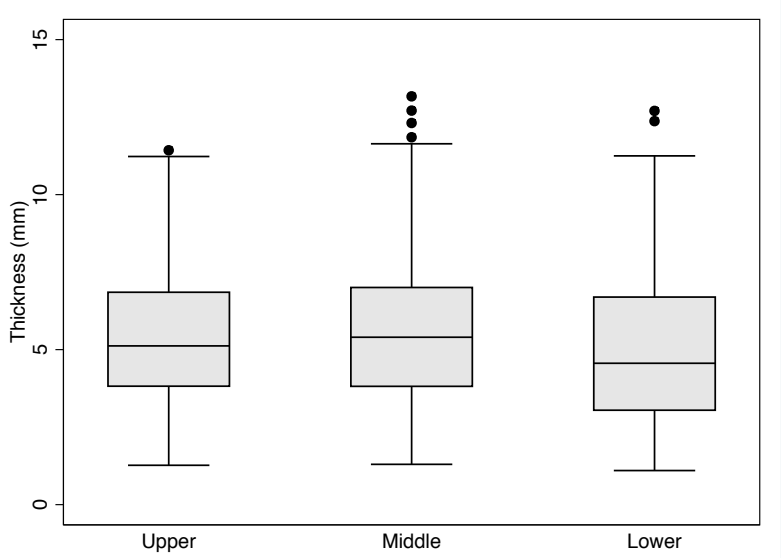


Figure 7.11. Grotte des Pigeons (Taforalt): Boxplot showing thickness of chert flakes by phase

In summary, there were a few differences between the chert flakes from each unit. The Lower Phase had relatively wider and thinner flakes, with slightly more punctiform butts, than in the Middle and Upper Phases. Nonetheless, there were high proportions of cortical flakes throughout, which indicates that the flakes served primarily for roughing out and shaping the cores, rather than as blanks. The major differences on the chert flakes mirror those observed on the blades (see below).

In total, across the three phases, there were only 78 whole limestone flakes (≥20 mm maximum dimension). The majority of these were from the Upper Phase (n=59), with much smaller

numbers in the Middle (n=5) and Lower (n=14) Phases. The small number of flakes limited statistical comparisons between these three chronological divisions. As such, the limestone flakes were grouped for description. The vast majority of the of the limestone flakes retained cortex, divided between less than 25% cortex (18.0%), between 25-50% cortex (14.1%), more than 50% cortex (20.5%), and 100% cortex (100.0%). Only a small proportion had no cortex (25.6%). The butts were overwhelming cortical (35.9%) and plain (42.3%), with strong proportions of crushed (15.4%), and only two examples of dihedral (2.6%) and three of faceted (3.5%) types. There was only abrasion in a single case, which accounted for only 1.3% of the flakes. Of the identifiable non-cortical dorsal scar patterns (n=28) the vast majority were multidirectional (67.9%) and the rest were unidirectional (32.1%). The flakes were generally quite large, squat, and thick, with median length, width, and thickness, of respectively 28.3 mm (range 12.1-77.3 mm, n=78), 26.0 mm (range 10.4-59.1 mm, n=78), and 6.2 mm (range 1.7-24.4 mm, n=78).

In conclusion, the limestone flakes were dominated by relatively long, wide, and thick cortical flakes. The limestone flakes tended to come from multidirectional cores. The majority of flakes had cortical or plain striking platforms. The edge was rarely abraded.

7.4.2 Blades

Blades were quite poorly represented throughout the sequence, but their relative frequencies decreased significantly over time accounting for a higher proportion in the Lower Phase (20.9%) than the Middle Phase (16.9%), and in turn, in the Middle Phase than the Upper Phase (12.8%)(Table 7.1). The Lower and Middle Phases were characterised by blade:flake ratios of 0.36:1 and 0.35:1 respectively, while the Upper Phase blade:flake ratio declined to 0.21:1.

All of the blades were on chert. The proportions of the different colour cherts on the blades are shown in Table 7.18 and Figure 7.12. The vast majority were indeterminate in colour as a result of the high proportions of burning in the assemblage (see below). There is a clear dominance of pale brown/yellowish brown and brown/strong brown cherts, which, excluding those indeterminate in colour, made up the majority of blades (34.5% and 29.6%, respectively). There was not a significant

difference in the colour of the blades between the Upper, Middle, and Lower Phases (Fisher's exact, p = .410).

Table 7.18. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of the colour of blades by phase

	Upper Phase	Middle Phase	Lower Phase
Black	1 4.6%	1 2.1%	2 4.4%
Dark grey	1 4.6%	-	2 4.4%
Grey/light grey	2 9.1%	3 6.4%	5 10.9%
Greyish brown	1 4.6%	6 12.8%	3 6.5%
Pale brown/yellowish brown	8 36.4%	15 31.9%	17 37.0%
Brown/strong brown	5 22.7%	13 27.7%	16 34.8%
Reddish brown	2 9.1%	1 2.1%	1 2.2%
Dusky red/weak red	1 4.6%	2 6.4%	-
White	1 4.6%	5 10.6%	-
Subtotal	22	47	46
Indeterminate	(71) (76.3%)	(31) (39.7%)	(23) (33.3%)
Total	93	78	69

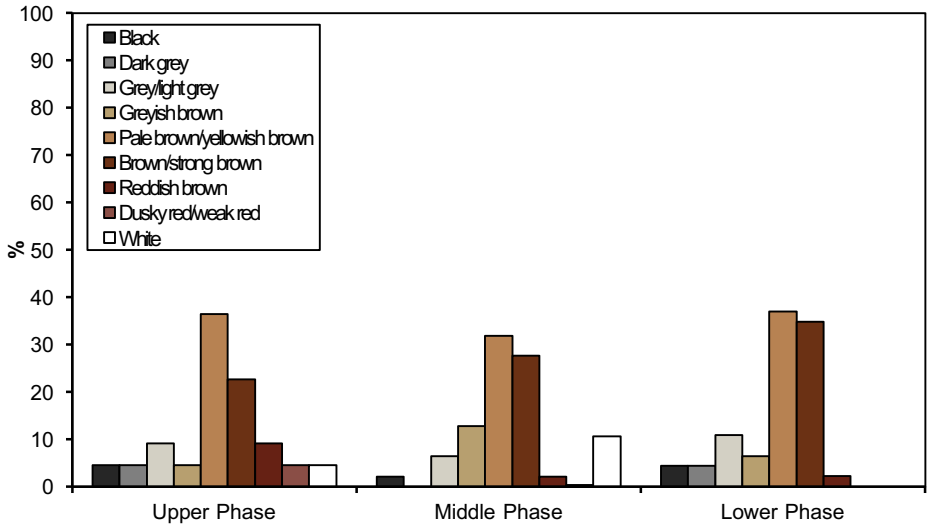


Figure 7.12. Grotte des Pigeons (Taforalt):
Relative frequencies of colour of blades by phase (excluding indeterminate)

The proportion of dorsal cortex retained on the blades is shown in Table 7.19 and Figure 7.13. Fisher's exact test indicates that the difference between the phases and the proportion of dorsal cortex retained on blades was significant (p=.003). There was a clear increase in the proportion of blades without any cortex, and corresponding decreases in the cortical blades towards the bottom of the

sequence. There were relatively few blades without cortex in the Upper Phase (43.0%), with an intermediate frequency in the Middle Phase (64.1%), and many more in the Lower Phase (73.9%). On the blade fragments there was a significant difference between the phases and the proportion of blades retaining cortex (Fisher's exact, $p < .001$). In each phase the majority of blade fragments retained cortex, but there were much higher frequencies of blade fragments without cortex in the Lower Phase (83.2%), than in the Middle and Upper Phases (64.0% and 62.3%, respectively).

Table 7.19. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of cortex on blades by phase

	Upper Phase	**Middle Phase**	**Lower Phase**
None	40 43.0%	50 64.1%	51 73.9%
Less than 25%	26 28.0%	16 20.5%	8 11.6%
Between 25-50%	18 19.4%	6 7.7%	5 7.3%
More than 50%	6 6.5%	6 7.7%	3 4.4%
100%	3 3.2%	-	2 2.9%
Total	93 100.1%	78 100.0%	69 100.1%

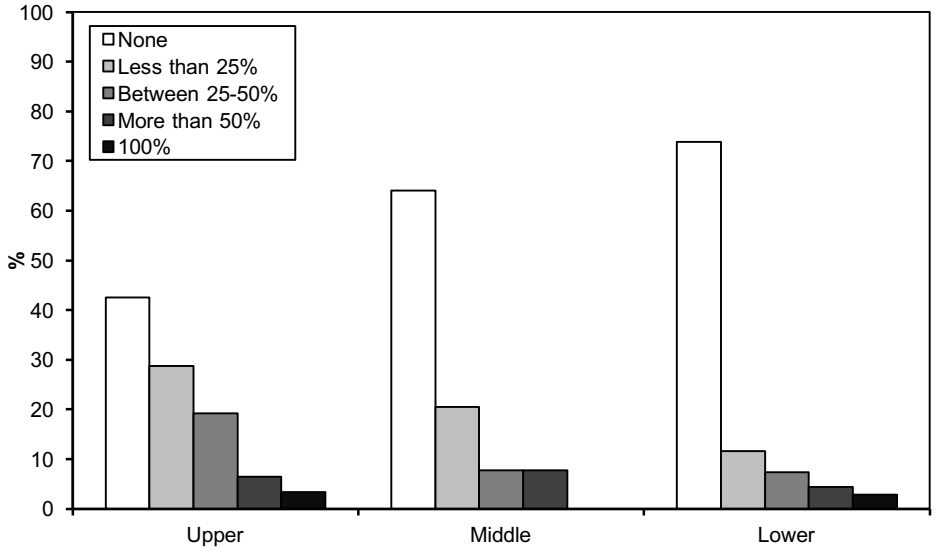


Figure 7.13. Grotte des Pigeons (Taforalt):
Relative frequencies of cortex on blades by phase

The proportion of striking platform types on blades is shown in Table 7.20 and Figure 7.14. Fisher's exact test indicates that the striking platform types differed significantly between and across the sequence (p <.001). Pairwise comparisons indicate that the Lower Phase was significantly different from the Middle ($p < .001$) and Upper Phases ($p < .001$). However, the Upper Phase and Middle Phase

did not differ significantly (p=.255). There was a clear increase in the proportion of blades with punctiform striking platforms, and corresponding decreases in plain and crushed striking platforms, towards the bottom of the sequence. There were similarly low proportions of punctiform butts in the Upper (25.8%) and Middle Phases (28.2%) and much higher proportions in the Lower Phase (65.2%). Of the blade fragments a similar pattern was observed, with much lower proportions of punctiform butts in the Upper (26.7%) and Middle Phases (43.8%), than observed in the Lower Phase (74.0%). The change in the butt morphologies might indicate a shift from hard-hammer manufacture in the Upper and Middle Phases, towards soft-hammer manufacture in the Lower Phase.

Table 7.20. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of butt types on blades by phase

	Upper Phase	**Middle Phase**	**Lower Phase**
Cortical	6 6.5%	5 6.4%	4 5.8%
Plain	25 26.9%	18 23.1%	6 8.7%
Dihedral	3 3.2%	1 1.3%	2 2.9%
Faceted	9 9.7%	3 3.9%	-
Punctiform	24 25.8%	22 28.2%	45 65.2%
Crushed	26 28.0%	29 37.2%	12 17.4%
Total	93 100.1%	78 100.0%	69 100.1%

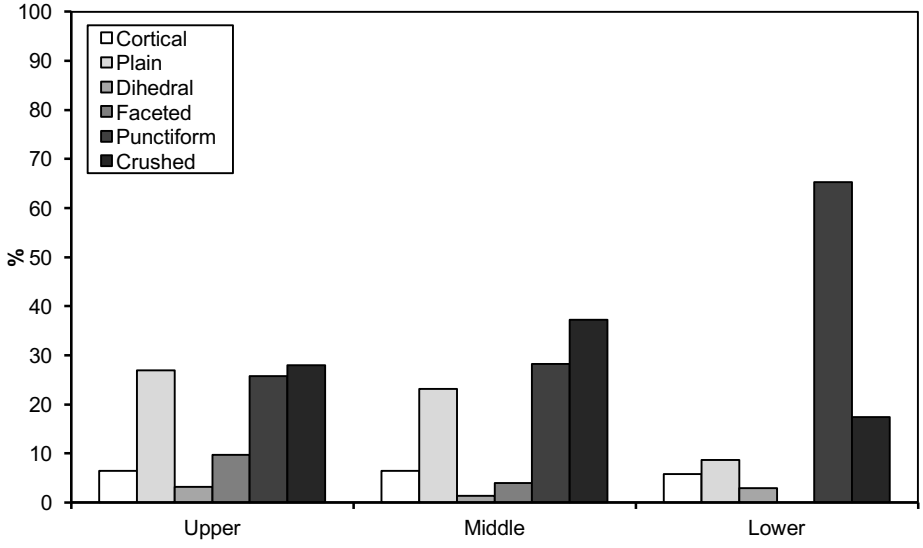


Figure 7.14. Grotte des Pigeons (Taforalt):
Relative frequencies of butt types on blades by phase

The proportions of striking platforms on blades with abrasion are shown in Table 7.21 and Figure 7.15. Fisher's exact test indicates that there was a significant difference in the occurrence of abrasion across the sequence (p = .001). The highest relative frequency of abrasion was recorded in the Lower Phase (50.7%), with an intermediate number in the Middle Phase (41.0%), and many fewer in the Upper Phase (22.6%). Of the blade fragments a similar pattern was observed, with much higher proportions of abrasion in the Lower Phase (64.8%), an intermediate number in the Middle Phase (53.1%), and many fewer in the Upper Phase (21.7%).

Table 7.21. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of abrasion on blades by phase

	Upper Phase	**Middle Phase**	**Lower Phase**
Present	21 22.6%	32 41.0%	35 50.7%
Absent	72 77.4%	46 59.0%	34 49.3%
Total	93 100.0%	78 100.0%	69 100.1%

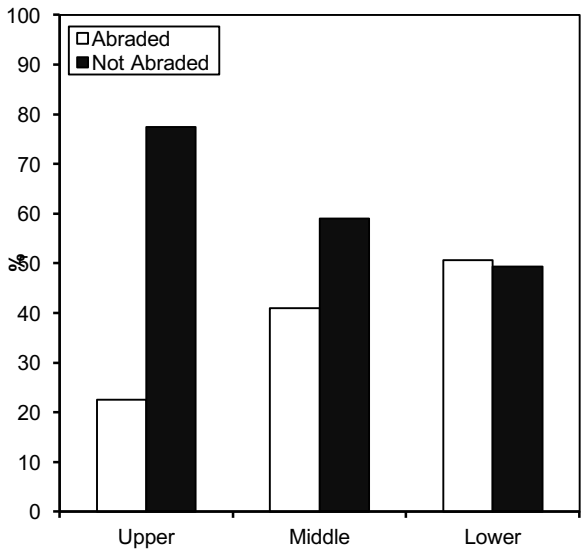


Figure 7.15. Grotte des Pigeons (Taforalt):
Relative frequencies of abrasion on blades by phase

The proportions of identifiable dorsal scar patterns on blades are shown in Table 7.22 and Figure 7.16. Fisher's exact test indicates that there was no significant difference in the dorsal scar patterns observed across the sequence (p = .345). Overall, unidirectional patterns were the most common (61.1%), followed by opposed (20.1%), and similar proportions of crossed (8.9%) and multidirectional (9.4%) scars. Interestingly, there was a notable increase in the proportion blades with opposed dorsal scars in

the Upper Phase (27.6%) from the Lower Phase (16.7%). A similar pattern was broadly reflected in blade fragments, with much higher proportions of opposed dorsal scars in the Upper Phase (26.0%) than in the Lower Phase (7.9%). There was not a clear dichotomy in relation to the Middle Phase; of the blades a similar proportion (16.4%) was observed as in the Lower Phase, but of the blade fragments the proportion (20.8%) was more similar to that observed in the Upper Phase.

Table 7.22. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of dorsal scar patterns on blades by phase (excluding indeterminate)

	Upper Phase	**Middle Phase**	**Lower Phase**
Unidirectional	42 55.3%	44 65.7%	38 63.3%
Opposed	21 27.6%	11 16.4%	10 16.7%
Crossed	4 5.3%	8 11.9%	6 10.0%
Multidirectional	9 11.8%	4 6.0%	6 10.0%
Total	76 100.0%	67 100.0%	60 100.0%

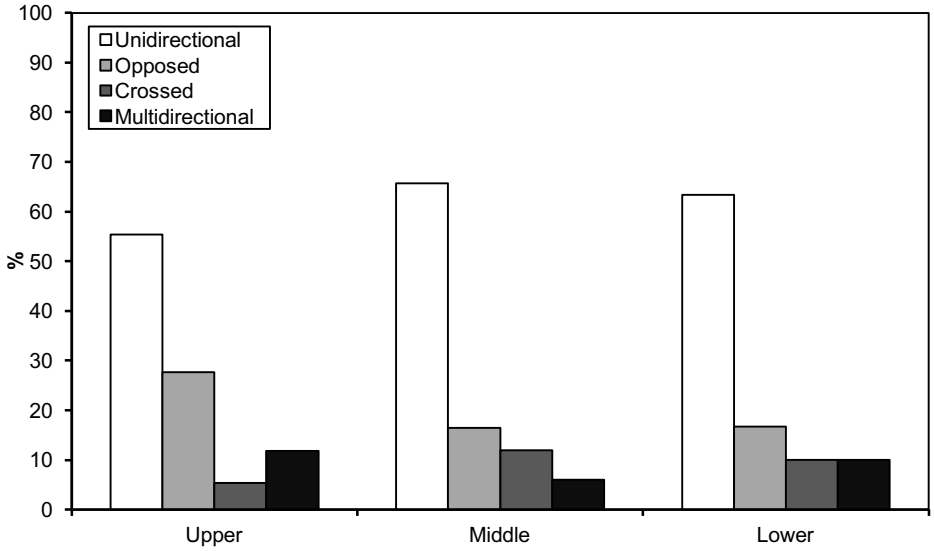


Figure 7.16. Grotte des Pigeons (Taforalt):
Relative frequencies of dorsal scar patterns on blades by phase (excluding indeterminate)

The proportions of terminations on blades are shown in Table 7.23 and Figure 7.17. Fisher's exact test indicates that there was no significant difference in the individual terminations observed across the sequence (p = .701). Overall, the terminations were most often feathered (47.5%), but there were high proportions of hinged (20.8%), overshot (15.0%), and stepped (16.7%) examples. It is interesting to note that the highest proportion of blades with feathered terminations was recorded in the Upper Phase

(53.8%), whereas smaller similar proportions were observed in the Middle Phase and Lower Phase (43.6% and 43.5%, respectively).

Table 7.23. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of terminations on blades by phase

	Upper Phase	Middle Phase	Lower Phase
Feathered	50 53.8%	34 43.6%	30 43.5%
Hinged	15 16.1%	18 23.1%	17 24.6%
Overshot	13 14.0%	11 14.1%	12 17.4%
Stepped	15 16.1%	15 19.2%	10 14.5%
Total	93 100.0%	78 99.9%	69 100.0%

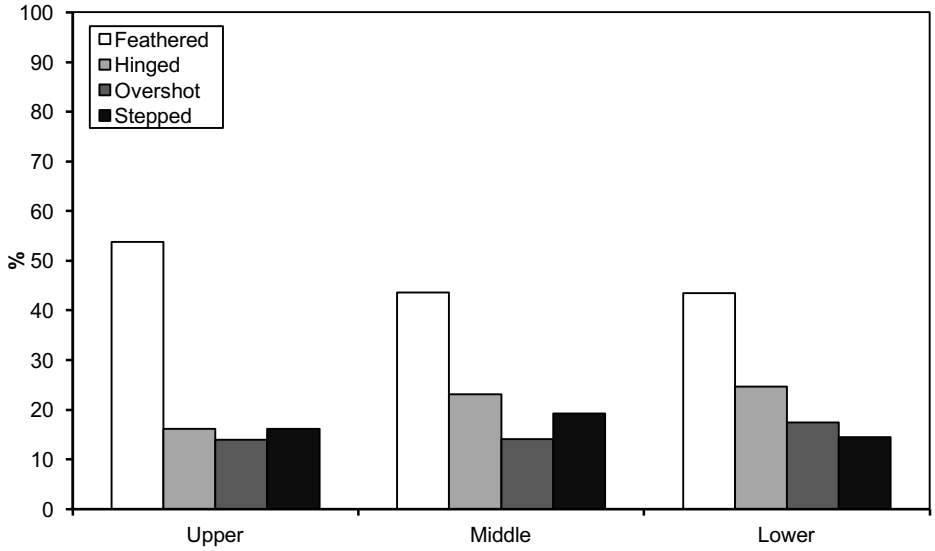


Figure 7.17. Grotte des Pigeons (Taforalt):
Relative frequencies of terminations on blades by phase

The metric data on blades in shown in Table 7.24 and Figures 7.18 through 7.20. None were blades *sensu stricto* (Tixier, 1963, p.38), all were small blades or bladelets. Nonetheless, there was some indication of size variation in the blades between the Upper, Middle, and Lower Phases. Kruskal-Wallis tests were used to compare the dimensions of blades across the sequence. There was not a significant difference in terms of length (H=1.248(2), p=.536), but there was in both the width (H=7.854(2), p=.020) and thickness (H=13.753(2), p=.001) of the blades. Post-hoc tests were conducted given the statistically significant results of the Kruskal-Wallis tests.

In terms of width, the Lower Phase was found to be significantly different from both the Upper Phase (p=.003) and Middle Phase (p=.022). However, the Upper Phase and Middle Phase did not differ significantly (p=.255). The blades are narrower from the Lower Phase than in the Middle Phase and Upper Phase. In terms of thickness, the Lower Phase was found to be significantly different from both the Upper Phase (p<.001) and Middle Phase (p=.018). In addition, the Upper Phase and Middle Phase was of borderline significance (p=.057). The blades are thinner in the Lower Phase, than in the Middle Phase, and, in turn, the Upper Phase.

Table 7.24. Grotte des Pigeons (Taforalt): Dimensions on blades by phase

	N	Mean	S.D	Median	Range	Midrange
Upper Phase						
Length	93	26.75	7.27	27.0	11.6-45.1	20.9-31.6
Width	93	10.08	3.23	9.7	4.1-18.2	7.8-11.7
Thickness	93	4.03	1.85	3.6	1.1-8.8	2.7-5.5
Middle Phase						
Length	78	26.23	6.59	24.0	14.9-40.7	21.4-30.6
Width	78	9.65	2.80	9.5	4.5-16.8	7.9-11.1
Thickness	78	3.63	1.75	3.1	1.2-8.6	2.3-4.9
Lower Phase						
Length	69	25.39	7.09	24.3	13.2-45.8	19.7-28.3
Width	69	8.78	2.84	8.2	4.6-16.6	6.9-10.5
Thickness	69	2.99	1.22	2.7	1.2-5.7	2.0-3.9

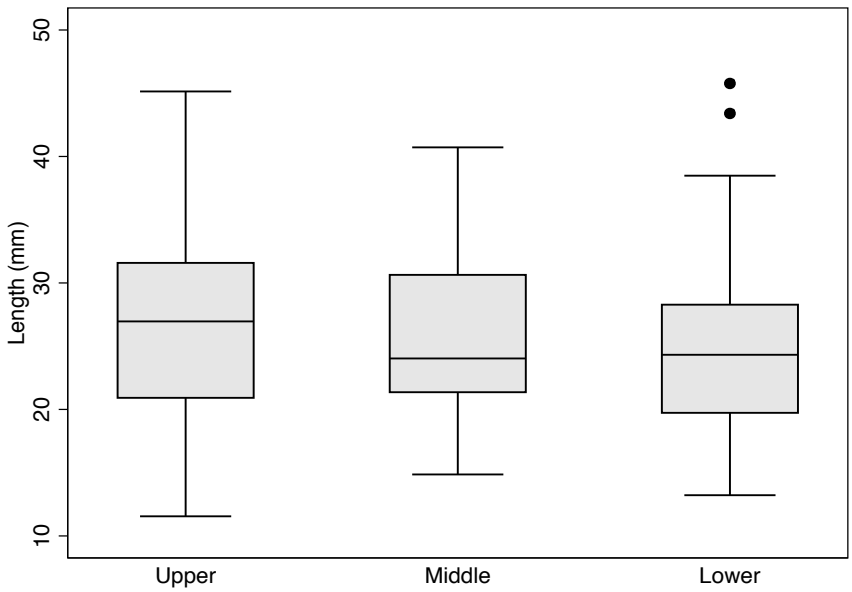


Figure 7.18. Grotte des Pigeons (Taforalt): Boxplot showing length of blades by phase

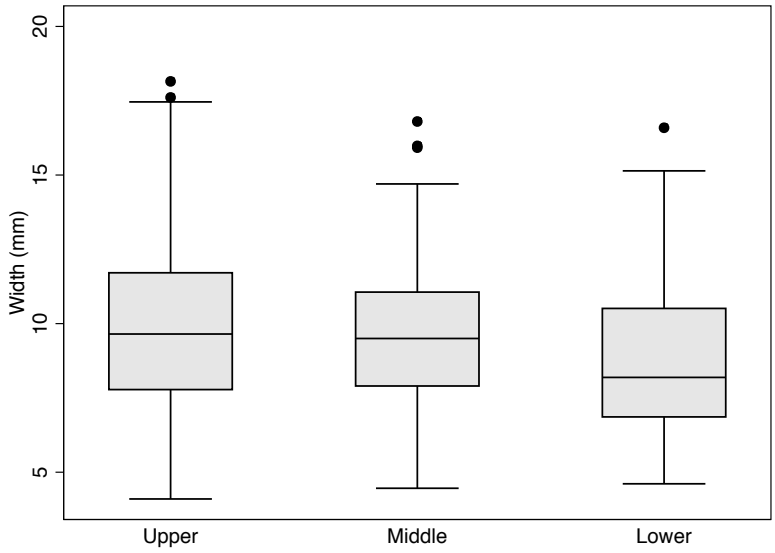


Figure 7.19. Grotte des Pigeons (Taforalt): Boxplot showing width of blades by phase

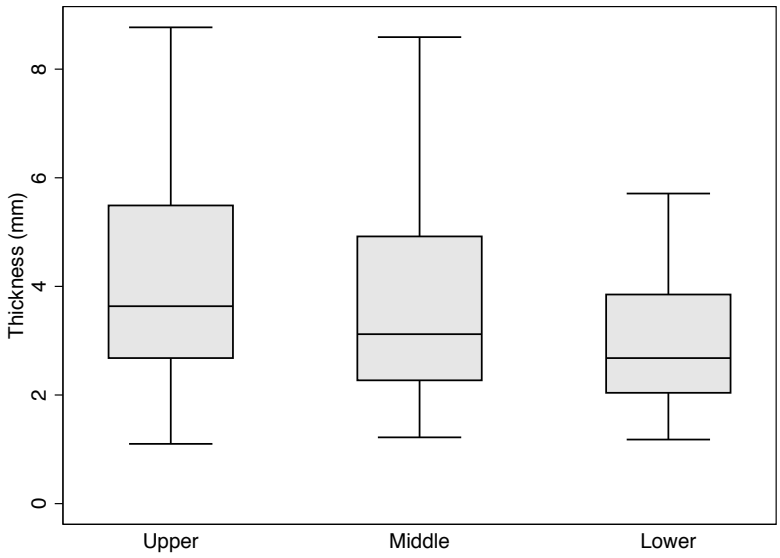


Figure 7.20. Grotte des Pigeons (Taforalt): Boxplot showing thickness of blades by phase

In summary, the blade assemblage from the Lower Phase was most distinct from those of the Middle and Upper Phases. The Lower Phase was dominated by relatively narrow and thin small blades. It had also more punctiform blades with abrasion. In addition, the blades accounted for higher proportion of the diagnostic artefacts, especially non-cortical blades. In contrast, the Middle had significantly wider and thicker blades. Plain and crushed platforms were much more common. There was also a reduction in the proportion of blades, with fewer non-cortical blades. The Upper Phase differed little from Middle Phase. The only significance difference was a further reduction in the

number of blades, especially non-cortical blades. The reduction in the numbers of blades, specifically non-cortical blades, was probably due to a more intensive use of available blanks towards the top of the sequence, particularly in the Upper Phase.

7.4.3. Core-trimming elements

In total 82 core-trimming elements, including 65 crested blades, 10 *flanc de nucleus*, and 7 platform rejuvenation flakes, were recovered from deposits assigned to a specific phase. These were found in low proportions throughout the sequence, accounting for a slightly higher proportion of the diagnostic artefacts from the Upper and Middle Phase (2.2% and 2.6%, respectively), than in the Lower Phase (1.1%). However, the core-trimming element:core ratios indicated that shaping of the core was slightly more common in the Upper Phase (0.93:1), than in the Middle and Lower Phases (0.60:1 and 0.69:1, respectively). Fisher's exact test indicate that there was no significant difference in the types of core-trimming elements across the sequence (p = .836).

The most common core-trimming element were crested blades (between 1.0 – 2.0% of the diagnostic artefacts from each phase). These were all on chert. The vast majority were indeterminate in colour as a result of burning. There was a significant difference in the proportions of crested blades with evidence of burning across the sequence (Fisher's exact p = .004). In the Upper Phase the overwhelming majority were burnt (72.7%) with much smaller frequencies in the Middle and Lower Phases (31.8% and 30.0%, respectively).

Of those crested blades without evidence of burning (n=31) there was not a significant difference in terms of colour of raw material (Fisher's exact, p = .559). Overall these were most often brown/strong brown (40.7%) and pale brown/yellowish brown (40.7%), followed by much lower proportions of black (3.7%), greyish brown (7.4%), red/reddish brown (3.7%), and white (3.7%).

The overwhelming majority (63.1%) of the crested blades were prepared only along a single versant. There were much fewer of these prepared along both versants (9.2%). A very small proportion of the crested blades were second removals (3.1%). There were also a number of fragments (24.6%).

There were no perceivable differences in the morphology of the crest blades across the phases. The crested blades tended to be rather crude. The crested blades often retained some cortex (41.5%).

Kruskal-Wallis tests were used to compare the dimensions of crested blades across the sequence. There was not a significant difference in terms of length ($H=1.295(2)$, $p = .523$), width ($H=0.172(2)$, $p = .917$), and thickness ($H=4.011(2)$, $p = .135$). The median length, width, and thickness values, were respectively, 28.8 mm (range 17.1-37.9 mm), 9.0 mm (range 3.9-17.9 mm), and 4.8 mm (range 2.6-11.9 mm).

The platform rejuvenation flakes were found in smaller proportions (between 0.1 - 0.2%). None of these were core tablets, but instead removed only the edge of the platform. There were too few of these artefacts (n=7) to make useful statistical comparisons between the phases. They were all on chert. Most showed evidence of burning (n=5) and there were a couple on pale brown/yellowish chert (n=2). Overall, the median length, width, and thickness values, were respectively, 16.9 mm (range 14.7-21.6 mm), 18.9 mm (8.1-21.6 mm), and 4.8 mm (range 2.7-8.3 mm).

The *flancs de nucleus* only represented a small proportion of the diagnostic artefacts from Upper Phase and Middle Phase (0.3% and 0.4%, respectively) and were absent in the Lower Phase. However, as noted above, there was not a significant difference in the types of core-trimming elements across the sequence. The absence might be an effect of the much smaller number of artefacts in the Lower Phase. In absolute terms there were too few of these artefacts (n=10) to make useful statistical comparisons of the attribute and metrical from each of the phases. All of the *flancs de nucleus* were on chert. There was a high proportion that are burnt (n=7). Those without evidence of burning were made on black (n=1), greyish brown (n=1), and brown/strong brown (n=1) cherts. The median length, width, and thickness values, were respectively, 28.0 mm (range 15.7-38.1 mm), 19.4 mm (range 14.5-29.5 mm), and 8.7 mm (range 5.0-14.9 mm).

7.5. Microburins & Related Products

In total, 166 microburins and related products were recorded, including 158 true microburins, seven Krukowski microburins, and one trihedral point. These were in absolute and relative terms overwhelmingly from the Middle Phase (n=145, 13.4%). There were only small frequencies from both the Upper (n=11, 0.6%) and Lower (n=10, 1.0%). The microburin index was 0.598 in the Middle Phase, whilst it was only 0.040 in the Upper Phase and 0.066 in the Lower Phase. A description of the microburins from each phase is given below.

The Upper Phase included only a small number of microburin products, five microburins, and six Krukowksi microburins. The microburins were restricted to the top of the Upper Phase (L2-9), however absence from the lower deposits of the phase might be accounted for by the limited sample size. There was one more microburin from the proximal end (n=3) than at the distal end (n=2) of the blank. Notching was generally not deep, but characterised by fine shallow retouch. The notch was more often at the left margin (n=4) than at the right margin (n=1). Of the small sample, the microburins were quite restricted in size, and on narrow and thin blanks. The median values of length, width, and thickness, were respectively, 7.8 mm (5.7-15.3 mm, n=5), 7.2 mm (3.7-10.3 mm, n=5), and 2.4 mm (range 1.2-3.4 mm, n=5). Despite the lack of microburins and trihedral points, the retouched tools were dominated by microlith forms normally thought to involve the microburin technique (e.g. convex backed bladelet *sensu lato*, segments).

The Middle Phase included 143 microburins, one trihedral point, and one Krukowski microburin. The microburins most often removed the distal end of the blank (77.0%), with much lower frequencies removing the proximal end (23.0%). Notching was always direct, usually quite regular, and did not always form a distinct notch. The notch was overwhelmingly applied to the left margin (76.3%) and less frequently at the right margin (23.7%). There was a significant correlation between the end of the blade that was removed and the position of the notch (Fisher's exact, $p < .001$). The distal microburins were almost exclusively notched at the left edge (93.5%) and, in contrast, the proximal microburins had a strong tendency to be notched at the right edge (81.3%). The most

distinctive feature of the microburins was the generally large size and thickness, although there was a wide size distribution. The median values of length, width, and thickness, were respectively, 17.6 mm (8.1-32.3 mm, n=143), 10.4 mm (4.1-22.6 mm, n=143), and 3.6 mm (range 1.5-8.1 mm, n=143). In addition to the numerous microburins, the Middle Phase was overwhelming dominated by microlith forms commonly agreed to have involved the microburin technique (e.g. convex backed bladelets *sensu lato*, La Moulliah points).

The Lower Phase included only 10 microburins. These were most often from the proximal end (n=8) rather than the distal end (n=2) of the blank. Notching was always direct, quite regular, and shallow. The notch was most often at the right edge (n=8) and less often at the left edge (n=2). The proximal microburins were each notched at the right edge and, in contrast, the distal microburins were both notched at the left edge. The few microburins were quite restricted in size, and on narrow and thin blanks. The median values of length, width, and thickness, were respectively, 11.2 mm (5.5-19.9 mm, n=10), 6.9 mm (4.3-13.8 mm, n=10), and 2.2 mm (range 1.2-5.5 mm, n=10). In addition to the low proportions of microburins, microlith forms commonly associated with microburin technique were extremely rare, or absent, in the Lower Phase.

In summary, microlith forms associated with the microburin technique dominatd in the Upper and Middle Phases (76.8% and 80.0%, respectively), although there were only a few microburins from the Upper Phase (n=5), whilst these were common in the Middle Phase (n=143). There was no significant difference in the end of blank removed by the microburins (Fisher's exact, $p = .093$) or the position of the notch (Fisher's exact, $p = 1.000$). Nonetheless, the microburins were longer, wider, and thicker, in the Middle Phase (Mood's median tests, $p = .058$). In fact, the Upper Phase microburins were on average half the length of those observed in the Middle Phase.

In contrast to the overlying phases, the microburin technique appears to have been rarely utilized in the Lower Phase. There were few microburins (n=10) and also relatively few microlith forms associated with the microburin technique (21.2%). In addition to the fact that the microburin technique was utilised less frequently, there were some salient differences in the microburins from the

Upper and Middle Phases. The majority of the microburins removed the butt on the blank in the Lower Phase (80.0%), more commonly than in the Upper Phase (60.0%), and significantly more so than in the Middle Phase (23.0%)(Fisher's exact, $p < .001$). The notch was most often applied to the right margin in the Lower Phase (80.0%), more so than in the Upper Phase (20.0%) and significantly more so than in the Middle Phase (23.0%)(Fisher's exact, $p < .001$). On average the microburins were narrower and thinner than in the Upper Phase and significantly more so than in the Middle Phase (Mood's median tests, $p < .003$), consistent with the dimensions of the unmodified blades. Nonetheless, there was not significant difference in terms of length, with microburins in the Lower Phase falling in-between the extremes of sizes observed in the Upper and Middle Phases.

7.6. Retouched Tools

The absolute and relative frequencies of tools according to class are given in Table 7.25. The retouched tools occured with the highest frequencies in the Upper Phase (21.4%), with slightly lower frequencies in the Middle and Lower Phases (15.1% and 17.4% respectively). The microlith and microlith fragments dominated throughout and were found in similar frequencies in the Upper Phase (85.8%), Middle Phase (86.0%), and Lower Phase (84.4%).

Table 7.25. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of retouched tool classes by phase

	Upper Phase	**Middle Phase**	**Lower Phase**
End-scrapers	13 3.1%	8 4.9%	4 2.4%
Backed flakes and blades	3 0.1%	-	-
Composite tools	1 0.0%	-	-
Microliths	181 42.8%	85 51.8%	56 33.5%
Microlith fragments	182 43.0%	56 34.1%	85 50.9%
Notches and denticulates	13 3.1%	1 0.6%	8 4.8%
Truncations	8 1.9%	3 1.8%	6 3.6%
Miscellaneous	23 5.4%	11 6.7%	8 4.8%
Total	423	164	167

A breakdown of the different microliths types is given in Table 7.26. A series of comparative statistical analyses were undertaken on the microliths and are discussed below. The number of artefacts belonging to each of the other retouched tool categories were too small to make meaningful statistical comparisons. A full description of these artefacts is given in Chapter 6.

7.6.1. Typological Classification

Upper Phase

The Upper Phase was dominated by convex backed bladelets *sensu lato* (types 56-59), which accounted for 67.5% of the microliths. Of these there was a relatively high proportion (34.2%) that were convex backed bladelets leading to segments (type 56b). The latter type differed little from the segments (type 82). These were technologically similar and represented variation along a continnum; each form was bi-truncated by convex retouch, differing only in the straightness of the unmodified edge and symmetry of retouched margin. The segments (type 82) were also found in their highest proportion in the Upper Phase.

Another notable feature of the of convex backed bladelets *sensu lato* (type 56-59) was the high proportion of types with additional basal retouch (26.3%). These were almost exclusively convex backed bladelets with acutely truncated bases (type 58), but did include, in much smaller proportions, those with rounded (type 57) and other forms of retouch (type 59).

The pointed straight backed bladelets *sensu lato* (types 45-52) also made up a relatively strong proportion (15.1%) of the microliths. These included a high proportion of types with additional basal retouch (59.2%), which tended to be dominated by those with acute truncated bases (type 47), as was the case with the convex backed bladelet *sensu lato* (types 56-59). It should be noted that Aïn Kéda points (type 52) were found only at the top of the Upper Phase, although only in very small numbers (3 or 1.7% of the microliths).

Table 7.26 Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of microliths by phase

Typology following Tixier's scheme	**Upper Phase**		**Middle Phase**		**Lower Phase**	
	N	%	N	%	N	%
16. Drill	1	0.6	-	-	-	-
34. Backed flake	2	1.1	-	-	-	-
45. Pointed straight backed bladelet	11	6.1	2	2.4	7	12.5
46. Pointed straight backed bladelet with rounded base	3	1.7	-	-	1	1.8
47. Pointed straight backed bladelet with truncated base	9	5.0	1	1.2	-	-
51. Pointed straight backed bladelet with retouched base	1	0.6	-	-	-	-
52. Aïn Kéda point	3	1.7	-	-	-	-
55. Bladelet with convex backed end	4	2.2	-	-	2	3.6
56. Convex backed bladelet						
a. typical	45	24.9	16	18.9	3	5.4
b. leading to segment	39	21.5	13	15.3	-	-
57. Convex backed bladelet with rounded base	2	1.1	2	2.4	2	3.6
58. Convex backed bladelet with truncated base	24	13.3	5	5.9	-	-
59. Convex backed bladelet with retouched base	4	2.2	2	2.4	-	-
60. Backed bladelet with gibbousity	1	0.6	1	1.2	-	-
61. Backed bladelet with narrowed base	4	2.2	-	-	-	
62. La Mouillah point	-	-	26	30.6		
63. Partially backed bladelet						
a. with pointed end	-	-	3	3.5	6	10.7
b. with unmodified ends	-	-	-	-	2	3.6
64. Shouldered bladelet	-	-	-	-	1	1.8
65. Shouldered point	-	-	1	1.2	-	-
67. Obtuse ended backed bladelet						
a. natural end	1	0.6	2	2.4	8	14.3
b. retouched end	-	-	-	-	-	-
68. Scalene bladelet	1	0.6	3	3.5	6	10.7
69. Pointed bladelet with Ouchtata retouch	5	2.8	-	-	2	3.6
70. Ouchtata bladelet						
a. retouched along entire lateral	1	0.6	1	1.2	8	14.3
b. retouched at proximal	-	-	-	-	5	8.9
71. Bladelet with Ouchtata retouch	5	2.8	3	3.5	1	1.8
82. Segment or semicircle	9	5.0	3	3.5	-	-
89. Isosceles or equilateral triangle	2	1.1	1	1.2	-	-
90. Scalene triangle	3	1.7	-	-	1	1.8
112. Pointed denticulated backed bladelet	-	-	1	1.2	-	-
112. Asymmetrical trapeze	1	0.6	-	-	1	1.8
Total	181		85		56	

None of the other microlith forms were well represented in the Upper Phase. There was a single backed bladelet with gibbosity (type 60) and a small proportion (2.2%) of backed bladelets with narrowed bases (type 61), which might well represent extremes of variation within the convex backed bladelets *sensu lato* (types 56-59). Likewise, the backed flakes (type 34) might be best understood in relation to this group. It is also possible that the few the bladelets with convex backed ends (type 55) were variants on a common theme of convex-backed bladelets *sensu lato* (types 56-59). In fact, these types were grouped with the latter by Brahimi (1970). These accounted for only a small proportion of the microliths (2.2%) and were the only forms with partial backing from the Upper Phase.

A relatively small proportion (6.2%) of the microliths were bladelets with Ouchata retouch *sensu lato* (types 69-71). These tended to be pointed bladelets with Ouchtata retouch (type 69) and bladelets with Ouchtata retouch (type 71), which were found in equal proportions. These tended to be morphologically similar to the convex backed bladelets *sensu lato* (type 56-59), although differed in the retouch intensity. A single microlith was recorded as an Ouchtata bladelet (type 70).

So-called 'geometrics' were also rare. In addition to the aforementioned segments (type 82), a couple of microliths were classified as isosceles or equilateral triangles (type 89) and three as scalene triangles (type 90), which together accounted for only 7.8% of the microliths. Nonetheless, the 'geometrics' were found in their highest proportion in the Upper Phase.

In should also be noted that a few other types were represented by a single artefact and were rare in the Upper Phase, including scalene bladelets (type 68) and obtuse ended backed bladelets (type 67). In addition, many microlith types were simply absent from the Upper Phase, including La Mouillah points (type 62)(Table 7.26).

Middle Phase

The Middle Phase was similarly dominated by convex backed bladelets *sensu stricto* (types 56-59), which accounted for 44.9% of the microliths. An almost identical proportion (34.2%) of these were convex backed bladelets leading to segments (type 56b). Likewise, these differed little from true segments (type 82), although the latter were slightly less common in the Middle Phase. Whilst many

of the convex backed bladelets *sensu lato* (type 56-59) were types with additional basal retouch (23.7%) these were somewhat less common than in the Upper Phase. Furthermore, the convex backed bladelets with acutely truncated bases (type 58) were not as dominant, although were nonetheless still the most frequent of the types with additional basal retouch.

As a general note, the convex backed bladelet *sensu lato* (type 56-59), and the other microliths types, appeared to some extent less well made than in the Upper Phase. It seems probable that the backed bladelet with gibbosity (type 60) from the Middle Phase represented one extreme of variation within the convex backed bladelets *sensu lato* (type 56-59).

A major difference from the overlying phase was the low proportion (3.5%) of pointed straight backed bladelets *sensu stricto* (types 45-52). There were only three artefacts in this group. Another microlith was pointed with well-formed denticulated backing. It did not fit any of the existing type definitions and was classified with the varia (type 112). Nonetheless, the pointed and elongated nature of the piece seems most similar to the pointed straight backed bladelets *sensu lato* (type 45-52).

One of the most distinct features of the Middle Phase was the presence and relatively high proportion (30.6%) of La Mouillah points (type 62). This type retained a microburin facet at the end(s). La Mouillah points (type 62) were absent from the other strata. There is some question as to whether these represent an intermediate stage within the manufacture of other microlith forms (e.g. convex-backed bladelets *sensu lato*, segments) or final tool forms in and of themselves. Judging by the lack of damage it seemed most plausible that the La Mouillah points were not utilised and served as an indeterminate stage in microlith manufacture. If this were the case, then the high discard rates of these 'unfinished' tools might indicate relative ease of access and a liberal use of raw material during the Middle Phase. Nonetheless, whether or not the La Mouillah points were utilised has yet to be fully tested. As such, the La Mouillah points were classified with the microliths as this is the standard convention in the study of the LSA of Northwest Africa.

None of the other microlith forms were particularly well represented in the Middle Phase. However, there still appeared to be some marked differences with the Upper Phase. A notable

difference was in the forms with partial backing. In contrast to the above strata, bladelets with convex backed ends (type 55) were absent in the Middle Phase. Instead, partially backed bladelets *sensu stricto* (type 63), specifically pointed forms, made up a small proportion (3.5%) of the microliths, although were still less important than in the Lower Phase. Likewise, a number of other forms appeared to increase in importance from the Upper Phase. For instance, obtuse ended backed bladelets (type 67) and scalene bladelets (type 68) were found in higher absolute and relative frequencies, but were still much less common than in the Lower Phase (Table 7.26).

In should be noted that the proportion of bladelets with Ouchtata retouch *sensu lato* (types 69-71) was slightly reduced from the Upper Phase. In the Middle Phase these accounted for only 4.7% of the microliths. Whilst bladelets with Ouchtata retouch *sensu stricto* (type 71) remained common within this category, pointed bladelets with Ouchtata retouch (type 69) were absent.

As noted above, segments (type 82) were slightly less common than in the Upper Phase. The only other so-called 'geometric' recorded from the Middle Phase was an isosceles triangle (type 89). As a group, the 'geometrics' accounted for only 4.7% of the microliths, which was slightly less than in the Upper Phase. One microlith was also recorded as a shouldered point (type 65). This form in many respects was similar to a triangle with one concave side (type 86), although was distinct in retaining the part of the butt (Tixier, 1963, p. 112).

Lower Phase

The Lower Phase marks a clear departure from the overlying phases. One of the most notable features was that convex backed bladelets *sensu lato* (types 56-59) were found only in a small numbers (5 or 8.0% of the microliths). In contrast, the convex backed bladelets *sensu lato* (types 56-59) were found in high frequencies in the Upper Phase and Middle Phase (67.5% and 44.9% respectively). None of these were sub-typed as convex backed bladelets leading to segments (type 56b) in the Lower Phase, which were common feature in the overlying phases. Likewise, no true segments (type 82) were recovered from the Lower Phase.

The class of pointed straight backed bladelets *sensu lato* (types 45-52) made up a strong proportion (14.3%) of the microliths, which was also the case in the Upper Phase. Nonetheless, some striking differences were observed in the expression of this form. In the Upper Phase, pointed straight backed bladelets *sensu lato* (types 45-52) tended to have abrupt or anvil retouch forming an extremely regular backed edge. The back was more or less parallel to the 'cutting edge', narrowing the piece along its entire length, producing a distinctively elongated microlith. A common feature was the presence of basal retouch, which was most often in the form of an acute truncation. In fact, over half of the pointed straight backed bladelets *sensu lato* (types 45-52) had additional basal retouch.

In contrast, in the Lower Phase, the pointed straight backed bladelets *sensu lato* (types 45-52) tended to have marginal to semi-abrupt, rarely more intense, retouch that was less regular forming the backed edge. There were few pointed straight backed bladelets with basal retouch (types 46-52). In fact, only a single microlith, a pointed straight backed bladelet with rounded base (type 46), had additional basal retouch. The others were classified as pointed straight backed bladelets *sensu stricto* (type 45). Nonetheless, the group appears quite heterogeneous. A few of the pointed straight backed bladelets *sensu stricto* (type 45) had more marginal retouch at the base that becomes more abrupt towards the tip producing a tapered outline to the piece. These appeared similar to the partially backed bladelets with a pointed end (type 63a). The only major difference being in the proportion of the margin that had been retouched. The latter form made up a relatively strong proportion (10.7%) of the microliths in the Lower Phase. In addition, there was a shouldered bladelet (type 64) recorded from the Lower Phase. These were often grouped with the partially backed bladelets (type 63).

The most dominant type was the Ouchtata bladelet (type 70), which accounted for 23.2% of the microliths in the Lower Phase. In contrast these were absent or found only in very small numbers in the Upper Phase and Middle Phase (0.6% and 1.2% respectively). The Ouchtata bladelets (type 70) were divided into those retouched along the entire lateral edge (type 70a) and those with retouch at the proximal end (type 70b).

The former with continuous lateral retouch made up a slightly higher proportion of the microliths (14.3%). These were morphologically similar to the obtuse ended backed bladelets with natural ends (type 67a), which also occured in relatively high proportions (14.3%) compared to the Upper Phase and Middle Phase (0.6% and 2.4% respectively). The only difference between these types was in the retouch intensity.

The proximally retouched examples made up a slightly lower proportion of the microliths (8.9%), although were still more numerous than in the Upper and Middle Phases (0.6% and 1.2% respectively). These were morphologically similar to the partially backed bladelets with unmodified ends (type 63b), which only occured in the Lower Phase. Likewise, the only difference being retouch intensity. The other forms of bladelets with Ouchtata retouch *sensu lato* (types 69-71) were poorly represented (5.4%), as was the case throughout the sequence.

The scalene bladelets (type 68) were found in their highest proportion (10.7%) in the Lower Phase. This type was poorly represented in the Upper and Middle Phase (0.6% and 3.5% respectively).In addition, a scalene triangle (type 90) was recorded. As it was not particularly regular it might be better understood in relation to the scalene bladelets (type 68) than the 'geometrics' as was suggested by Close (1980-1981) at contemporary assemblages at the site of Tamar Hat (Algeria)(*cf.* Tixier, 1963). Beyond this one irregular scalene triangle (type 90), which accounted for 1.8% of the microliths, no other forms were classified as 'geometrics' in the the Lower Phase. The only other microlith from these horizons was a trapeze/rectangle (type 112), which was similar to an example from the Upper Phase.

7.6.2. Attribute analysis

All of the microliths were on chert. The proportions of the different colour raw materials on cherts are shown in Table 7.27 and Figure 7.21. The vast majority were indeterminate in colour as a result of the high proportions of burning in the assemblage. There was a clear dominance of pale brown/yellowish brown and brown/strong brown cherts, which, excluding those indeterminate in colour, made up the majority of microliths (39.0% and 23.8%, respectively) The sample size of unburnt microliths was

small and this may explain any perceived variation in the proportions of different colour cherts between phases. Excluding the indeterminate examples, Fisher's exact test indicates that there was no significant difference between the phases in terms of colour of microliths (p = .137).

Table 7.27. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of the colour of microliths by phase

	Upper Phase	Middle Phase	Lower Phase
Black	3 5.9%	7 11.3%	3 7.9%
Dark grey	1 2.0%	2 3.2%	4 10.5%
Grey/light grey	2 3.9%	3 4.8%	-
Greyish brown	5 9.8%	6 9.7%	3 7.9%
Pale brown/yellowish brown	15 29.4%	24 38.7%	20 52.6%
Brown/strong brown	18 35.3%	11 17.7%	7 18.4%
Reddish brown	1 2.0%	5 8.1%	-
Dusky red/weak red	-	1 1.6%	-
White	6 11.8%	3 4.8%	1 2.6%
Subtotal	51	62	38
Indeterminate	(130) (71.8%)	(23) (27.1%)	(18) (32.1%)
Total	181	85	56

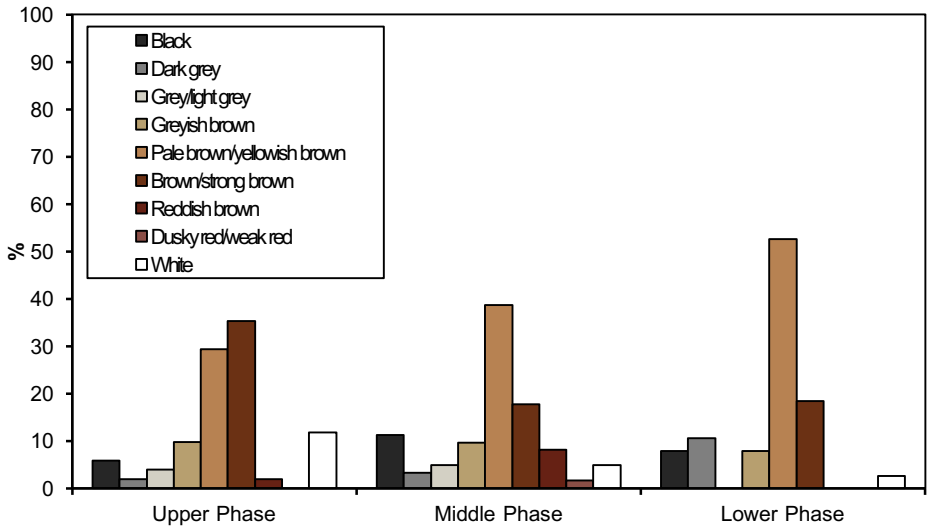


Figure 7.21. Grotte des Pigeons (Taforalt):
Relative frequencies of colour of microliths by phase (excluding indeterminate)

The absolute and relative frequencies of retouch lateralisation on microliths is shown in Table 7.28 and Figure 7.22. Fisher's exact test indicates that there was a significant difference in the proportion of left lateral and right lateral retouch between the phases (p = .006). The majority of

microliths were retouched at the left lateral margin in the Upper Phase and the Middle Phase (61.1% and 82.5%, respectively). In contrast, there was a much smaller proportion retouched at the left lateral margin in the Lower Phase (37.5%). Here, right lateral retouch dominated. There was only a single microlith with retouch at both margins, which was from the Upper Phase.

Table 7.28. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of retouch lateralisation on microliths by phase

	Upper Phase	Middle Phase	Lower Phase
Left	97 61.1%	66 82.5%	21 37.5%
Right	61 38.4%	14 17.5%	35 62.5%
Both	1 0.6%	-	-
Subtotal	159 100.1%	80 100.0%	56 100.0%
Indeterminate	(21) (11.6%)	(5) (5.9%)	(-)
Total	181	85	56

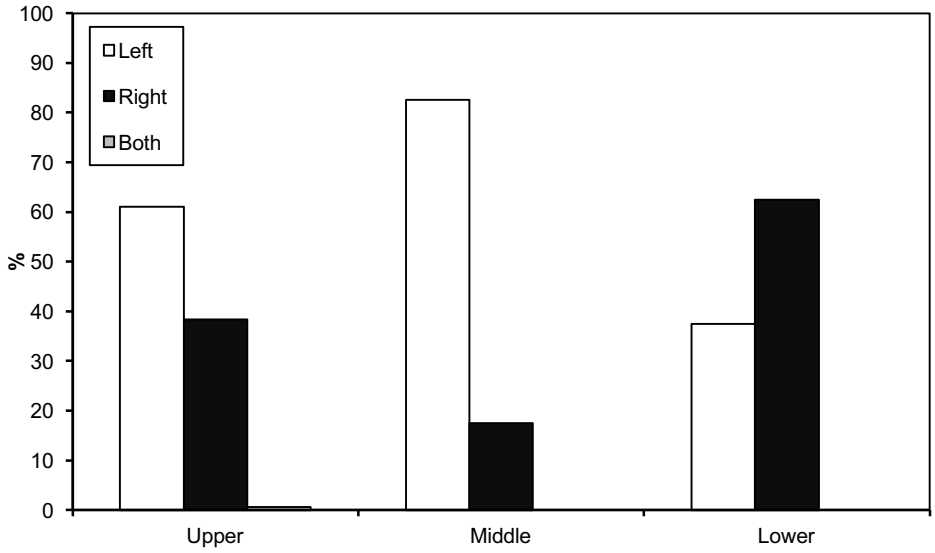


Figure 7.22. Grotte des Pigeons (Taforalt):
Relative frequencies of retouch lateralisation on microliths by phase

The absolute and relative frequencies of retouch distribution on microliths is shown in Table 7.29 and Figure 7.23. Fisher's exact test indicates that there was a significant difference in retouch distribution on microliths according to phase ($p < .001$). There was only a small proportion with partial retouch in the Upper and Middle Phases, with the overwhelming majority retouched along the entire lateral margin (97.8% and 96.5%, respectively). In contrast, there was a much higher proportion of microliths with partial retouch, and comparatively few with retouch along the entirety of the lateral

margin (67.9%). Overall, of those with partial retouch (n=25) the majority was restricted to the proximal (58.3%), with a strong proportion at the distal (33.3%), and only a single case at the mesial (4.2%).

Table 7.29. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of retouch distribution on microliths by phase

	Upper Phase	Middle Phase	Lower Phase
Continuous	177 97.8%	82 96.5%	38 67.9%
Partial	4 2.2%	3 3.5%	18 32.1%
Distal	(3)	(-)	(6)
Mesial	(-)	(1)	(-)
Proximal	(1)	(2)	(12)
Total	181	85	56

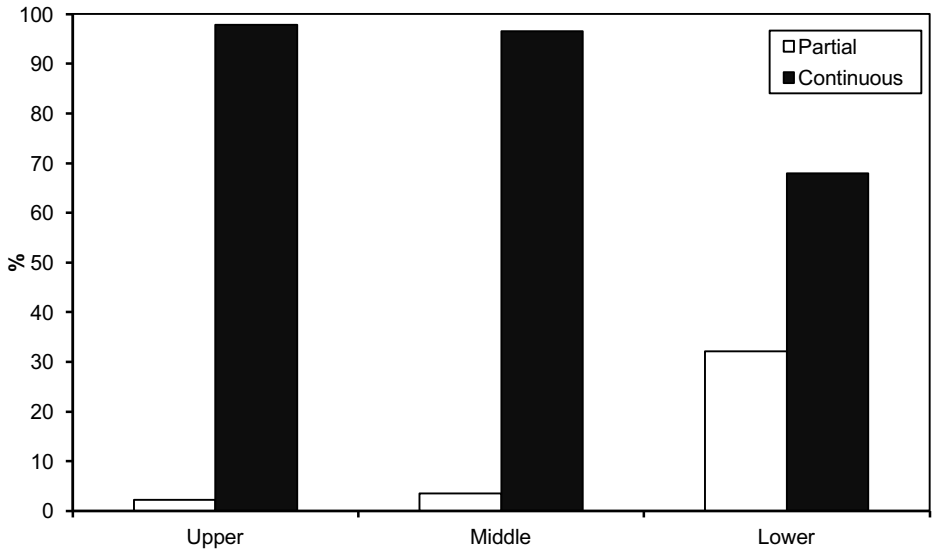


Figure 7.23. Grotte des Pigeons (Taforalt):
Relative frequencies of retouch distribution on microliths by phase

The absolute and relative frequencies of retouch direction on microliths is shown in Table 7.30 and Figure 7.24. Fisher's exact test indicates that there was a significant difference in retouch direction on microliths according to phase (p <.001). The overwhelming majority of microliths had direct retouch in the Lower Phase (96.4%), there were slightly fewer in the Middle Phase (82.1%), and smaller proportions again in the Upper Phase (62.0%). Nonetheless, direct retouch was the most dominant retouch direction on the microliths throughout the sequence. There were only small frequencies of mixed direct/crossed and crossed in the Lower Phase (1.8% and 1.8%, respectively), the frequencies increased in the Middle Phase (7.1% and 8.3%, respectively), and accounted for a strong

proportion of the retouch on microliths in the Upper Phase (16.2% and 18.4%, respectively). The shift to towards direct/crossed and crossed retouch was reflective of a trend towards more invasive retouch at the top of the sequence. There were significantly higher proportions of microliths with Ouchtata retouch in the Lower Phase (28.6%) than in the Middle and Upper Phases (4.7% and 6.1% respectively)(Fisher's exact, $p < .001$). The increasing proportion of microliths with invasive retouch related to the manufacture of narrower microliths (see below).

Table 7.30. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of retouch direction on microliths by phase

	Upper Phase	Middle Phase	Lower Phase
Direct	111 62.0%	69 82.1%	53 96.4%
Inverse	1 0.6%	-	-
Direct/crossed	29 16.2%	6 7.1%	1 1.8%
Inverse/crossed	-	1 1.2%	-
Crossed	33 18.4%	7 8.3%	1 1.8%
Alternating	5 2.8%	1 1.2%	-
Subtotal	179	84	55
Indeterminate	(2) (1.1%)	(1) (1.2%)	(1) (1.8%)
Total	181	85	56

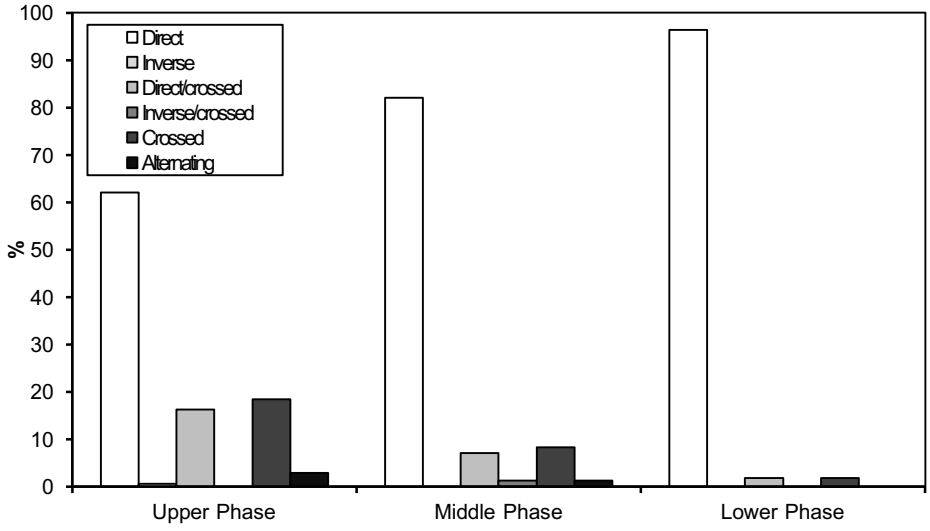


Figure 7.24. Grotte des Pigeons (Taforalt):
Relative frequencies of retouch direction on microliths by phase

The absolute and relative frequencies of points of microliths are given in Table 7.31 and Figure 7.25. Fisher's exact test indicates that there was a highly significant difference between the relative frequencies of points on microliths between the phases (p <.001). In the Upper and Middle

Phases, the majority of the microliths had a single point (65.2% and 74.1%, respectively), there was a strong proportion that had a point at each end (32.6% and 22.4%, respectively), and only a handful had unmodified ends (2.2% and 3.5%, respectively). In contrast, in the Lower Phase the proportion of single points diminished (51.8%), there were only a few double points (5.4%), and there was a high proportion of microliths with unmodified ends (42.9%). Of the single points these tended to be at the distal end (72.4% - 86.7%)(Table 7.32). There was no significant difference in the position of single points across the sequence (Fisher's exact, $p = .240$).

Table 7.31. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of points on microliths by phase

	Upper Phase	Middle Phase	Lower Phase
None	4 2.2%	3 3.5%	24 42.9%
Single	118 65.2%	63 74.1%	29 51.8%
Double	59 32.6%	19 22.4%	3 5.4%
Total	181	85	56

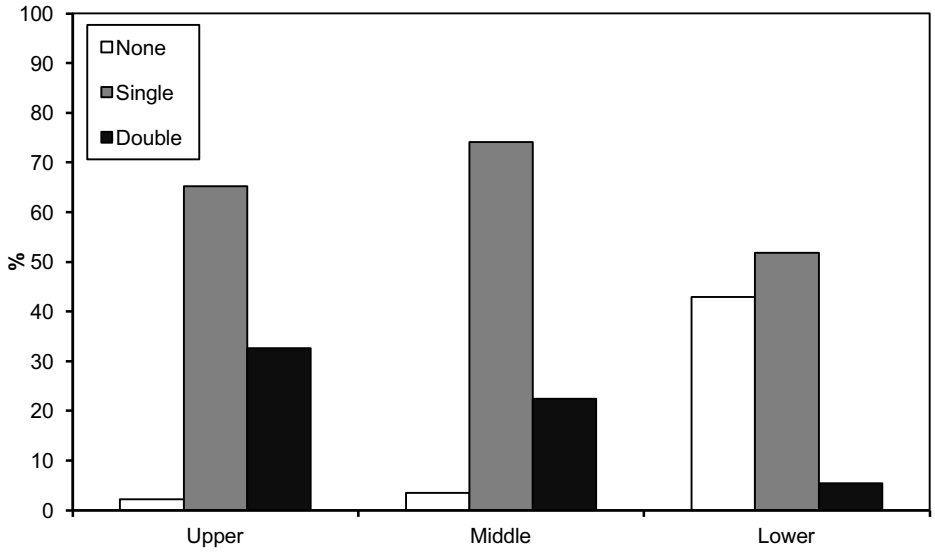


Figure 7.25. Grotte des Pigeons (Taforalt):
Relative frequencies of the position of single points on microliths by phase

Table 7.32. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of the position of single points on microliths by phase

	Upper Phase	Middle Phase	Lower Phase
Distal	80 79.2%	52 86.7%	21 72.4%
Proximal	21 20.8%	8 13.3%	8 27.6%
Subtotal	101 100.0%	60 100.0%	29 100.0%
Indeterminate	(17) (9.4%)	(3) (4.8%)	(-)
Total	181	63	56

The absolute and relative frequencies of microliths retaining the butt are given in Table 7.33 and Figure 7.26. Fisher's exact test indicates that there was a highly significant difference between the relative frequencies of microliths with intact butts across the phases (p <.001). The majority of microliths retained their butt in the Lower Phase (57.1%), whilst there was a slightly smaller proportion in the Middle Phase (47.6%), and strikingly few in the Upper Phase (23.2%).

Table 7.33. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of the retention of the butt on microliths by phase

	Upper Phase	Middle Phase	Lower Phase
Butt	42 23.2%	30 47.6%	32 57.1%
No Butt	139 76.8%	33 52.4%	24 42.9%
Total	181 100.0%	63 100.0%	56 100.0%

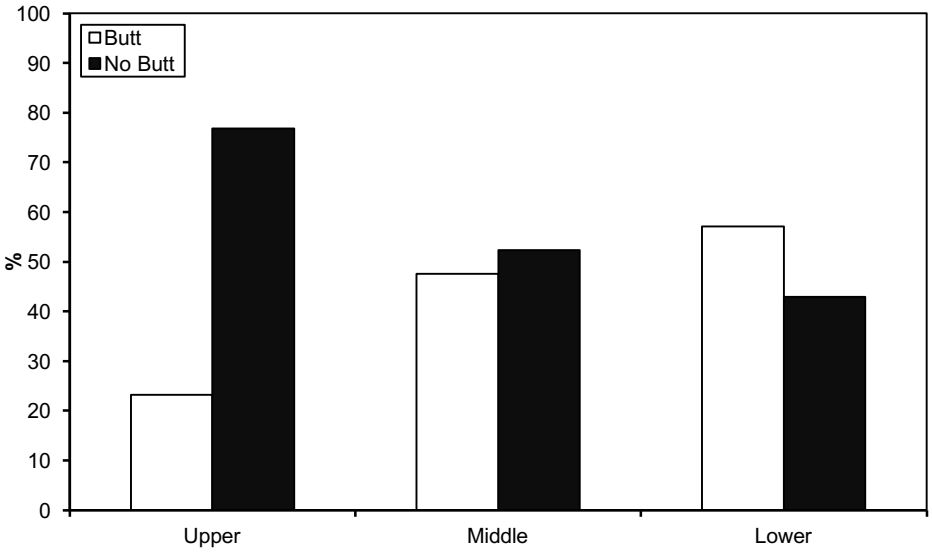


Figure 7.26. Grotte des Pigeons (Taforalt):
Relative frequencies of the retention of the butt on microliths by phase

Fisher's exact indicates that there was a significant difference between the relative frequencies of microliths with basal truncations between the phases (p = .012)(Table 7.34). In the Upper and Middle Phases there was a relatively high proportion of microliths with basal truncations (21.5% and 20.6%, respectively). In contrast, in the Lower Phase only a small proportion (5.4%) of microliths had basal truncations. There was also a significant difference in the delineation of the basal truncations (Fisher's exact, p = .002). In the Upper Phase the basal truncations (n=34) tended to be acute (87.2%), with a much smaller proportion that were rounded (12.8%). In the Middle Phase (n=13) the basal truncations were less often acute (61.5%) with many more rounded (38.5%). In the Lower Phase (n=3) all of the basal truncations were rounded. However, there was no significant difference in the direction of retouch of the basal truncations (Fisher's exact, p = .777). Overall, the basal truncations (n=54) were overwhelming direct (74.1%), followed by strong proportions that were inverse (20.4%), and only one crossed (1.9%). In addition, the direction of retouch on a couple was indeterminate (3.7%).

Table 7.34. Grotte des Pigeons (Taforalt):
Absolute and relative frequencies of basal truncations on microliths by phase

	Upper Phase	Middle Phase	Lower Phase
None	142 78.5%	50 79.4%	53 94.6%
Present	39 21.5%	13 20.6%	3 5.4%
Total	181 100.0%	63 100.0%	56 100.0%

The metric data for microliths are shown in Table 7.35 and Figures 7.27-7.29. Kruskal-Wallis tests were used to compare the dimensions of microliths across the sequence. There was a significant difference in terms of length (H=25.132(2), p < .001), width (H=32.474(2), p <.001) and thickness (H=12.674(2), p=.002). Post-hoc tests were conducted given the statistically significant results of the Kruskal-Wallis tests.

In terms of length, the Lower Phase was found to be significantly different from both the Upper Phase (p < .001) and Middle Phase (p < .001). However, the Upper and Middle Phases did not differ significantly from each other (p = .255). In the Lower Phase the median length was 27.1 mm, whereas in the Middle and Upper Phases, the microliths were smaller on average with median lengths of respectively, 21.4 mm and 20.8 mm. This was almost certainly an effect of much higher rates of

microliths with one or both ends removed towards top of the sequence rather than reflecting the selection of longer blanks in the Lower Phase. There was no significant difference in the length of the unmodified flakes and blades throughout the sequence (see above).

In terms of width, the Lower Phase was found to be significantly different from both the Upper Phase ($p<.001$) and Middle Phase ($p<.001$). In addition, the Upper and Middle Phases differed significantly ($p<.002$). In the Lower Phase the median width was 8.2 mm, whereas in the Middle Phase and Upper Phase, the microliths on average were narrower with median widths of respectively, 6.5 mm and 7.0 mm. This was almost certainly an effect of the much higher rates of microliths with intensive retouch rather than the result of special blank selection. In fact, analysis of the debitage indicated that the unmodified blades were significantly wider than those in the Upper and Middle Phases.

In terms of thickness, the Lower Phase was found to differ significantly from both the Upper ($p<.002$) and Middle Phases ($p<.001$). However, the Upper Phase and Middle Phase did not differ ($p = .132$). In the Lower Phase the median thickness was 2.9 mm, whereas in the Middle Phase and Upper Phase, the microliths on average are thicker with the medians both 3.4 mm. This pattern was repeated on the unmodified flakes and blades (see above).

Table 7.35. Grotte des Pigeons (Taforalt): Dimensions on microliths by phase

	N	Mean	S.D	Median	Range	Midrange
Upper Phase						
Length	81	21.31	5.38	20.8	11.7-41.2	17.7-25.1
Width	181	7.11	1.60	7.0	3.5-12.3	6.0-8.0
Thickness	181	3.37	1.00	3.4	1.4-7.2	2.6-4.0
Middle Phase						
Length	42	21.94	3.71	21.4	16.3-31.3	19.1-24.6
Width	85	6.53	1.09	6.5	4.6-9.6	5.7-7.3
Thickness	85	3.51	0.93	3.4	1.4-6.0	2.9-4.1
Lower Phase						
Length	36	26.77	5.38	27.1	14.8-39.5	24.4-30.0
Width	56	8.46	2.17	8.2	4.8-14.4	7.0-10.0
Thickness	56	2.95	0.90	2.9	1.3-5.6	2.3-3.5

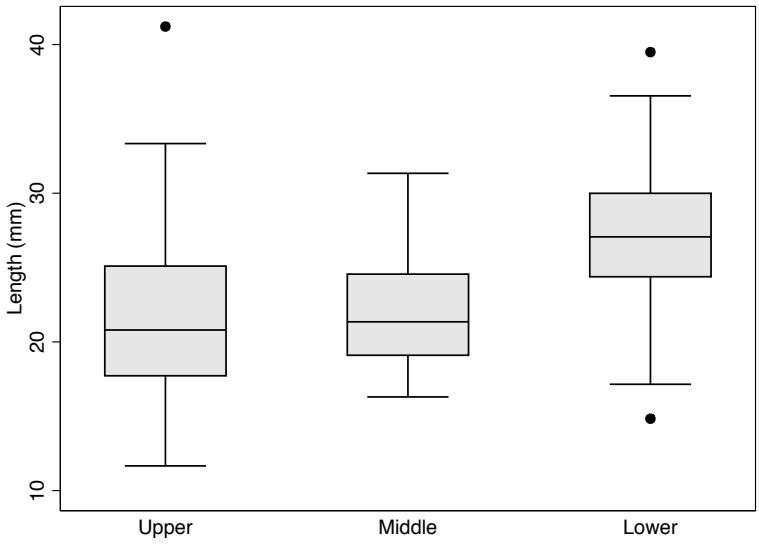


Figure 7.27. Grotte des Pigeons (Taforalt): Boxplot showing length of microliths by phase

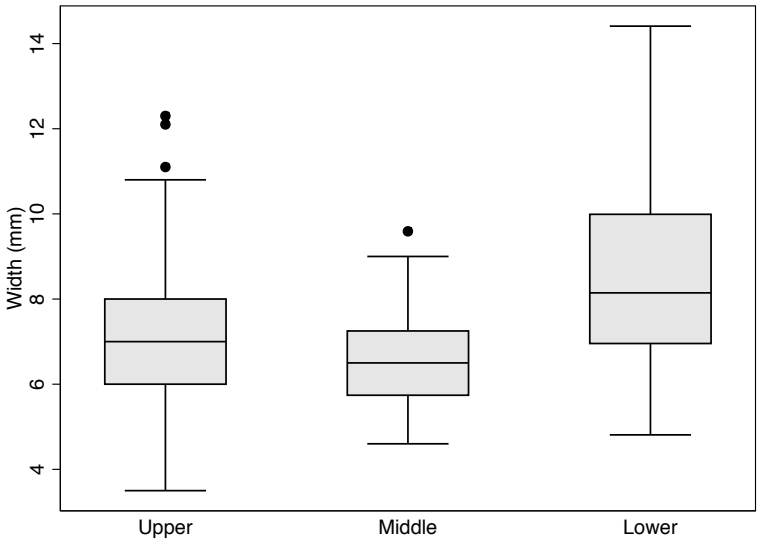


Figure 7.28 Grotte des Pigeons (Taforalt): Boxplot showing width of microliths by phase

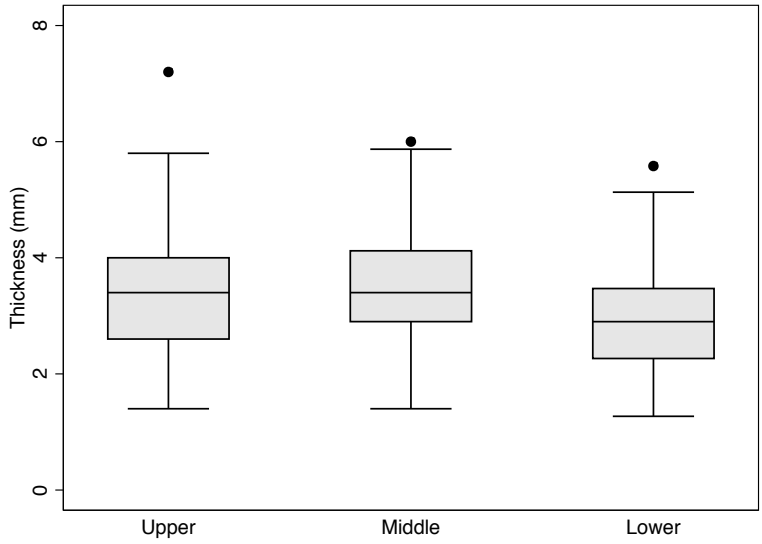


Figure 7.29. Grotte des Pigeons (Taforalt): Boxplot showing thickness of microliths by phase

7.7. Summary

The excavations at Grotte des Pigeons (Taforalt) have yielded a series of well-stratified assemblages relating to the LSA. The analysis of this material has shown the superposition of a Lower, Middle, and Upper Phase. The assemblages differ statistically in terms of raw material selection, core reduction strategies, blank selection and morphology, the proportions of different microliths, and the methods of microlithic tool manufacture.

Each of the assemblages was characterised by small blade manufacture on a range of different colour fine-grained cherts from the Moulouya River. However, the blade reduction strategies varied significantly between the phases. The Lower Phase was characterised by the production of short, narrow, and thin blades from single platform cores with abraded striking platforms struck using a soft hammer. In contrast, the Middle and Upper Phases were characterised by the production of short, wide, and thick blades from single platform cores that were more often struck back from the edge of the core using a hard hammer. There was a reduction in the number of discarded non-cortical blades from the Lower Phase, to the Middle Phase, and in-turn the Upper Phase. This might relate to a more intensive use of available blanks towards the top of the sequence.

The microburin technique was utilised throughout the sequence. However, whilst the technique was sometimes utilised in the Lower Phase it became more prolific in the Middle and Upper Phases. In the Lower Phase, when the microburin technique was utilised it was most often to remove the butt of the blank with the notch being formed at the right margin. However, in general the sectioning of blanks was rare. The Lower Phase was characterised by microliths that tended to retain the butt and the natural termination, which were long, wide, and thin, with marginal retouch along the right margin that was often restricted to the section of the edge nearest to the butt (e.g. obtuse ended backed bladelets, Ouchtata bladelets). In contrast, in the Middle and Upper Phases the microburin technique was used most of the time to remove the distal end of the blank with the notch formed at the left margin. The sectioning of blanks was very common and this was done almost exclusively with the microburin technique. The Middle and Upper Phases were characterised by microliths that tend to be truncated at one or both ends, which are short, narrow, and thick, with intensive convex retouch along entirety of the left margin (e.g. convex-backed bladelets *sensu lato*, segments).

Whilst high-quality fine-grained cherts continue to dominate, coarse-grained limestone was utilised much more frequently towards the top of the sequence, especially in the Upper Phase. Throughout the sequence limestone was used exclusively for the production of flakes. These were rarely retouched into tools. There are a couple of examples, all on particularly large primary flakes, with contiguous notches, which might have occurred during use (see Chapter 6 for descriptions). It seems most probable that these limestone flake tools would have been used in maintenance tasks (e.g. hide preparation, tool manufacture), rather than extractive tasks (e.g. hunting, harvesting). There was little time investment needed to produce tools of this sort, as the technology is basic, and the inhabitants of the site had an essentially limitless supply of coarse-grained limestone to hand. An increasing dependency on local poor-quality coarser-grained limestone, coupled with the more intensive use of the available high-quality fine-grained cherts towards the top of the sequence, raises some interesting questions that relate to the changes in the subsistence and settlement patterns, which will be further discussed in Chapter 9.

Chapter 8.

Correspondence Analysis & Inter-site Assemblage Variation

Differences in lithic-type frequencies are the primary means of distinguishing between assemblages in the Maghreb (Camps, 1974; Lubell et al., 1984). However, these type-based groups are most often intuitively derived and do not hold up under closer scrutiny (see Chapter 2). Nonetheless, considering the lack of other standardised forms of data collection and reporting, type counts of lithic artefacts often provide the only means for making comparisons between assemblages and looking at inter-site variation (see Chapter 3). Thus, it is essential to find methodologies to make sense of this data. This chapter shows the potential of one such methodology, correspondence analysis (CA), for teasing out temporal and non-temporal variation within the LSA.

8.1. Method

The origins of correspondence analysis (CA) can be found in the work of K. Pearson (1906; 1904), although the original mathematical derivation is most often attributed to Hirschfield (1935). In the 1960s, a major development was made when CA was given geometric form by French scholar J.-P. Benzècri (1973). Following this, it became a popular technique in France across a number of disciplines, and this led to the first journal dedicated to the topic, entitled *Cahiers de l'Analyse des Données.* M.O. Hill (1974), an ecologist, first coined the term 'correspondence analysis', and introduced the concept widely to English speaking researchers. Interestingly, he chose published archaeological data to illustrate the potential of CA, showing that the technique could be used to cluster (on temporal grounds) tombs, based on frequencies of artefacts within each tomb, at the Iron Age site of Münsingen Rain.

Despite the early application of CA to archaeology, with the exception of a number of ground-breaking studies (e.g. Bolviken et al., 1982; Djindjian, 1978), the technique was slow to be adopted. However, the technique has recently gained momentum and today CA is used for a variety of purposes in order to better understand intra- and inter-site variation, at both a spatial and temporal level, from a range of different artefact classes of archaeological evidence, including lithic, fauna,

ceramic, and botanical remains (e.g. Alberti, 2013; Baxter and Cool, 2010; Cancellieri and di Lernia, 2014; Chazan and Horwitz, 2006; Habu, 2008; Kuijt and Goodale, 2009; Smith and Neiman, 2007; Sullivan and Kealhofer, 2004).

CA at a conceptual level is relatively easy to understand. It is an exploratory technique for displaying data from contingency tables (i.e. row and column frequencies) on a scatterplot so that underlying clusters can be more easily observed and interpreted within the data. Greenacre (2007) gives a detailed account of the principles CA and a guide to implementing the technique. In summary, CA uses a derivative of chi-square statistic as a measure the total *inertia* (i.e. variation) within a contingency table and as a measure of distance between row profiles (or the column profiles) from the average profile, which represents homogeneity in the dataset. The distances between profiles can then be transformed in order to observe them in physical space, which has a number of *dimensions* that account for a proportion of the total inertia. The graphical output of the CA is a scatter plot. The row/column points that are similar to each other reside near the origin of the axes at the centroid, and represents homogeneity within the dataset, whereas those row/column points that are the most distinct will be spread the furthest from the origin of the axes. The row/column points have a contribution to the inertia of the dimensions, which allow us to determine, a) the points most responsible for the dimension, those with the highest *contribution*, and b) the position of each point and whether it is well-represented on the plot, so-called *quality of display*. The row/column points analysed by CA are called *active* points. In addition, *supplementary* points can be plotted by the CA, which are row/column points projected on the space defined by the active points, but do not have a contribution to the definition of the dimensions. A number of textbooks on statistics for archaeologists have also given brief introductions into CA (Drennan, 2009; Orton, 1982; Shennan, 1997).

The slow adoption CA by archaeologists might be best attributed to the lack of computational power and need for in-depth knowledge of the statistical procedures of the technique during the early years in its use. It can now be carried out with relative ease using a number of commercial (e.g. SPSS®, Stata®) and freely available (e.g. R software environment) statistical software packages on a personal computer. Here, the CA was carried out in the R software environment (R Core Team, 2014) using the 'ca' package (Nenadić & Greenacre, 2007).

8.2. Data

The dataset consists of microlith type counts from 25 contexts, representing distinct assemblages from 10 sites (Table 8.1). The frequency counts of each type along with the number of artefacts from each assemblages is given in Table 8.2. The relative frequencies of the major retouched tool classes are given in Table 8.3.

The sites are distributed from the Eastern Rif in Morocco to the Jebel Babor in eastern Algeria, a distance of over 750 km. The sites inhabit a range of environments from the Mediterranean coastline, to mountains of Tell Atlas, and the edge of the Sahara (Fig. 8.1). Whilst the sample covers a massive area, it should be noted that it does not cover some regions of the Maghreb. For instance, it does not include any sites from the Atlantic Coast of Morocco or from Tunisia. It is possible that this distribution reflects that of hunter-gatherers during the study period, but, at least in part, different research agendas have affected the available data.

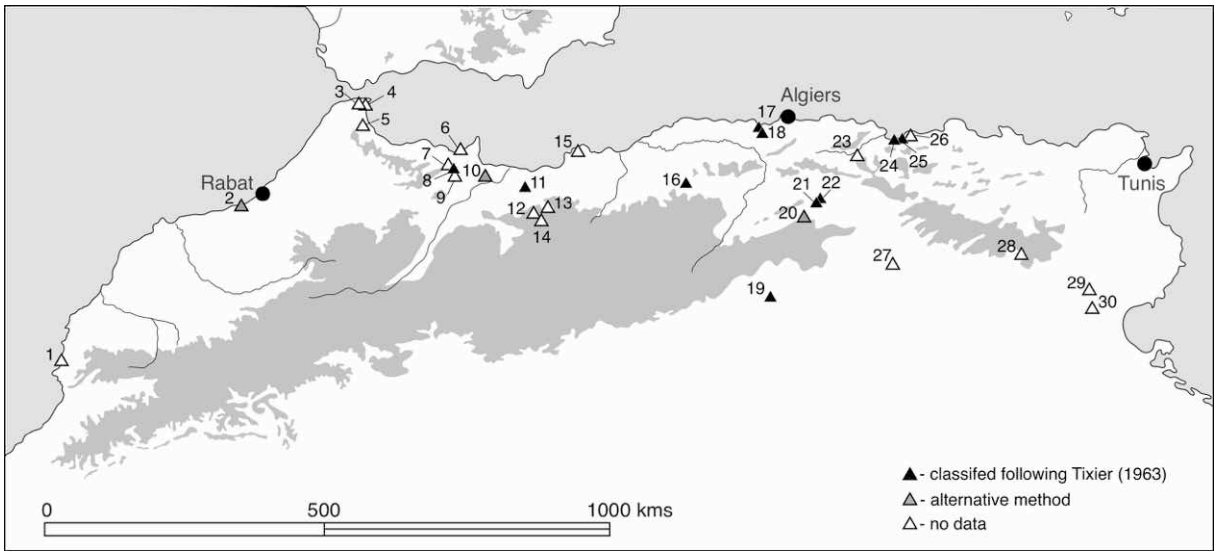
The few available sites along the Mediterranean coast of Morocco all have questionable radiocarbon determinations and/or most do not have fully published lithic assemblages (e.g. Contrebandiers, Point d'El Majni). Therefore, these could not be included in the dataset. This study was also going to provide the first description of the lithics from a number of well-dated sites along the Tingitana Peninsula (e.g. Ghar Cahal, Kehf el Hammar), although it was decided not to use the data from these sites for reasons of small sample size and the fact that some of the contextual information was lost during flooding of the Institut National des Sciences de l'Archéologie et Patrimoine (INSAP) in 2008.

In relation to Tunisia, there are no published data from sites with radiocarbon determinations. The lack of assemblages is most likely a reflection of the history of research. A number of undated assemblages have been assigned to the period based on lithic similarities, but these were primarily excavated before the advent of radiocarbon dating in the 1950s (e.g. Ouchtata localities, Horizon Collignon, etc).

Gragueb (1983) re-analysed these early-excavated assemblages and provided type counts of each of the artefacts. However, these data were not included in the CA, as most of these assemblages

are not well-stratified and a number of the assemblages might also be a mixture of material from different cultures (e.g. Ouchtata rive droite, Presqu'île 26)(ibid*,* p. 85). Most of the sites are deflated open-air sites with little stratigraphic control.

In should be noted that some of the sites/assemblages have been studied by multiple scholars, resulting in a number of datasets being available for Columnata (Brahimi, 1972; Sari, 2012), Rassel (Brahimi, 1970; Close, 1977; Sari, 2012), and Tamar Hat (Close, 1980-81; 1977; Sari, 2012). In order to limit idiosyncratic variation as a result of data being recorded by different authors the type-counts used in the CA follow those given by Sari (2012). A set of preliminary comparisons using the type-counts published by the different scholars showed no major differences in the observed patterns, suggesting a relatively strong level of consistency between different scholars in assigning individual types.



1. Point d'El Majni; 2. Contrebandiers, 3. Kehf Taht el Ghar, 4. Ghar Cahal, 5. Kehf el Hammar, 6. Ifri Armas, 7. Taghit Haddouche, 8. Ifri el Baroud, 9. Hassi Ouenzga, 10. Ifri n'Ammar, 11. Taforalt, 12. Chaâba Bayda, 13. Oued Charef, 14. Rafas, 15. Oued Guettara II, 16. Columnata, 17. Rolland, 18. Rassel, 19. El Haouita terrasse, 20. El Hamel, 21. El Onçor, 22. Es Sayar, 23. Gueldaman, 24. Tamar Hat, 25. Afalou Bou Rhummel, 26. Taza, 27. M'Doukal, 28. Wadi Mezeraa, 29. El Oghrab, 30. Bir Oum Ali.

Figure 8.1. Pleistocene LSA sites with published retouched tool data (mountainous regions indicated by shading ~1000m above sea level)

Table 8.1. Pleistocene LSA assemblages from the Maghreb in the study sample

Assemblage (abbreviated name)	Assemblage (site and/or layer)	Geographic location	Microburin index	Approximate age (ka cal BP)
Bar E	Ifri el Baroud/Escargotière	Eastern Rif	0.004	15.8-13.2
Bar R	Ifri el Baroud/Couche Rouge	Eastern Rif	0.041	20.5-15.8
Taf U	Taforalt/Upper	Beni Snassen Mountains	0.030	14.6-12.5
Taf M	Taforalt/Middle	Beni Snassen Mountains	0.598	15.7-14.4
Taf L	Taforalt/Lower	Beni Snassen Mountains	0.067	22.1-16.9
Taf B	Taforalt/Burials	Beni Snassen Mountains	0.154	14.6-14.2
Col 69	Columnata/1969 Excavations	Sersou Plateau	0.129	13.5-11.4
Col 71	Columnata/1971 Excavations	Sersou Plateau	0.072	
Ras III	Rassel/Niveau III	Chenoua Mountains	0.140	17.6-17.2
Rol	Rolland	Chenoua Mountains	0.012	16.8-14.3
Onc	El Onçor	Bou Saâda Valley	0.000	12.4-11.2
Say	Es Sayar	Bou Saâda Valley	0.485	16.5-15.0
Hao	El Haouita terrace	Bou Saâda Valley	0.064	11.7-7.6
Afa I	Afalou Bou Rhummel/Couche I	Petite Kabylie	0.124	
Afa II	Afalou Bou Rhummel/Couche II	Petite Kabylie	0.062	
Afa III	Afalou Bou Rhummel/Couche III	Petite Kabylie	0.138	14.1-12.8
Afa IV	Afalou Bou Rhummel/Couche IV	Petite Kabylie	0.135	16.9-13.5
Afa V	Afalou Bou Rhummel/Couche V	Petite Kabylie	0.082	
Tam 67	Tamar Hat/1967 Excavations	Petite Kabylie	0.237	16.1-11.1
Tam I	Tamar Hat/Unit I	Petite Kabylie	0.073	21.7-19.6
Tam II	Tamar Hat/Unit II	Petite Kabylie	0.019	
Tam III	Tamar Hat/Unit III	Petite Kabylie	0.028	
Tam IV	Tamar Hat/Unit IV	Petite Kabylie	0.032	22.5-22.0
Tam V	Tamar Hat/Unit V	Petite Kabylie	0.057	23.2-22.5
Tam VI	Tamar Hat/Unit VI	Petite Kabylie	0.024	25.9-25.3

Table 8.2. Frequency of microliths from assemblages in the study sample

	Microliths																	Total
	T45-53	T54	T55	T56-59	T60-61	T62	T63-64	T65	T67	T68	T69	T70	T71	T82	T83-88	T89-93	T94-100	
Bar E	52	2	9	89	9	1	15		11	1	3	8	6	16				222
Bar R	40		4	51	4	6	18		13	6	4	10	3	11				170
Taf U	27		4	114	5				1	1	5	1	5	9		5		177
Taf M	3			38	1	26	3	1	2	3		1	3	3		1		85
Taf L	8		2	5			9		8	6	2	13	1			1		55
Taf B	27		1	64	2	2	2			2		1	1	1			2	105
Col 69	89		6	210	2	8	15		2	8	3		2	54		1	1	401
Col 71	115	5	6	291		14	18	1		7	9		9	28		2		505
Ras III	130		3	36	3	27	207		23		11	39	40	5				524
Rol	37		1	19	3	1	24		11	1	8	7	9					121
Onc	10	5	2	68	4								4	2		1		96
Say	1	1	8	87	11	13	16		2	1	1		1					142
Hao	62	1	1	97	9	2	46	1	4	2			19		1			245
Afa I	26	1	1	28	1	1	4		4			1		11		2	1	81
Afa II	83	6	1	78	5	3	15		16	2	2	3	2	29	1	7	5	258
Afa III	71		2	68	8	6	7	1	14	4	1	5		21	1	6	1	216
Afa IV	223	7	14	193	20	16	19		30	11		3	8	35	2	71	9	661
Afa V	45		2	66	14	6	4		8	6		1		6	2	4	1	165
Tam 67	106		2	58	6	29	109		24		8	10	14	4				370
Tam I	79		1	72	1	13	82	2	26	4	7		2	5				294
Tam II	129		2	29	2	1	36		31	2	4	3	7					246
Tam III	43	1		14	4	3	23	4	18	1	3	3						117
Tam IV	180		9	79	8	8	40	1	69	9	18	4	8	3				436
Tam V	183	5	5	117	6	20	52		24	5	9	1	7	3				437
Tam VI	211		5	78	16	7	30		10	1	18	6	11	1				394
Total	1980	34	91	2049	144	213	794	11	351	83	116	120	162	247	7	101	20	6523

Table 8.3. Relative frequency of retouched tools from assemblages in the study sample

Assemblage	End-scrapers	Piercers	Burins	Backed flakes and blades	Composite tools	Microliths	Microlith fragments	Notches and denticulates	Truncations	Retouched pieces	Side-scrapers	Varia	Total
Bar E	10.9	0.2	2.6	7.6	0.0	52.7	2.6	10.7	1.4	7.4	1.4	2.4	421
Bar R	4.4	0.3	0.9	5.6	0.0	53.3	6.9	12.2	0.9	9.7	5.0	0.6	319
Taf U	3.1	0.2	0.0	1.2	0.2	41.8	43.0	3.1	1.9	5.0	0.5	0.2	423
Taf M	4.9	0.0	0.0	0.0	0.0	51.8	34.1	0.6	1.8	4.9	0.0	2.4	164
Taf L	2.4	0.0	0.0	0.0	0.0	32.9	50.9	4.8	3.6	3.0	0.0	1.2	167
Taf B	15.2	0.5	0.0	5.1	0.5	48.4	19.8	7.8	0.5	1.8	0.5	0.0	217
Col 69	6.6	0.2	0.1	2.2	0.1	48.0	26.2	6.5	2.6	6.9	0.0	0.5	835
Col 71	9.2	0.2	0.6	2.1	0.0	39.6	30.2	9.2	2.3	6.1	0.0	0.5	1275
Ras III	5.3	0.5	0.1	0.3	0.0	52.7	31.3	4.3	2.0	3.5	0.0	0.0	995
Rol	4.2	0.0	0.0	0.0	0.0	57.1	20.3	5.2	0.9	11.8	0.0	0.5	212
Onc	8.9	1.3	6.3	1.3	0.0	60.8	7.0	13.3	0.0	1.3	0.0	0.0	158
Say	1.4	3.4	0.0	3.7	0.0	40.7	36.7	9.5	3.4	0.9	0.0	0.3	349
Hao	9.5	0.5	1.8	8.2	0.2	39.5	14.8	23.2	2.3	0.0	0.0	0.0	620
Afa I	4.2	1.4	2.1	8.5	0.0	57.0	3.5	12.7	4.2	4.9	0.0	1.4	142
Afa II	4.5	1.9	0.2	6.3	0.0	55.8	3.5	17.5	2.4	7.4	0.2	0.2	462
Afa III	4.0	2.6	1.1	5.6	0.0	57.1	3.7	15.9	1.6	8.2	0.0	0.3	378
Afa IV	4.1	2.2	0.8	7.9	0.2	56.3	4.0	17.1	1.8	5.1	0.0	0.5	1174
Afa V	7.0	0.7	0.0	7.8	0.7	61.1	3.7	13.7	0.7	4.1	0.0	0.4	270
Tam 67	8.9	0.6	0.0	0.0	0.0	46.4	29.3	7.5	1.3	5.9	0.0	0.1	798
Tam I	14.3	0.3	0.3	0.5	0.0	39.6	39.1	1.9	1.9	2.0	0.0	0.1	742
Tam II	9.6	0.4	0.1	0.3	0.0	32.3	50.3	1.6	2.5	2.0	0.0	1.0	762
Tam III	3.6	0.3	0.0	0.0	0.0	37.9	54.0	0.6	1.3	0.0	1.0	1.3	309
Tam IV	8.4	0.0	0.1	0.5	0.0	38.6	45.8	3.1	2.0	1.0	0.1	0.4	1129
Tam V	8.8	1.8	1.5	0.5	0.0	46.9	32.2	2.3	3.5	2.0	0.0	0.4	932
Tam VI	1.5	1.6	0.6	1.1	0.0	49.6	39.5	1.3	2.0	2.0	0.0	0.6	794
Total	7.0	0.9	0.6	2.7	0.1	46.4	27.7	7.8	2.1	4.0	0.2	0.5	14047

Notes on typological data

In order to limit classification inconsistencies as a result of poor definitions the dataset in this analysis is restricted to frequencies of microlithic types classified according to Tixier's (1963) typology. A couple of assemblages have been described using alternative site-specific typologies, which lack clear definitions, and therefore have been excluded from the correspondence analysis (i.e. Contrebandiers, El Hammar, Ifri n'Ammar).

The dataset is also restricted to microlithic forms classified as 'backed bladelets *sensu lato*' or 'geometric microliths'. A few other classes (e.g. notches and denticulates, truncations, varia, etc) might include microlithic technology, but the small size of an object is rarely essential to the definition of the types within these classes. Individual types were collapsed together in order to reduce potential error as a result of idiosyncratic variation amongst researchers. This was done broadly following standard conventions outlined elsewhere (Brahimi, 1972a; Inizan and Tixier, 1980; Sari, 2012; Tixier, 1963): pointed straight backed bladelets *sensu lato* (types 45-53), convex backed bladelet *sensu lato*

(types 56-59), irregular backed bladelets (types 60-61), partially backed bladelets (types 63-64), triangles (types 89-93), and elongated triangles (types 94-100). However, a number of the types could not be easily collapsed without losing important descriptive information.

For instance, the decision was made not to collapse three types of bladelets with Ouchtata retouch *sensu lato* (types 69-71) into one, which has been done on occasion (e.g. Olszewski et al., 2011). Whilst these are similar in the extent of their retouch, in other respects each form may be morphologically and/or technologically more similar to an existing backed bladelet *sensu stricto* forms (Close, 1977; see Chapter 5).

There is a similar issue with the bladelets with a convex backed end (type 55). Some scholars have grouped this type with the convex backed bladelets *sensu lato* (types 56-59) based on the outline of the retouch edge (Brahimi, 1970). However, considering that a bladelet with convex backed end (type 55) does not have continuous retouch along the entire lateral margin, it might be better grouped with the other bladelets with partial retouch *sensu lato* (types 63-64).

Likewise, as mentioned in Chapter 5, the classification of 'convex-backed bladelets leading to segments' (type intra-56) and 'segments' (type 82) might be subject to individual variation. However, as 'segments' (type 82) have been considered diagnostic of younger assemblages (Camps, 1974; Lubell et al., 1984), it seemed important to maintain this form as a 'distinct' entity.

8.3. Brief Description of Sites

A brief description of each site in the sample is given below, excluding the site of Grotte des Pigeons (Taforalt) as this has been described in detail in Chapter 4. The following section provides an opportunity to highlight some of the difficulties with a number of the collections, such as issues with chrono-stratigraphic control. It also provides an opportunity to outline a new series of AMS radiocarbon determinations for the site of Tamar Hat (Algeria), which are now the earliest reliable dates for the LSA in Northwest Africa.

8.3.1. Afalou Bou Rhummel

Afalou Bou Rhummel (*c.* 36˚41'N, 5˚26'E) is located in eastern Algeria (Fig. 8.1). It is a rockshelter site located around 30 km east of the regional capital of Béjaïa at the edge of an upland massif known as the Jebel Babor the eastern extension of the Petite Kabylie. The rockshelter faces in a northerly direction overlooking the Mediterranean Sea. It is situated near the site of Tamar Hat.

C. Arambourg et al. (1934) conducted the first major excavations at the site between 1928-1930. A ~17 m long trench was excavated through the centre of the site exposing three archaeological levels to a combined depth of ~7.5 m. A large number of human skeletal remains belonging to as many as 50 individuals were uncovered. Given the large size of the excavations and extremely low numbers of lithic artefacts recovered it seems that the site was dug hurriedly, although it plausible that this might reflect lower intensity occupation within the site. However, this is considered unlikely due to the large collection of faunal remains and numerous human skeletal remains collected at the same time. Of those reported, the lithic artefacts were described as being similar to those of the sites of the Moulliah, which is type-site location of the Iberomaurusian *sensu stricto*.

Between 1983-1993 excavations were undertaken by the Centre de Recherches Anthropologiques, Préhistorique et Ethnographique (C.R.A.P.E) under the directionship of S. Hachi (1996, 2003, 2006; Hachi et al., 2002). During the 1983-1984 excavations an area of ~50 m^2 was dug using artificial spits of variable thickness (Hachi, 2003, 1996). Few details have been given relating to the specifics of work undertaken in subsequent seasons. In total the excavations reached a depth of ~6 m (Hachi, 2003; Hachi et al., 2002).

The stratigraphic sequence was divided into two major units: a lower series of reddish clays (*couches* XIII to XI) and an upper series of less compact brownish sediments with a strong anthropogenic input (*couches* X to I). In addition, the upper series was sub-divided between a series of relatively thin brownish archaeological horizons (*couches* X to V) and lighter coloured more friable ashy lenticular sediments with numerous cobbles, molluscs remains, and bone fragments (*couches* IV to I).

A lithics report is only available relating to the chipped-stone assemblages from *couches* V to I (Hachi, 2003, 1996). Based on the description of the excavation methods, the relatively low frequencies of lithic artefacts given the size of the excavations, and the extremely low numbers of microlith fragments (Hachi, 2003, 1996)(Table 8.3), it seems that the excavations were carried out hurriedly with little stratigraphic control. Thus, there is some doubt over the extent to which each *couche* represents a distinct chrono-stratigraphic unit. Considering these issues, the available published type-counts are used as supplementary data within the CA. While the chipped-stone assemblages have only been described from *couches* V to I, it should be noted that there is also a brief mention of a bladelet industry from the underlying levels (Hachi et al., 2002).

There are three radiocarbon determinations on charcoals available from both *couches* IV and III. The combined radiocarbon determinations from *couche* IV date at 14,934-13,853 ka cal BP and from *couche* III at 13,605-13,295 ka cal BP. Unfortunately, there are no radiocarbon dates available for the uppermost contexts, although these are thought to relate to the same techno-complex (Hachi, 2003). In addition, a radiocarbon determination is available from *couche* VII of 18,568-17,715 cal BP, although the lithic artefacts associated with this horizon have not been described. All of the radiocarbon determinations have large error margins and given the poor stratigraphic control must be treated with extreme caution (Table 8.4).

A number of human skeletal remains have been recovered including an almost complete individual from *couche* X and at least eight individuals from *couches* V and IV (Hachi et al., 2002). In addition, a number of clay figurines have been identified from the upper series (Hachi, 2006, 2003, 1996; Hachi et al., 2002)(Chapter 2).

Table 8.4. Published radiocarbon determinations from Afalou Bou Rhummel (after Hachi et al., 2002)

Lab No	14C	cal BP (95.4%)	Material	Context
Ly-3227	11,450 ± 230	13,753-12,824	Charcoal	Layer III
Unknown	11,560 ± 90	13,570-13,216	Charcoal	Layer III
Unknown	11,900 ± 140	14,080-13,456	Charcoal	Layer III
Gif-6532	12,020 ± 170	14,477-13,461	Charcoal	Layer IV
Ly-3228	12,400 ±230	15,268-13,788	Charcoal	Layer IV
Alger-0008	13,120 ± 370	16,894-14,409	Charcoal	Layer IV
Gif-9637	14,910 ± 180	18,568-17,715	Charcoal	Layer VII

cal BP determinations are corrected using IntCal 13 calibration curve (Reimer et al., 2013) and OxCal 4.2 (Bronk-Ramsey, 2009).

8.3.2. Columnata

Columnata is situated at the bottom of the cliffs of the Jebel Bou Ghezoul, near the settlement of Sidi Hosni, northeast of the regional capital Tiaret (Algeria)(35˚ 27.462'N, 01˚ 31.682'E). It is a large open-air site with an area of approximately 750 m^2, although it was once protected by a shelf at the foot of the cliff that has since collapsed. Excavations were first conducted under the direction of P. Cadenat between 1937 and 1962. These showed the succession of the stone-age industries of the Iberomaurusian, Columnatian, Upper Capsian, and Neolithic. In addition, human skeletal remains of more than 100 individuals were recovered from graves associated with each of the cultures (Cadenat, 1960, 1948).

Brahimi (1972b) undertook the first systematic excavations at the site in 1969 and 1971. In total 9 m^2 were excavated using thin arbitrary spits (~5 cm thickness). The upper ~15 cm of sediments were considered to be reworked and were excluded. He studied the lithic assemblages from the underlying deposits and considered them to be homogenous. This work is largely restricted to the retouched tools. L. Sari (Sari, 2014, 2012) has recently re-analyzed the assemblages focusing on the *chaîne opératoire*. This recent work is the basis for the data in the CA.

A single radiocarbon determination on freshwater mollusc shells (*Unio*) of 13,544-11,394 cal BP (10,800±425 BP, Alg-97) is often given as the age of the Iberomaurusian (Lubell, 2001; Sari, 2014, 2012). However, it is problematic as the date was first reported in association with the Epipalaeolithic/Neolithic (Brahimi, 1970; Rahmouni et al., 1972). Nonetheless, it most likely provides a reasonable *terminus anti quem* for the assemblage placing the origins of the assemblage within the Pleistocene.

8.3.3. El Haouita terrasse

El Haouita terrasse is an open-air site located at the top of the western embankment of the river of the same name, on the edge of the Saharan Atlas, some 45 km southwest of Laghouat (Algeria)(*c.* 33˚41'N, 2˚43'E). Excavations were undertaken in 1966 and 1968 by the Centre de Recherches Anthropologiques, Préhistorique et Ethnographique (CRAPE)(Amara et al., 1977; Camps et al., 1966; Estorges et al., 1969). These investigations revealed a series of archaeological lenses covering an area of 16.5 m^2, which are thought to result from the intermittent occupation of the locality. Given the large size of the site and the intermittent nature of the occupation, it seems plausible different populations might have visited and contributed to the former of the site.

A preliminary description of the chipped-stone assemblages was provided following the initial fieldwork season (Camps et al., 1966). An inventory of the retouched tools is given for the entire site in a subsequent publication with only some brief comments on variation within the chipped-stone assemblages (Estorges et al., 1969). Here, retouched tool frequencies were plotted as supplementary data for the CA, as lithic assemblages might be a combination of material from distinct cultural entities.

A single radiocarbon determination is available on charcoal at 11,170-7,576 cal BP (8,220±820 BP, Alg-28), which is considered to be problematic due to the sample size and laboratory procedures (Rahmouni et al., 1972, pp. 1–2). Nonetheless, based on stratigraphic grounds the assemblages are thought to relate to the terminal Pleistocene (Estorges et al., 1969)).

8.3.4. El Onçor

El Onçor is situated at the top of a consolidated sand embankment on the western edge of the river Bou Saâda, some 10 km south of the town of El Hamel (Algeria)(*c.* 35˚10'N, 4˚08'E). A surface collection was taken and an area 4 m^2 was excavated in 1976 by CRAPE. A single archaeological horizon was exposed to a depth of ~ 0.4 m. No signs of erosion were recorded and the horizon was deemed to be *in situ*. A single radiocarbon determination is available on ostrich eggshell dating at 12,390-11,161 cal BP (10,040±190 BP, Gif-4433) (Heddouche, 1977). Published frequencies of retouched tools are available for the surface collection and the underlying archaeological horizon (ibid). In this study the type counts from were used only from the consolidated archaeological

horizons. This limits error occurring from deflated surface collections that might be mixed and/or missing certain size classes of material

8.3.5. Es Sayar

Es Sayar is located within a sand embankment to the west of the river Bou Saâda, some 7 km south of town of El Hamel (Algeria)(*c.* 35˚10'N, 4˚08'E). An area 4 m^2 was excavated in 1976 by CRAPE. A darkish archaeological horizon between 20-25 cm thick was identified underlying a thick series of natural sands. A single radiocarbon determination is available dating on ostrich eggshell at 16,491-14,955 BP (13,100±250 BP, Gif-4349) (Amara, 1977). Published type-count data is available from a surface collection and the thin archaeological horizon (*ibid*). Here, only the data from the latter consolidated level are included.

8.3.6. Ifri el Baroud

Ifri el Baroud is a cave site located in the cliffs of the Jebel Ich-Chaboun, on route from Guercif to Nador, some 8 km southwest of Afsou (Morocco)(*c.* 34˚46'N, 3˚19'E). In 1995/1996 excavations were undertaken by the Institut National des Sciences de l'Archéologie et du Patrimoine (INSAP) and the Deustchen Archäologischen Institus (DAI). In total an area covering ~32 m^2 was excavated using relatively large arbitrary spits (~10 cm thickness) reaching a maximum depth of ~3.4 m. The deposits were coarsely divided into three major stratigraphic units: a greyish-black upper 'dump' horizon (*couche supérieure*) with few lithic artefacts and a number of potsherds, an *escargotière* consisting of a series of grey silt-rich deposits with numerous terrestrial mollusc remains with evidence of mixing at the bottom of the unit, and an underlying horizon of compacted red clays (*couche rouge*) (Nami, 2007).

A list of 24 AMS determinations on charcoal has been published, although it contains few details on the archaeological context of the samples (Görsdorf and Eiwanger, 1999). Further details on a number of the radiocarbon determinations have been given in a subsequent publication (Nami, 2007). Of the dates sixteen can be associated with a specific archaeological horizon. These include, four associated with the red clays ranging from 20,488-20,003 cal BP to 16,287-15,826 cal BP, nine relating to the *escargotière* ranging from 15,738-15,204 cal BP to 13,469-13,230 cal BP, and three correlated with the upper horizon ranging from 13,578-13,336 cal BP to 9,628-9,466 cal BP (Table 8.5).

Nami (2007) provides type-counts of the lithic artefacts following the classification suggested by Tixier (1963). A list is available from each trench with finds divided between those from the *escargotière* and *couche rouge*. Here, due to the small number of finds from each trench, the type-counts for the *escargotière* were combined across the site, which was also done in the case of the *couche rouge.* Judging by the description of the excavation methods, the incredibly low frequencies of lithic artefacts given the size of the excavations, and the extremely low numbers of microlith fragments (Nami 2007, Table 8.1), it seems that the excavations were carried out hurriedly with relatively little stratigraphic control. As such, here the type-counts only form supplementary data within CA.

Table 8.5. Published radiocarbon determinations from Ifri el-Baroud (after Moser, 2003)

Lab No	14C	%13c	cal BP (95.4%)	Record	Context
Trench II					
Bln-4750	11,508±60	-22.4	13,469-13,230	II, IB95-L	Escargotière
Bln-4749	12,253±67	-22.49	14,570-13,960	II, IB95-H	Escargotière
Bln-4747	12,481±57	-23.05	15,037-14,275	II, IB95-E	Escargotière
Bln-4748	12,574±65	-23.07	15,178-14,472	II, IB95-F	Escargotière
Bln-4746	12,626±59	-23.09	15,225-14,711	II, IB95-D	Escargotière
Bln-4745	13,359±72	-22.6	16,287-15,826	II, IB95-C	Couche rouge
Bln-4751	14,299±72	No Value	17,635-17,161	II, IB95-M	Couche rouge
Bln-4744	16,777±83	-22.09	20,488-20,003	II, IB95-A	Couche rouge
Trench III					
Bln-4755	9,677±60	-22.42	11,223-10,785	III, IB96-B	Couche supérieure
Bln-4754	11,895±64	-22.76	13,952-13,554	III, IB95-R	Escargotière
Bln-4752	12,128±70	No Value	14,167-13,775	III, IB95-P	Escargotière
Bln-4753	12,198±65	-22.23	14,315-13,830	III, IB95-Q	Escargotière
Trench IV					
Bln-4872	8,556±52	-22.29	9,628-9,466	IV, IB96-B	Couche supérieure
Bln-4926	11,027±49	-22.43	13,030-12,747	IV, IB96-4	n/a
Bln-4871	11,639±58	-22.92	13,578-13,336	IV, IB96-A	Couche supérieure
Bln-4928	11,926±68	-22.61	13,970-13,569	IV, IB96-21	n/a
Bln-4933	11,946±52	No Value	13,977-13,592	IV, IB96-94	n/a
Bln-4931	12,083±61	-21.92	14,103-13,766	IV, IB96-51	n/a
Bln-4929	12,172±61	-22.78	14,231-13,825	IV, IB96-38	n/a
Bln-4927	12,294±49	-22.65	14,571-14,043	IV, IB96-5	n/a
Bln-4934	12,309±58	-22.59	14,659-14,060	IV, IB96-96	n/a
Bln-4932	12,607±75	No Value	15,242-14,521	IV, IB96-83	n/a
Bln-4930	12,841±80	No Value	15,633-15,092	IV, IB96-49	n/a
Bln-4873	12,932±78	No Value	15,738-15,204	IV, IB96-C	Escargotière
Bln-4911	16,485±68	-21.89	20,099-19,645	IV, IB96-68	Couche rouge

cal BP determinations are corrected using IntCal 13 calibration curve (Reimer et al., 2013) and OxCal 4.2 (Bronk-Ramsey, 2009).

8.3.7. Rassel

Rassel (36˚37'N, 2˚24'E) is located in central Algeria (Fig. 8.1). The now collapsed rockshelter lies around 6 km west of Tipasa and around 80 km west of the capital of Algiers. It is located at the bottom of a cliff face of the Jebel Chenoua overlooking the Mediterranean Sea. M. Rassel first reported the site in 1958 C. Brahimi (1972a) along with other researchers from CRAPE conducted excavations at the site between 1959-1968.

The stratigraphy of the site was divided into two major units: an upper layer of grey ashy sediments with numerous ceramic fragments (*niveau supérieur*) and a homogenous lower layer of powdery ashy sediments with superimposed lenses of tools, bones, marine and terrestrial mollusc shells, thought to be food debris (*niveau inférieur*)(Brahimi, 1972a). A single date is available on bulked charcoal from the lower layer at 17,581-17,156 cal BP (14,270±59 BP, Alg-3), which is associated with artefacts attributed to the Iberomaurusian (ibid). The chipped stone-assemblages have subsequently been the focus of a number of other studies (Close, 1977; Sari, 2014, 2012). Here, the lithic type-counts from the most recent study contribute to the CA data (Sari, 2014; 2012).

8.3.8. Rolland

Rolland (36˚37'N, 2˚20'E) is cave site located along the Jebel Chenoua, central Algeria (Fig 8.1). H. Marchand conducted the first excavation in the 1930s. In 1967-1968, C. Brahimi conducted more detailed excavations at the site. He collected a small collection of stone-tools in the interior of the cave, although the main focus was on the excavation of a cone of material 4.5 in diameter and 0.8 m thick in front of the cave. He considered the material in front of the cave to have been the result of runoff along the talus of the cave sediments and was therefore not *in situ* (Brahimi, 1972, p. 24). Here, the lithic type-counts are included as supplementary data as the assemblages are thought to be in a secondary context and therefore might be potentially mixed. A single date is available on bulked marine and terrestrial mollusc shells of 16,750-14,283 cal BP (13,330±280 BP, Alg-47)(Rahmouni et al., 1972), which is problematic due to issues with the stratigraphic context and dating of bulked materials from mixed terrestrial and marine sources with different reservoir effects (see Chapter 2 for discussion).

8.3.9. Tamar Hat

Tamar Hat (36º38.344'N, 5º21.787'E) is situated in eastern Algeria (Fig. 8.1). The rockshelter lies about 2 km east of the mouth of the Oued Agrioun and around 30 km east of the regional capital of Béjaïa. It is located at the edge of the Jebel Babor overlooking a sandy coastal strip and the Mediterranean Sea.

History of research

The rockshelter was first discovered by F. Ehrmann in 1920 (Ehrmann, 1920). C. Arambourg of the Institute of Agriculture in Algiers directed the first excavation project at the site between 1928-1930 (Arambourg et al., 1934). During this period an extensive trench about 1 m wide was dug through the centre of the site, from the rear of the shelter through and into the talus outside, reaching a maximum depth of 7 m. Excavations were primarily undertaken to investigate the palaeontological record at the site. This might account in part for the small number of lithic artefacts recovered in comparison with later work, but also probably reflects the coarse nature of these early excavations. Nonetheless, Arambourg et al. (1934) provided an early insight into the nature of deposits.

With the exception of a brief mention of a number of pieces being collected from the surface during the Pan-African Congress of Prehistory in 1952 (Balout, 1955) the site received little attention until the late 1960s/early 1970s. In 1967, C. Brahimi revisited the site in order to obtain a sample of lithic artefacts for comparative purposes (Brahimi, 1969). Few details are given as to the nature of the fieldwork, although it is indicated that only a small area of approximately 1 m^3 was excavated in the uppermost deposits.

In 1973, E. C. Saxon led excavations at the site with the explicit aim of the controlled sampling of the archaeological deposits (Saxon et al., 1974). The fieldwork focused on the standing section exposed during the course of the 1929 excavations. An area 4.5 m^2 was excavated to a depth of 0.7 m, at this point the excavation area was reduced to 2 m^2 and excavated to a depth of 1.4 m, and then reduced to 1 m^2 to a depth of 4 m. The excavations were conducted systemically with sediment beginning removed according to individual context rather than by the use of artificial units. In total 7 m^3 of sediment was removed, all of which was dry sieved through a 2 mm mesh and subsequently wet sieved through a 5 mm mesh. These excavations are some of the most detailed relating to the Pleistocene LSA in Northwest Africa.

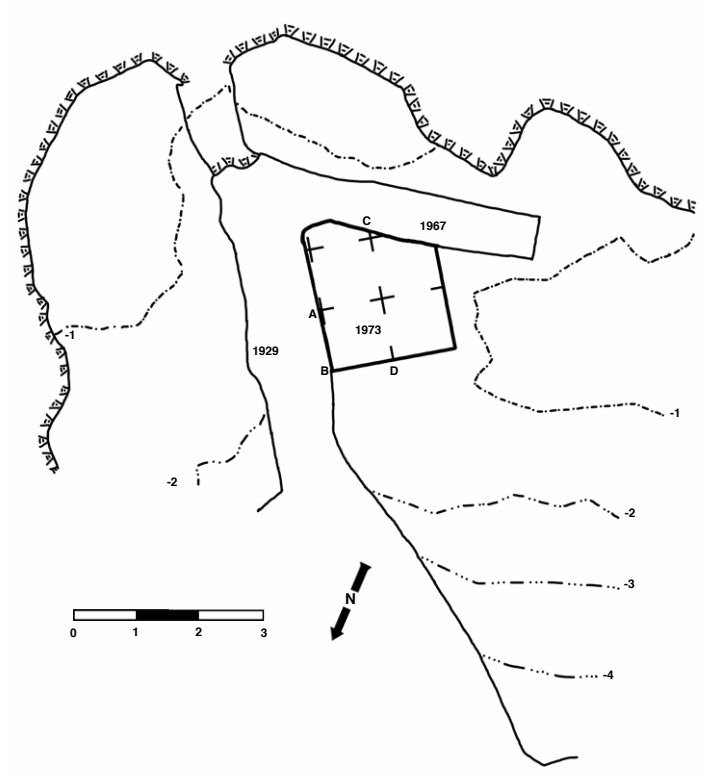


Figure 8.2. Plan of excavations at Tamar Hat (after Saxon et al., 1974)

Stratigraphy

Arambourg et al. (1934) first described the stratigraphy at the site. The sequence was divided into two major units: an upper series of stratified ash and gravel deposits abundant in faunal remains and lithic artefacts, and a lower series of compact red clays with few faunal remains and no lithic artefacts. In addition, the upper archaeological deposits were subdivided into five levels (Table 8.6). Saxon et al. (1974) following new excavatons at the site described the stratigraphy in much greater detail (Table 8.7; Fig. 8.3).

Table 8.6. Description of the stratigraphy from 1928-1930 excavations at Tamar Hat (Arambourg et al., 1934, own translation)

Level	Thickness (m)	Description
1	1.60	Grey, not very compact deposit, with numerous lithic artefacts, faunal remains, and marine/ terrestrial mollusc debris.
2	0.50	Light brown deposit, with comparable assemblage to the overlying deposits.
3	0.40	Light brown deposit, separated from overlying deposit by a fine layer of white ash, with fewer lithic remains than deposits above..
4	c. 2.00	Deposit, separated from those overlying by a second ash layer, witnesses a reduction in the number of marine and terrestrial molluscs remains.
5	0.70-0.80	Reddish brown deposit, with similar proportions of fauna remains in overlying deposits.

Table 8.7. Description of stratigraphy from 1973 excavations at Tamar Hat (Saxon et al., 1974)

Unit	Layers	Description
I	1-15	Layer 1-4 is a disturbed surface soil (e.g. burrowing) and possibly unsieved sediment from 1929 excavations. The underlying deposits are undisturbed and consist of inter-stratified bone rich and thin less finds rich soils with a slower rate of accumulation.
II	16-26	Layers 16-22 consist of a dry powdery soil, variously coloured as a result of dripping mineral-rich water from the cave roof. Layers 23-26 are similar to the above deposits, but less dry. Bone preservation is poor throughout.
III	27-34	Layers 27-28 has a purple-brown matrix, with numerous shell and bone remains. Layers 29-31 consist of red and green clayey soil overlying the ash/hearth deposits in Layers 32-34. Layer 34 consists of thin laminated bands of crushed shell and sandy orange soil flecked with carbon; at its base is a 'living floor' with shells, bones, and tools.
IV	35-49	Layers 35-49 consist of a series of inter-stratified ash lenses and intervening soil horizons, generally orange in colour. Theses deposits are the last to have an appreciable number of terrestrial mollusc remains.
V	50-70	Layer 50 is disturbed. The underlying deposits are are a series of inter-stratified ash lenses and soft dark brown soils. In most cases the hearths were associated with stake holes considered evidence of the use of a cooking/drying frame.
VI	71-85	Layers 71-85 include layers with numerous bone fragments alternating with ash lenses. These deposits overlay a sterile red clayey deposit.

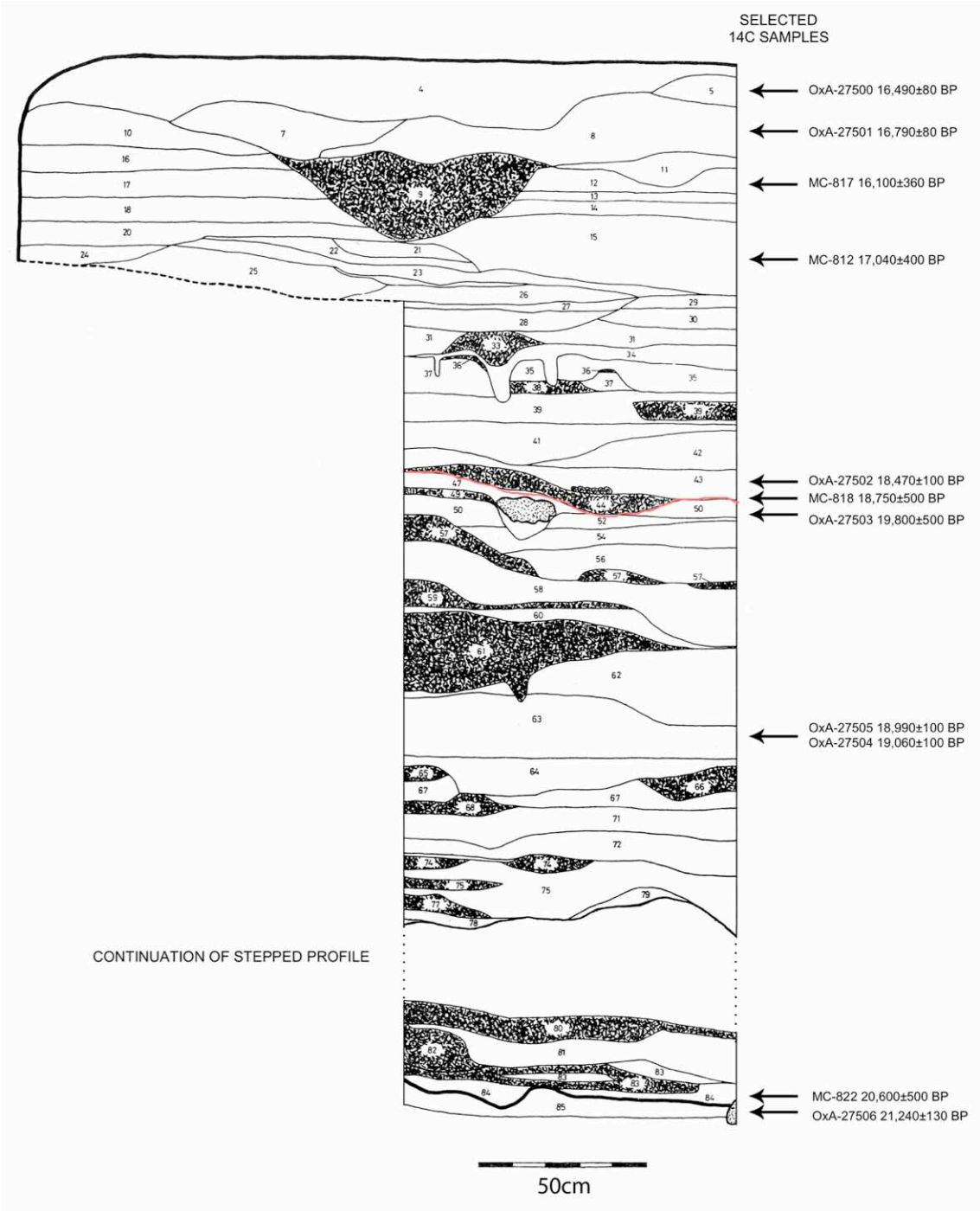


Figure 8.3. Section of the 1973 excavations at Tamar Hat showing radiocarbon determinations (modified after Saxon et al., 1974)

Chronology

Seven radiocarbon dates have been previously published from Tamar Hat (Table 8.8). There are two on samples collected during the 1967 excavations (Brahimi, 1969) and five on samples collected during the 1973 excavations (Saxon et al., 1974). All of these dates were made on charcoals with the decay counting method.

The dates from the 1967 excavations are problematic as they derive from deposits that are thought to be unsieved sediments from the 1929 excavations (Saxon et al., 1974, p. 53). If this is the case then an admixture of carbon of different ages might explain the difference in radiocarbon determinations between the 1967 and 1973 excavations.

The dates from the 1973 excavations provide a coherent sequence with no reversals and central values between 20,600-16,100 BP. All of the radiocarbon determinations were on charcoals obtained from individual stratigraphic contexts, with the exception of the oldest date of 25,895-23,710 cal BP (20,600±500 BP, MC-822) that is on charcoals from Layers 85/6. Prior to the work undertaken as part of this thesis these represented the oldest radiocarbon determinations associated with the LSA from Algeria. However, re-evaluations of the radiocarbon chronologies based on decay counting using AMS methods have shown consistently younger ages for the LSA in Maghreb (N. Barton et al., 2013; Bouzouggar et al., 2008). Thus, there was a perceived need to re-evaluate the age of the LSA at Tamar Hat.

Funding for new dating work in 2012 was provided by NERC (NF/2012/1/12) for the AMS radiocarbon measurements from Tamar Hat. The samples were taken from a small collection of material collected during the 1973 excavations and now stored at the Natural History Museum, London. Each sample can be assigned to a specific stratigraphic unit as described by Saxon et al. (1974). All of the samples were on individual bones (collagen fraction) of *Ammotragus lervia*, commonly known as the Barbary sheep (identification by S. Jones). All samples were pre-treated to remove potential contaminants using standard ORAU protocols.

The AMS radiocarbon determinations appear to confirm the general chronology established after the 1973 excavations (Table 8.9). The beginning of the sequence can now be more accurately dated to 25,845-25,270 cal BP (21,240 BP, OxA-27506), which is the oldest reliable age for the LSA in Algeria and anywhere else in Northwest Africa. Though not on modified bone, it originates from a stratigraphic horizon, rich in lithic artefacts. The youngest sediments can now to be dated to 20,122-19,632 cal BP (16,490±80 BP, OxA-27500). This indicates a narrow timeframe for the occupation of the site and seems to confirm that the radiocarbon determinations from the 1967 excavations at the site

of 13,031-11,105 cal BP (10,350±375 BP, Alg-5) and 16,140-13,441 cal BP (12,450±450 BP, Alg-4) are erroneous.

Table 8.8. Traditional C^{14} radiocarbon determinations from Tamar Hat (after Brahimi, 1969; Saxon et al., 1974)

Lab No	14C	cal BP (95.4%)	Material	Context	Reference
1967 excavations					
Alg-5	10,350 ± 375	13,031-11,105	Charcoal	0-30 cm	Brahimi 1969
Alg-4	12,450 ± 450	16,140-13,441	Charcoal	30-50 cm	Brahimi 1969
1973 excavations					
MC-817	16,100 ± 360	20,337-18,689	Charcoal	Layer 9	Saxon et al. 1974
MC-812	17,040 ± 400	21,665-19,623	Charcoal	Layer 15	Saxon et al. 1974
MC-818	18,750 ± 500	23,914-21,538	Charcoal	Layer 44	Saxon et al. 1974
MC-820	19,800 ± 500	25,194-22,723	Charcoal	Layer 50	Saxon et al. 1974
MC-822	20,600 ± 500	25,895-23,710	Charcoal	Layers 84/5	Saxon et al. 1974

cal BP determinations are corrected using IntCal 13 calibration curve (Reimer et al., 2013) and the OxCal 4.2 (Bronk-Ramsey, 2009).

Table 8.9. AMS radiocarbon determinations from Tamar Hat

Lab No	14C	%13c	cal BP (95.4%)	Material	Context
OxA-27500	16,490 ± 80	-19.59	20,122-19,632	Bone	Layer 5
OxA-27501	16,790 ± 90	-19.76	20,511-20,006	Bone	Layer 8
OxA-27502	18,470 ± 100	-19.33	22,547-22,019	Bone	Layer 43
OxA-27503	18,440 ± 110	-19.39	22,525-21,190	Bone	Layer 48
OxA-27504	19,060 ± 100	-19.31	23,320-22,625	Bone	Layer 63
OxA-27505	18,990 ± 100	-19.59	23,164-22,537	Bone	Layer 63
OxA-27506	21,240 ± 130	-19.81	25,845-25,270	Bone	Layer 85

cal BP determinations are corrected using IntCal 13 calibration curve (Reimer et al., 2013) and the OxCal 4.2 (Bronk-Ramsey, 2009).

Lithic assemblages

The lithic assemblages recovered from the 1928-30 excavations were subjected to a number of early studies (Arambourg et al., 1934; Balout, 1955; Vaufrey, 1955). As noted by Brahimi (1969), the total number of artefacts from these excavations was small and the material was not collected in a systematic fashion.

Brahimi (1969) provides a more detailed description of the lithic assemblages from the 1967 excavations. Nonetheless, the lithic report primarily consists of type-counts. As noted above, the lithic assemblages are not thought to be *in situ* (Saxon et al., 1974, p. 53). However, the sediments appears to have been carefully excavated and with even the smallest artefacts being collected, as indicated by the high proportions of microlith fragments (Table 8.1). Brahimi's (1969) retouched tools type-counts are used as supplementary data.

Saxon et al. (1974) provides a preliminary description of the lithic assemblages from the 1973 excavations, which are published in full soon after (Close, 1980-1981; 1977) and have recently been re-analysed (Sari, 2014; 2012). Close (1980-1981; 1977) uses an amended version of the type-list so

this data is excluded here. Instead the data in this study is from the recent analysis of the museum collections conducted by Sari (2014; 2012), which follows the classification of retouched tools suggested by Tixier (1963). Sari (2014; 2012) also studied a number of other collections from which the data are included in this CA (e.g. Columnata, Rolland)(see above). The assemblages are thought to be *in situ* and were carefully excavated (Saxon et al., 1973; see above). As such, the data from the major stratigraphic divisions contributes to the active data used in the CA.

8.4. Results of CA

Table 8.10 reports the inertia accounted for by each dimension in the CA. The square root of the total inertia can be interpreted a correlation coefficient, being exactly equal to the canonical correlation (Greenarce, 2007, p. 61). In the case given here the value is 0.804, which can be interpreted as showing a strong association between the row (i.e. assemblages) and columns (i.e. microliths). A range of different methods have been suggested for establishing the number of relevant dimensions, although it is commonly agreed the number is restricted by the ability of the researcher to give a meaningful interpretation of the selected dimensions (Alberti, 2013, p. 488). Here, it can be shown that the first three dimensions, which account for 71.8% of the inertia, are of particular relevance for understanding of microlith variation within the LSA of the Northwest Africa. The microliths having a major contribution to each of the dimensions are show in Table 8.11.

Table 8.10 Inertia accounted for by the CA dimensions. Proportion and cumulative proportion of interia accounted for by each dimension are also shown

Dimension	Inertia	Proportions (%)	Cumulative (%)
F1	0.304	44.8	44.8
F2	0.123	18.1	63.0
F3	0.060	8.8	71.8
F4	0.051	7.5	79.3
F5	0.044	6.5	85.7
F6	0.030	4.5	90.2
F7	0.017	2.4	92.7
F8	0.016	2.3	95.0
F9	0.012	1.8	96.8
F10	0.011	1.6	98.5
F11	0.006	0.9	99.4
F12	0.003	0.4	99.8
F13	0.001	0.2	100.0
Total	0.679	100.0	

Table 8.11. Contribution of the columns (i.e. microlith types) to the definition of the dimensions relevant to interpretation. In bold: higher-than-average contributions (i.e., categories having major contribution to the definition of a particular dimension).

		Column Contributions to the Interia (average column contribution = 0.067)			
		F1	F2	F3	F4
45-53	Pointed straight backed bladelets *sensu lato*	0.050	**0.342**	0.004	0.044
54	Burin spall with abrupt retouch	0.008	0.000	0.005	0.000
55	Bladelet with convex backed end	0.004	0.000	0.000	0.029
56-59	Convex backed bladelets *sensu lato*	**0.417**	0.021	0.000	0.000
60-61	Irregular backed bladelets	0.001	0.006	0.045	0.007
62	La Mouillah point	0.000	**0.117**	**0.531**	0.016
63-64	Partially backed bladelet	**0.247**	**0.207**	0.000	**0.148**
65	Shouldered point	0.001	0.000	0.040	0.016
67	Obtuse ended backed bladelet	**0.076**	**0.087**	0.012	**0.197**
68	Scalene bladelet	0.000	0.001	0.011	**0.210**
69	Pointed bladelet with Ouchtata retouch	0.006	0.017	0.001	0.004
70	Ouchtata bladelet	**0.080**	**0.138**	**0.185**	**0.229**
71	Bladelet with Ouchtata retouch	0.018	0.041	0.004	0.025
82	Segment	**0.079**	0.016	**0.149**	0.028
89-93	Triangles	0.010	0.007	0.009	0.046
94-100	Elongated triangles	0.003	0.000	0.004	0.000

A symmetric CA plot of sample data showing column points (i.e. microlith types) on the plane defined by the first and second dimension is shown in Fig. 8.4. Based on the major contributors (i.e. column points with higher-than-average contributions to the inertia) the first dimension is determined principally by the opposition of convex backed bladelets *sensu lato* and segments, on the one hand (positive pole), and partially backed bladelets, obtuse ended backed bladelets, and Ouchtata bladelets, on the other hand (negative pole). It is interesting to note that the microliths that lie on the positive side of the dimension, appear to be logically related to those having a major contribution to the definition of that pole of the dimension, in that each is typically associated with the utilization of the microburin technique (e.g. bladelets with convex backed end, scalene bladelets, triangles, etc). Conversely, in addition to the major contributors, those on negative side of the dimension are not usually associated with the technique (e.g. pointed straight backed bladelets *sensu lato*, pointed bladelets with Ouchtata retouch, bladelets with Ouchtata retouch).

The second dimension has a less clear-cut interpretation. If one takes into account those microlith types having a major contribution to the definition of the dimension, then the most clear distinction appears to be between forms with a continuous retouch along the lateral margin on the one hand, such as pointed straight backed bladelets *sensu lato* and obtuse ended backed bladelets (negative pole), and those with partial retouch along the lateral margin on the other hand, such as, partially

backed bladelets (types 63-64), and Ouchtata bladelets (type 70)(positive pole). However, it must be noted that whilst the Ouchtata bladelets (type 70) are typified by marginal retouch restricted to proximal portion of the lateral margin, the type definition also includes those with continuous retouch along the entirety of the edge (Tixier, 1963).

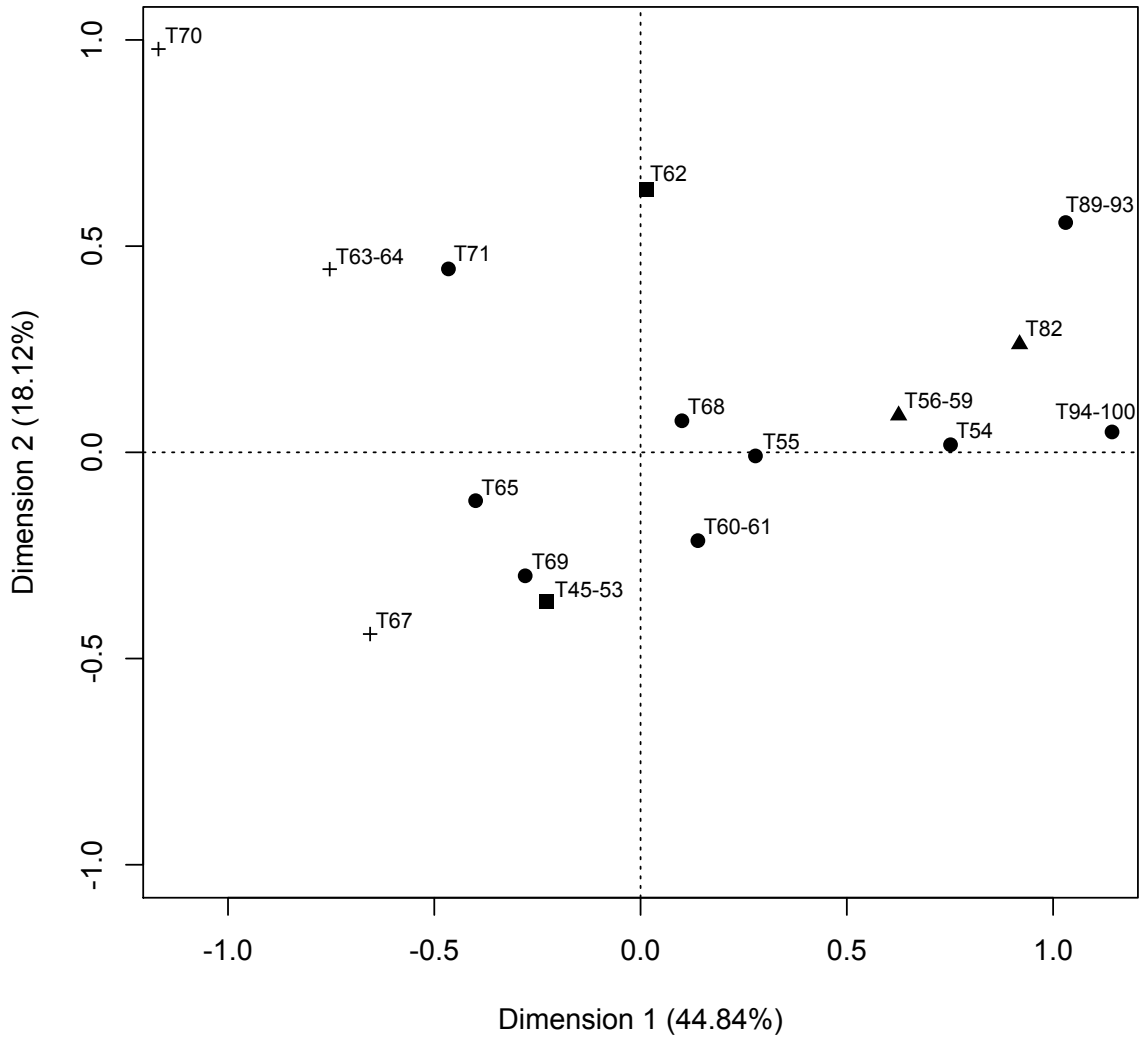


Figure 8.4. Symmetric CA map of sample data showing microlith types (i.e. column points) on the plane defined by the first and second dimension. Solid circles (●): active points; triangles (▲): points having major contribution to the definition of the first dimension only; crosses (+): major contributions to the first and second dimension; squares (■): major contributions to the second dimension only; type numbers and corresponding type names shown in Table 8.11

Fig. 8.5. shows a symmetric CA plot of the sample data showing the row points (i.e. assemblages) on the plane defined by the first and second dimension. It is possible to identify four clusters, which appear to be the most parsimonious interpretation of the data. It should be noted that the CA is descriptive and exploratory and provides a method for interpreting the data and defining

potential groups. However, it may not be possible to demonstrate that the defined groups differ statistically. Table 8.12. shows assemblages within the groups inferred from the CA.

Table 8.12. Pleistocene LSA assemblages arranged chronologically within identified CA groups (excluded radiocarbon ages shown in bold italics)

CA Group	Assemblage (abbreviated name)	Assemblage (site and/or layer)	Approximate age (ka cal BP)
I	Tam VI	Tamar Hat/Unit VI	25.9-25.3
	Tam V	Tamar Hat/Unit V	23.2-22.5
	Tam IV	Tamar Hat/Unit IV	22.5-22.0
	Tam III	Tamar Hat/Unit III	
	Tam II	Tamar Hat/Unit II	
II	Taf L	Taforalt/Lower	22.1-16.9
	Tam I	Tamar Hat/Unit I	21.7-19.6
	Ras III	Rassel/Niveau III	17.6-17.2
	Rol	***Rolland***	***16.8-14.3***
	Tam 67	***Tamar Hat/1967 Excavations***	***16.1-11.1***
III	***Say***	***Es Sayar***	***16.5-15.0***
	Taf M	Taforalt/Middle	15.7-14.4
IV	Afa V	Afalou Bou Rhummel/Couche V	
	Afa IV	***Afalou Bou Rhummel/Couche IV***	***16.9-13.5***
	Bar E	***Ifri el Baroud/Escargotière***	***15.8-13.2***
	Taf B	Taforalt/Burials	14.6-14.2
	Taf U	Taforalt/Upper	14.6-12.5
	Afa III	***Afalou Bou Rhummel/Couche III***	***14.1-12.8***
	Afa II	Afalou Bou Rhummel/Couche II	
	Afa I	Afalou Bou Rhummel/Couche I	
	Col 71	Columnata/1971 Excavations	
	Col 69	Columnata/1969 Excavations	13.5-11.4
	Onç	El Onçor	12.4-11.2
N/A	***Bar R***	***Ifri el Baroud/Couche Rouge***	***20.5-15.8***
	Hao	***El Haouita terrace***	***11.7-7.6***

The first two clusters (Groups I and II) lie to the left of the plane and consist of sites/assemblages with relatively high frequencies of types that are not usually associated with the microburin technique (e.g. pointed straight backed bladelets, partially backed bladelets, obtuse ended backed bladelets, and Ouchtata bladelets).

Group I is at the bottom left sector of the plane and includes assemblages with relatively high frequencies of types with continuous retouch along the lateral margin (e.g. pointed straight backed bladelets and obtuse ended backed bladelets). The calibrated radiocarbon ages range ~25.9 – 21.7 ka cal BP (at 95.4%).

Group II lies towards the upper left sector of the plane and includes assemblages with lower frequencies of the aforementioned types, and higher proportion of types with partial retouch along the lateral margin (e.g. partially backed bladelets and Ouchtata bladelets). These sites/assemblages have calibrated radiocarbon ages of ~21.7 – 11.1 ka cal BP (at 95.4%). However, two supplementary points within this group are from sites/assemblages that are disturbed and only have radiocarbon

determinations on bulked material that are most likely inaccurate due to admixture of carbon of different ages (Rolland, Tamar Hat – 1967 Excavations)(see above). If these are excluded the reliable sites/assemblages have calibrated radiocarbon ages of ~21.7 – 16.9 ka cal BP (at 95.4%).

Whilst Groups I and II have different age ranges a strict distinction between these groups is unclear. Close (1980-81) suggested that there was general continuity throughout Tamar Hat (Units VI-I) and that the upper deposits were similar to the collections from Rassel, which together were distinct from younger sites within the LSA (ibid, p. 102). A recent re-analysis of the assemblages came to similar conclusions (Sari, 2014). Some differences are to be expected given the large chronological and geographical span of the assemblages (see Chapter 9 for discussion).

Most of the sites/assemblages in Groups I and II are well represented on the plane defined by the first and second dimensions. However, it has to be noted that the majority of inertia of the Lower Phase at Taforalt is captured by the first and fourth dimension, and is strongly correlated with the latter (Table 8.13). The major contributors to the fourth dimension are, partially backed bladelets (type 63), obtuse ended backed bladelets (type 67), scalene bladelets (type 68), and Ouchtata bladelets (type 70).. The Lower Phase at Taforalt differs from the other assemblages in Groups I and II principally in the relatively high proportions of scalene bladelets (type 68) and Ouchtata bladelets (type 70). It is tempting to speculate that the differences in microlith forms might reflect variation related to the different ecological contexts of the assemblages. The Lower Phase at Taforalt is a hinterland assemblage, whilst the other assemblages are from coastal sites in Groups I and II. This is further discussed in Chapter 9. However, it should be noted that the assemblage from the Lower Phase at Taforalt is also the smallest in the dataset, consisting of relatively few microliths (n=54), and the observed pattern could be an effect of selection bias.

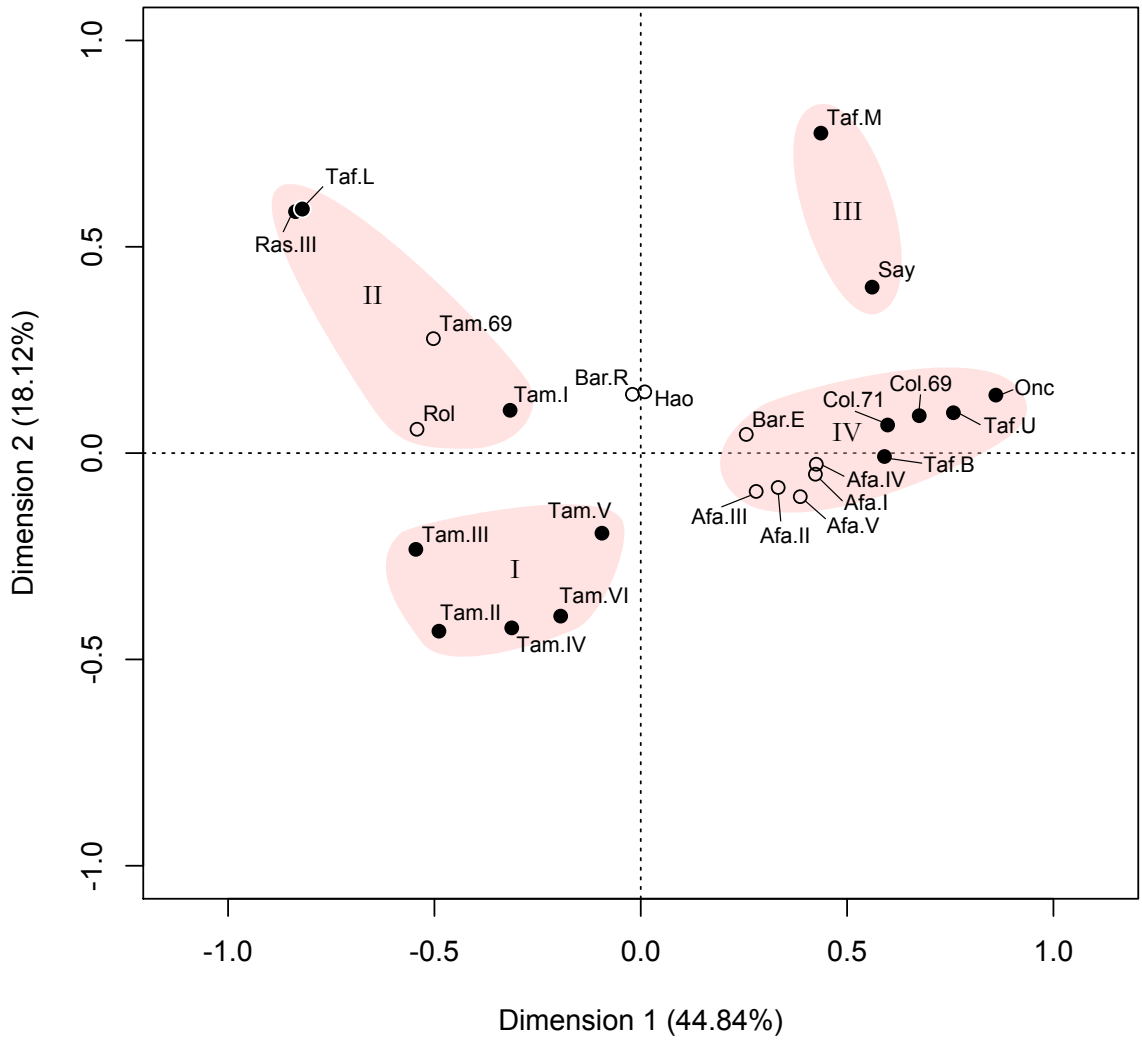


Figure 8.5. Symmetric CA map of sample data showing assemblages (i.e. row points) on the plane defined by the first and second dimension. Solid circles (●): active points; hollow circles (○): supplementary points; assemblage and abbreviated names shown in Table 8.1

An additional two clusters (Groups III and IV) lay to the right of the plane defined by the first and second dimensions (Fig. 8.5) and consists of assemblages with high frequencies of types commonly associated with the microburin technique (i.e. convex backed bladelet *sensu lato*, segments). It has to be noted that most of the sites/assemblages in these groups (with the exception of El Onçor) are better represented on the plane defined by the first and third dimensions. Nevertheless, the overall picture remains the same.

The third dimension is determined principally by the opposition of La Mouillah points, on the one hand (negative pole), and essentially all other types, on the other hand (positive pole), with La Mouillah points contributing more than half of the inertia to the dimension (Fig. 8.6). The placement

of the clusters on right of the plane (Groups III and IV) relate to the relative abundance of La Mouillah points (type 62) on the plane defined by the first and third dimension as shown in Figure 8.7.

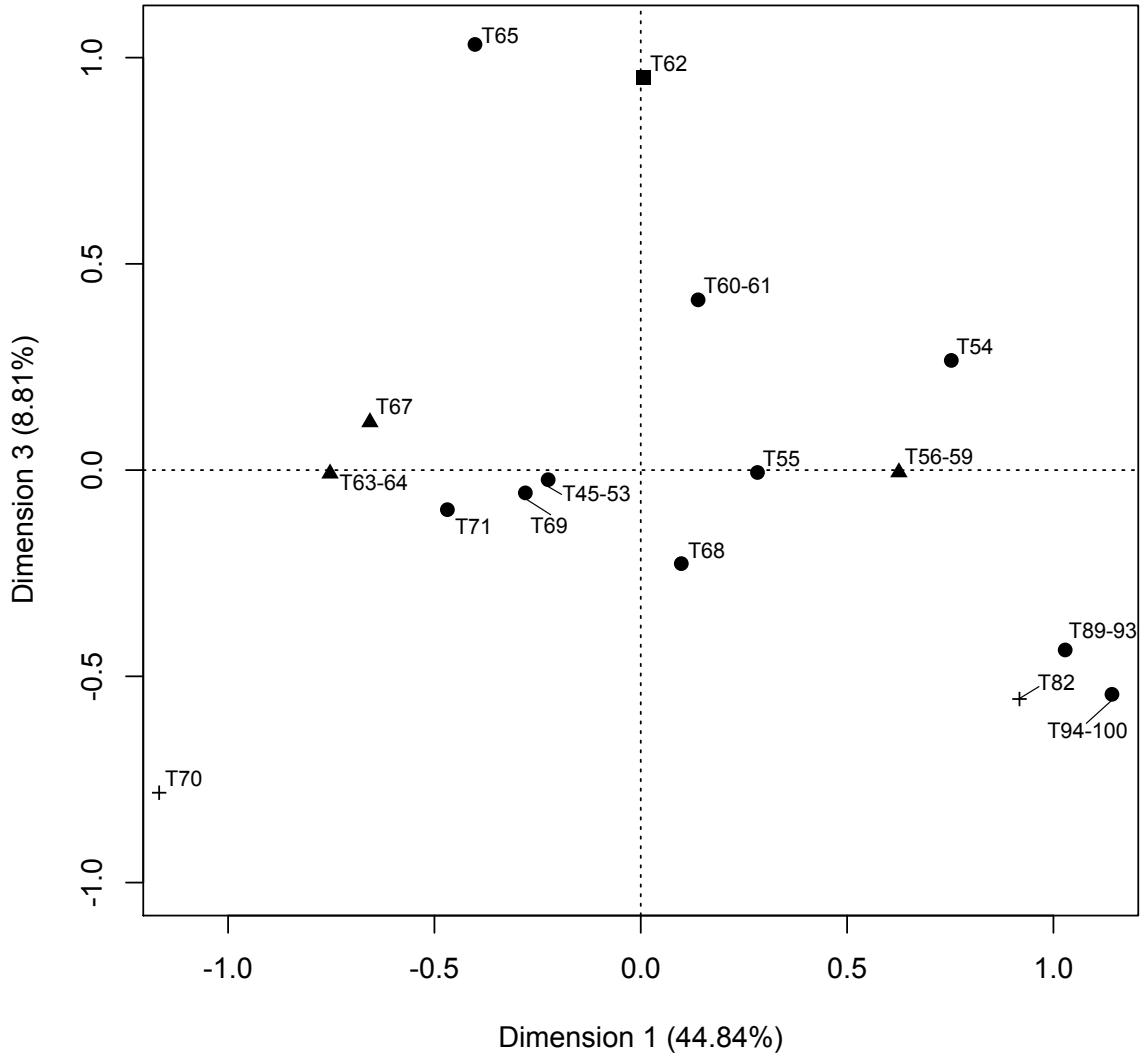


Figure 8.6. Symmetric CA map of sample data showing microlith types (i.e. column points) on the plane defined by the first and third dimension. Circles (●): active points; Triangles (▲): points having major contribution to the definition of the first dimension only; Crosses (+): major contributions to the first and third dimension; squares (■): major contributions to the third dimension only; type numbers and corresponding type names shown in Table 8.11

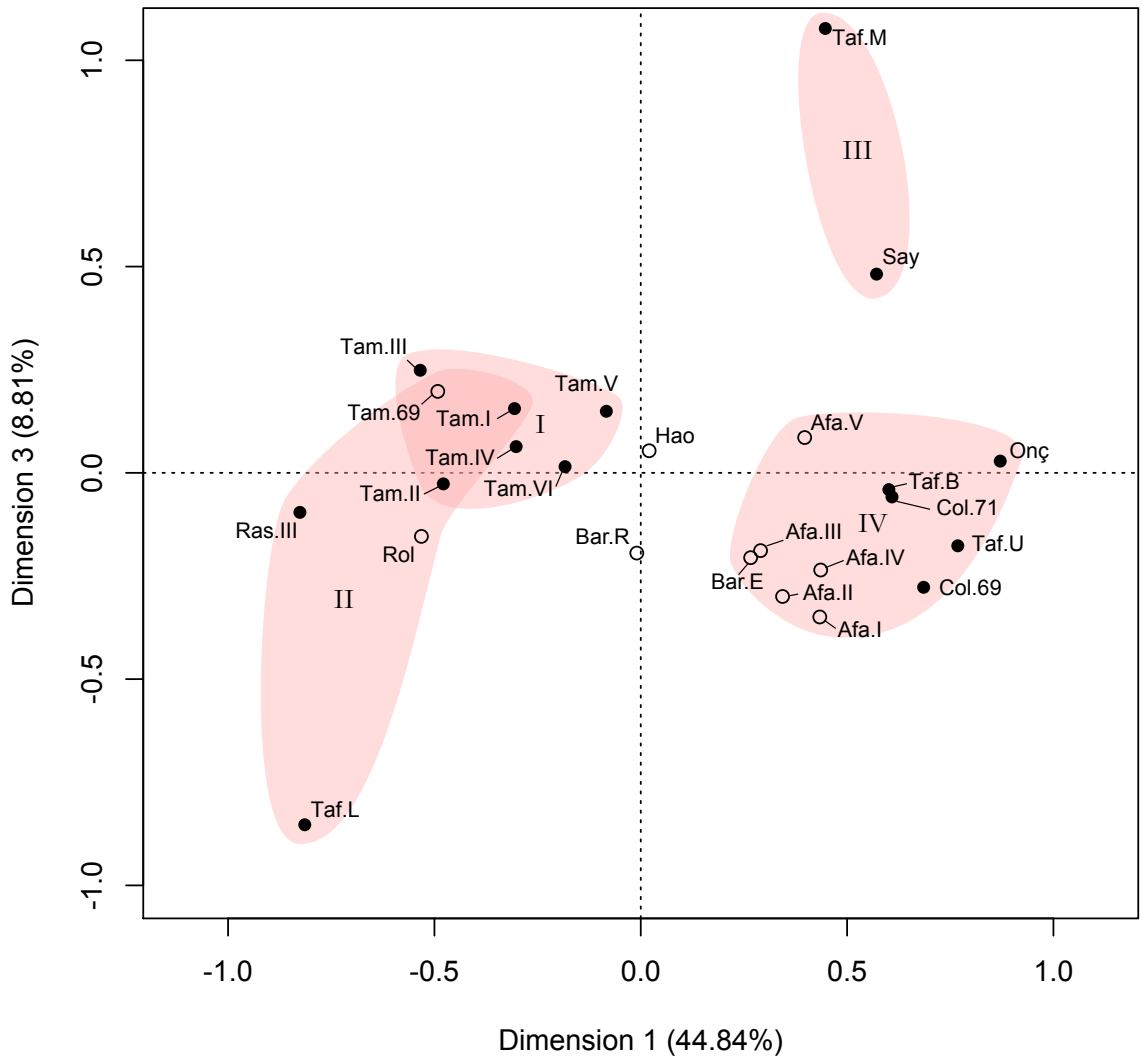


Figure 8.7. Symmetric CA map of sample data showing assemblages (i.e. row points) on the plane defined by the first and third dimension. Solid circles (●): active points; hollow circles (○): supplementary points; assemblage and abbreviated names shown in Table 8.1

Group III lies to towards the upper right sector of the plane and includes the assemblages with relatively high proportions of La Mouillah points. The calibrated radiocarbon ages range ~16.5 - 14.4 ka cal BP (at 94.5%). However, this does not give an accurate timeframe from Group III. There is a single radiocarbon determination with large error margins from Es Sayar. It gives an age of 16,491-14,955 cal BP (at 95.4%) with a central value of 15,692 cal BP. It is contentious as it is on bulked ostrich eggshell. If this is excluded the reliable sites/assemblages have narrow calibrated radiocarbon ages of between ~15.7 – 14.5 ka cal BP (at 95.4%).

Group IV is situated at the centre of the right-hand side of the plane and includes assemblages with relatively low proportions of this form, but nonetheless characterized by microliths associated

with the microburin technique (e.g. convex backed bladelet *sensu lato*, segments, etc). These sites/assemblages have calibrated radiocarbon ages of ~14.6 - 11.2 ka cal BP (at 94.5%). A number of supplementary points are in close proximity and slightly to the left of Group IV on each of the maps, which represent the assemblages from Afalou Bou Rhummel (*couches* V-I) and the *escargotière* at Ifri el Baroud. These might be included within Group IV, although a number of issues surround these assemblages.

None of the assemblages from Afalou Bou Rhummel (Couches V-I) are well represented on the planes defined by first, second, third, or fourth dimension (Table 8.13). This might relate to the observed lack of chronostratigraphic control at the site. Here, rather dubious radiocarbon determinations range ~16.9 - 12.8 ka cal BP (at 94.5%). There are also issues with the excavations methods and stratigraphic control at Ifri el Baroud. Here, the radiocarbon determinations overlap with those of Group III and IV between ~15.8-13.2 ka cal BP (at 94.5%)(see above).

Table 8.13. Quality of display of row points (i.e. assemblages) on the planes defined by pairs of dimensions. Correlation of row points to the dimensions is shown.

	Quality of display			Correlation to dimensions			
	F1+F2	F1+F3	F1+F4	F1	F2	F3	F4
Bar E	0.250	0.411	0.273	0.49	0.07	0.41	0.17
Bar R	0.075	0.182	0.412	0.00	0.27	0.43	0.64
Taf U	0.669	0.701	0.676	0.81	0.09	0.20	0.13
Taf M	0.303	0.511	0.146	0.28	0.48	0.66	0.26
Taf L	0.248	0.349	0.697	0.40	0.29	0.43	0.73
Taf B	0.390	0.393	0.391	0.62	0.00	0.05	0.03
Col 69	0.654	0.761	0.659	0.80	0.09	0.34	0.12
Col 71	0.904	0.909	0.904	0.95	0.09	0.11	0.09
Ras III	0.948	0.648	0.670	0.80	0.56	0.10	0.18
Rol	0.589	0.643	0.598	0.76	0.07	0.24	0.12
Onç	0.524	0.512	0.512	0.72	0.11	0.00	0.00
Say	0.430	0.487	0.311	0.54	0.37	0.44	0.14
Hao	0.063	0.006	0.194	0.03	0.25	0.07	0.44
Afa I	0.211	0.352	0.208	0.45	0.06	0.38	0.03
Afa II	0.114	0.194	0.107	0.33	0.09	0.30	0.03
Afa III	0.164	0.217	0.232	0.38	0.13	0.27	0.29
Afa IV	0.043	0.057	0.091	0.21	0.00	0.12	0.22
Afa V	0.233	0.222	0.349	0.46	0.13	0.08	0.37
Tam 67	0.806	0.706	0.686	0.79	0.43	0.29	0.26
Tam I	0.364	0.404	0.384	0.58	0.18	0.27	0.23
Tam II	0.916	0.499	0.497	0.70	0.65	0.06	0.04
Tam III	0.375	0.371	0.363	0.56	0.25	0.24	0.23
Tam IV	0.734	0.246	0.376	0.49	0.70	0.08	0.37
Tam V	0.450	0.235	0.116	0.25	0.62	0.41	0.23
Tam VI	0.532	0.090	0.127	0.30	0.66	0.00	0.19

There are two supplementary points that have not been discussed: El Haouita terrasse and Ifri el Baroud couche rouge. These are both poorly represented on the planes defined by the first, second, third, and fourth dimension and do not fit with any of the clusters. These reside near the origin of the

axes indicating that these are similar to the average for the entire dataset, which could be considered as indicative of a mixed assemblage.

8.5. Summary

In this chapter it has been shown how the use of methods such as CA can be used to provide a better clustering of sites according to variation in microlith frequencies. Using the technique four distinct chronological groups were observed in the sample of Pleistocene LSA assemblages from Northwest Africa.

Group I and II represent the earliest assemblages and date to ~25.9 – 21.7 ka cal BP and ~22.1 – 16.9 ka cal BP, respectively. These assemblages tend to have relatively high proportions of partially backed bladelets, obtuse ended backed bladelets, and Ouchtata bladelets, and relatively few convex backed bladelets *sensu lato* and segments. There is some variation between Group I and II, with relatively higher proportions of straight backed bladelets *sensu lato* and obtuse ended backed bladelets in Group I, and fewer of these forms in Group II. In addition, there are some interesting differences within Group II.

Group III and IV represent a series of later assemblages with dates of ~15.7 – 14.5 ka cal BP and ~14.6 – 11.2 ka cal BP, respectively. In contrast to the earlier assemblages, these tend to have high proportions of convex backed bladelets *sensu lato* and segments, and low proportions of partially backed bladelets, obtuse ended backed bladelets, and Ouchtata bladelets. There is variation between Group III and IV, with relatively higher proportions of La Mouillah points in Group III, and fewer of this form in Group IV.

Chapter 9.

Discussion

9.1. A Revised Nomenclature

This research has a number of implications concerning the much debated and contentious term *Iberomaurusian,* and to what extent, or lack thereof, it still has a role to play in the nomenclature of the Maghreb LSA. All the assemblages in the correspondence analysis (CA) have been previously labelled Iberomaurusian, irrespective of the recognised differences in the lithic assemblages. I would suggest its continued usage in this broad sense (so-called Iberomaurusian *sensu lato*) conflates observations made across a diverse range of sites with the idea of a specific facies, which gives the false impression of homogeneity within the LSA. It seems to me that the term has little, if any, advantage over the more widely recognised terminology for referring to blade/bladelet dominated assemblages (e.g. LSA, Upper Palaeolithic/Epipalaeolithic) with the exception that it is geographically restricted referring only to assemblages from North Africa. Therefore I would suggest abandoning the Iberomaurusian *sensu lato* in favour of more generic terminology, as has been done here, and been suggested by a number of past authors (Balout, 1955; Roche, 1963; Tixier, 1963).

In a restricted sense, referred to as the Iberomaurusian *sensu stricto* by Gobert (1954), the label is used to denote similarities with LSA assemblages recovered from the type-site of Mouillah. I would suggest that used in this way it might have more utility, but still remains unsatisfactory. A major question has to be raised as to the utility of a type-assemblage that is based on excavations with little stratigraphic information and excavated at the turn of the century that might very well represent a mix of different material of distinct ages. Nonetheless, if the term is used in its more restricted sense (so-called Iberomaurusian *sensu stricto*) then it seems reasonable that it is only applied to lithic assemblages that are chronologically equivalent to those dating to younger than the Heinrich 1 event at ~16 ka cal BP. Montet (1956) has most recently studied the collections from the type-site and based on the published details these seem to best fit with the post-H1 assemblages described in this thesis. For instance, he described that the

dominant microlith forms were convex and straight backed bladelets (*point à dos*) and that the assemblages also included La Mouillah points (*lames à dos et «piquant trièdre»*) and low numbers of geometrics, most often segments. However, it seems to me that there is circularity in this argument and to continue to use the term in this way would be fraught with obvious difficulties.

The term 'Southern Tunisian bladelet industries' has also led to some confusion, with a few authors equating it with a specific facies of the LSA, even though it was coined as an umbrella term referring to a wider range of industries. Furthermore, many authors do not consider many such assemblages distinct from those of the 'Iberomaurusian'. I am inclined to agree with this analysis, as there are no overt criteria for distinguishing between the assemblages, except perhaps from the point of view of geographic location. The question then arises if the existing terminology is insufficient and unsatisfactory how should one refer to variation observed within the Pleistocene LSA of Northwest Africa?

In answering this question in my thesis I have proposed an approach that is based on the correspondence analysis (CA) of well-stratified collections of lithic artefacts from Grotte des Pigeons (Taforalt) in Morocco. The lithic assemblages at Grotte des Pigeons (Taforalt) show three distinct techno-complexes and the CA indicated that these could be extrapolated much more widely throughout Northwest Africa. I was also able to recognise an additional variant not observed at the site, which was potentially earlier and could be identified in the lowermost horizons at the well-dated site of Tamar Hat (Algeria). Based on this research, I would propose that the Pleistocene LSA of Northwest Africa might be divided into four groups, an *Initial Maghreb LSA* time-coincident with the first appearance of microlithic technology and lasting up until the H2 event, a succeeding *Early Maghreb LSA* continuing through until the H1 event, a *Middle Maghreb LSA* marking the shift in technologies around this event, and an *Upper Maghreb LSA* occurring with the climatic amelioration of the Bølling-Allerød (Table 9.1). In addition, the term *Final Maghreb LSA* might be utilised to refer to the Holocene industries, which are outside the scope of this thesis. In the following each of the major divisions of the Pleistocene LSA

identified in this thesis are outlined with discussion of the relevant data that supports (or contradicts) this new chronological model. In addition, some tentative suggestions are made as to the implications for understanding the demographic history of Northwest Africa.

Table 9.1. Chronological framework for variation within the Maghreb LSA of Northwest Africa (excluded radiocarbon ages shown in bold italics)

Phase	CA Group	Assemblage (abbreviated name)	Assemblage (site and/or layer)	Approximate age (ka cal BP)
Initial	I	Tam VI	Tamar Hat/Unit VI	25.9-25.3
		Tam V	Tamar Hat/Unit V	23.2-22.5
Early		Tam IV	Tamar Hat/Unit IV	22.5-22.0
		Tam III	Tamar Hat/Unit III	
		Tam II	Tamar Hat/Unit II	
	II	Taf L	Taforalt/Lower	22.1-16.9
		Tam I	Tamar Hat/Unit I	21.7-19.6
		Ras III	Rassel/Niveau III	17.6-17.2
		Rol	***Rolland***	***16.9-15.2***
		Tam 67	***Tamar Hat/1967 Excavations***	***16.1-11.1***
Middle	III	***Say***	***Es Sayar***	***16.5-15.0***
		Taf M	Taforalt/Middle	15.7-14.4
Upper	IV	Afa V	Afalou Bou Rhummel/Couche V	
		Afa IV	***Afalou Bou Rhummel/Couche IV***	***16.9-13.5***
		Bar E	***Ifri el Baroud/Escargotière***	***15.8-13.2***
		Taf B	Taforalt/Burials	14.6-14.2
		Taf U	Taforalt/Upper	14.6-12.5
		Afa III	***Afalou Bou Rhummel/Couche III***	***14.1-12.8***
		Afa II	Afalou Bou Rhummel/Couche II	
		Afa I	Afalou Bou Rhummel/Couche I	
		Col 71	Columnata/1971 Excavations	
		Col 69	Columnata/1969 Excavations	13.5-11.4
		Onç	El Onçor	12.4-11.2

9.2. The Initial Maghreb LSA ~25.9-21.7 ka cal BP

Prior to the LSA occupation at Grotte des Pigeons (Taforalt) microlithic technology is rare throughout Northwest Africa. A notable exception is the earliest assemblages from Tamar Hat (Unit IV-V), which based on the AMS radiocarbon work in this thesis can now be shown to date from ~25 ka cal BP . This confirms an early inception date for Mode 5 technology in Northwest Africa and therefore corroborates current models that indicate an internal development of microlith technology in the area (N. Barton et al., 2013).

The CA indicated that these assemblages could not be distinguished clearly from slightly later assemblages at the site (Units IV-II) and that the first more distinct changes in microlith forms occurred in the uppermost deposits (Unit I; 1967 excavations). This is not inconsistent with previous studies, although in terms of the reduction techniques the assemblages can most clearly

be divided between Unit V and IV, which is time-coincident with a change in subsistence behaviour at the site (Saxon et al., 1974; see Chapter 2).

The AMS radiocarbon determinations given in this thesis indicate that these shifts occurred from ~22 ka cal BP, soon after Heinrich event 2. This is broadly time-coincident with the first appearance of the LSA at Grotte des Pigeons (Taforalt, Morocco). I have chosen to distinguish the earliest assemblages from Tamar Hat (Unit IV-V) occurring prior to this event as the Initial Mode 5 LSA, although I admit it is relatively early to speculate on how distinct these assemblages were from later assemblages at the site and elsewhere from Northwest Africa. Nonetheless, it seems to make sense to establish some sort of distinction, especially considering that after this period there is a proliferation of sites that share a number of similarities and appear to form the first clear cohesive Mode 5 techno-complex in the area.

9.3. The Early Maghreb LSA ~22.1-16.9 ka cal BP

The first clear evidence for the appearance of the LSA in Morocco occurs at ~22 ka cal BP and is shown by the Lower Phase at Taforalt. Here, short, narrow, and thin blades were made on simple cores using a soft hammer technique (Chapter 7). Based on the published literature there appear to be close similarities in terms of knapping procedures with contemporary assemblages along the Algerian coast, although Sari (2014) also recorded a knapping scheme for the production of small blades with triangle and sub-trapezoidal cross-sections in the uppermost deposits at Tamar Hat (Units II-I) and at Rassel (Lower Layer). The slight variances in reduction between sites seems likely to relate to the manufacture and dominance of different microlith forms (see below).

This thesis shows that in the Lower Phase at Taforalt, the microburin technique was seldom utilised. However, when employed it was most often used to remove the butt of the blank and might be linked to the manufacture of pointed partially backed bladelets (Chapters 6-7). Close (1980-81, p. 100) noted the particular abundance of proximal microburins in the uppermost deposits at Tamar Hat (Unit II-I), which she also thought was linked to the production of pointed partially backed bladelets. Likewise, Sari (2012; 2014) has come to similar conclusions showing

the production of pointed partially backed bladelets using the microburin technique continued at Rassel. Thus, there appear to be strong parallels in the nature of the microburin technique throughout the Early LSA assemblages.

The CA shows that the Lower Phase at Taforalt is broadly similar to the contemporary assemblages of Tamar Hat (Units IV-I; 1967 excavations), Rassel (Lower Layer), and Rolland, which are distinct from later assemblages in tending to have higher proportions of partially backed bladelets, obtuse ended backed bladelets, and Ouchtata bladelets, and relatively few convex backed bladelets *sensu lato* and geometrics, including segments, which are extremely rare. Nonetheless, there are some regional peculiarities within the earlier assemblages.

The Lower Phase at Taforalt, in contrast to contemporary assemblages, has relatively few partially backed bladelets and higher frequencies of blunted ended forms (e.g. scalene bladelets, obtuse ended backed bladelets, and Ouchtata bladelets). This is interesting as pointed partially backed bladelets are thought to have involved the microburin technique, which is also less abundant than at the other contemporary sites (Chapter 8). It is tempting to speculate that differences in the frequencies of this microlith type might be related to specific subsistence behaviours and there is some tentative evidence to support this assertion.

In general, the sites with higher frequencies of partially backed bladelets are all located at the coast and based on the available evidence there is support for the idea that at these locations terrestrial and marine molluscs, and also other marine resources, were heavily exploited. While not located far from the coast there is no evidence for this heavy dependence on molluscs during the earliest LSA at Taforalt. Thus, it seems probable that the differences between contemporary assemblages might reflect variation in the technological strategies associated with the exploitation of different resources available at the coast and at sites further inland. It is tempting to speculate that hunter-gatherer populations might have been practicing high residential mobility moving between seasonally available resources during this era and this is tentatively supported by isotopic

evidence that has shown a winter seasonal occupation of the coastal site of Tamar Hat (Saxon et al., 1984), although similar studies have yet to be conducted for inland assemblages.

Irrespective of the differences in the types of microliths at each location, there appear to be similarities in the shaping of microliths throughout this time, which indicates similar know-how, so-called *savoir-faire*, between the coastal and hinterland populations. In the Lower Phase at Taforalt the microliths tend to be retouched along right lateral with strong proportions of marginal (so-called Ouchtata) retouch (Chapter 8). Close (1980-1981, 1977) also recorded a dominance of right lateral retouch and high proportions of marginal retouch throughout the sequence at Tamar Hat (Unit VI to I) and also in the Lower Layer at Rassel. Sari (2014, 2012) confirmed the prevalence of right lateral retouch and marginal retouch at these sites.

A number of additional assemblages might be included in this picture and linked by available radiocarbon determinations and typological data. These include three assemblages from near the village of Ouchtata in northern Tunisia (O.R.G 1, 2, and 3)(Gobert, 1962), which have been suggested to date from at least ~21 ka cal BP based on the radiocarbon determinations for an eolinate stratigraphic member located ~50 km northeast at Cap Blanc (21,140±560 BP and 18,740±360 BP)(Poskoff et al., 1983, cited by Gragueb 1983, p. 16). Whilst the exact age of these assemblages remains highly speculative and possibly entirely erroneous due to the vast distances between the location of assemblages and that of the cited radiocarbon determinations, Gragueb's (1983) re-analysis indicated that the assemblages were dominated by Ouchtata bladelets, partially backed bladelets, and strong proportions of scalene bladelets, which appear to link these assemblages to the Early LSA.

There are also appear to be a number of similarities with collections from the Horizon Collignon (at Sidi Mansour) and Lalla in southern Tunisia. Here, Gragueb (1983) recorded high proportions of bladelets with Ouchtata retouch, obtuse ended bladelets, and scalene bladelets, along with the predominance of right lateral retouch (>70%) and low proportions of abrupt crossed retouch (<25%). This sounds very similar to the description of material from the Lower

Phase at Taforalt. Both of these sites are located in hinterland away from the coast and it is tempting to speculate that the greatest similarities might be observed between sites occupying similar ecological zones irrespective of distance, although further work is needed to test this hypothesis. There are no available radiocarbon determinations for the sites from southern Tunisian. However, an age from Bir Oum Ali (C-3569, 17,470±315 BP) indicates the appearance of Mode 5 technology in the area from 21,530-20,699 cal BP (95.4%), although the associated assemblages have not yet been fully described.

There are also potential related assemblages outside of the Maghreb. The appearance of Mode 5 technology occurs soon after in the Jebel Gharbi, western Libya. The earliest AMS radiocarbon date comes from Site SJ-00-56 and is 20,424-20,001 cal BP (95.4%)(16,750±60 BP; Beta-157689)(Garcea, 2010). There are few published details on the nature of the collections, although the presence of Ouchtata forms led the authors to suggest it was part of an older Iberomaurusian (Barich et al., 2010, p. 243).

The first appearance of Mode 5 LSA in Libya is most often described in relation to the 'Eastern Oranian' from Haua Fteah (Cyrenaica). Here, the assemblages have been described as being dominated by numerous scalene bladelets, partially backed bladelets, and obtuse ended backed bladelets, with Ouchtata retouch on a high proportion of these forms (Close, 1986, 1977). Previous authors have noted a strong resemblance to assemblages from the aforementioned Ouchtata localities (McBurney, 1967) and the Horizon Collignon (Close, 1986; Close and Wendorf, 1990). The 'Eastern Oranian' is now well-dated at the Haua Fteah and occurs from ~17 ka cal BP (Douka et al., 2014).

If these assemblages are all linked to the Early Mode 5 technological repertoire then it is clear from the dates that the inception of this technology was centred in eastern Algeria and that the LSA expanded from ~22 ka cal BP eastwards into Tunisia and as far as Cyrenaica in Libya by ~17 ka cal BP (Fig. 9.1). There may also have been a westward dispersal of ideas and people into Morocco. Overall, this would appear to support recent genetic models that indicate a population

expansion centred in the Maghreb at this time with gene flow into the adjacent regions (Pennarun et al., 2012).

Interestingly, there are less clear similarities with lithic artefact collections from Egypt. Phillips (1975, 1973) originally suggested that there were similarities between the 'Southern Tunisian bladelet industries' and assemblages associated with the Fakhurian industries (E71K12 and E71K13), which can now be shown to date at 23,946-22,318 cal BP (19,100±365 BP, SMU-2425)(Wendorf et al., 1997). However, Close (1986) preferred to see the material as distinct. Based on my own personal study of Phillips' material in the British Museum, I would suggest that there are few genuine similarities beyond the high frequencies of microliths. Thus, it is not yet possible to show an expansion of populations or ideas into Egypt. This is consistent with the current anthropological and genetic evidence that appears to show that the area had a distinct population history from the rest of North Africa (Fadhlaoui-Zid et al., 2011).

One of the interesting things that this new dating highlights is that the emergence and spread of the Early LSA occurs soon after Heinrich event 2. This major event, recognised in deep sea cores coincides with some of the coldest and most arid conditions recorded in North Africa over the last 30,000 years and the conditions following H2 would have marked a return to relatively stable conditions, though cooler and drier than those recorded in the modern era (see Chapter 2 for overview). It is tempting to speculate that the changing climate led to the rapid improvement in conditions for hunter-gatherers who had survived in small areas of the coastal Maghreb and this in turn was followed by local population growth and the movement of these people into new and potentially unpopulated regions to the east and west.

There are also some tentative indications of connections with Europe at the end of this era and moving towards the onset of Heinrich event 1. It comes in the form of evidence for the establishment of a ceramic figurine manufacturing tradition from *couche* VII at Afalou Bou Rhummel. Unfortunately, the inception date of this behaviour is poorly understood with only a single radiocarbon determination on bulked charcoal of 18,568-17,715 cal BP (14,910±180 BP,

Gif-9637) and the associated lithic assemblages have not been described. Interestingly, what appears to be a surprisingly similar ceramic figurine manufacturing tradition has recently been reported at the site of Vela Spila (Croatia) from 17,482-16,809 cal BP (14,100±100 BP, Z-3992) (Farbstein et al., 2012). Whilst, the available radiocarbon determinations are insufficient to determine the direction of travel, the co-existence of this behaviour might indicate connections between the two continents towards the end of the Early LSA.

9.4. The Middle Maghreb LSA ~15.7-14.5 ka cal BP

Following the Early LSA and broadly time-coincident with the Heinrich event 1 at ~16 ka cal BP there is a marked typo-technological shift, which is shown by the appearance of the Middle Phase at Taforalt. Here, short robust blades, wider and thicker than associated with the earlier assemblages, were struck back from the edge of the core often using hard hammer technique, which contrasts with the manufacture of less robust blades associated with the Early LSA. Furthermore, there are noticeable differences in the application of the microburin technique and shaping of microliths (see below).

In the Middle Phase at Taforalt the microburin technique is used prolifically and is characterised predominantly by the removal of the distal end of the blank. The microburins range considerably in size and a notable feature is the large dimensions of many of them. It is clear that these were used to produce La Mouillah points, which were then most often transformed into convex-backed bladelets *sensu lato* (Chapter 6-7). Amara (1977, p. 66) also recorded the dominance of distal microburins at Es-Sayar in Algeria and commented on the large size range of the microburins (ranging between 10-37 mm in length), which he also attributed to the manufacture of convex backed bladelets *sensu lato*. Unfortunately, no information is given on the method of blank manufacture at this site, so it is impossible to make other comparisons except those based on available radiocarbon determinations and data from the CA of the assemblage.

The CA shows that the Middle Phase at Taforalt is similar to the chronologically contemporary assemblage of Es-Sayar, which together are distinct from earlier LSA assemblages

in having higher proportions of convex backed bladelets *sensu lato* and La Mouillah points, and much lower numbers of partially backed, obtuse ended backed bladelets, and Ouchtata bladelets. In contrast, these assemblages differ from the succeeding LSA assemblages, principally in the higher proportions of La Mouillah points, and in the much lower frequencies of geometrics, such as segments. Thus, the most characteristic aspect of the assemblages of the proposed Middle LSA might be seen as relatively high proportions of La Mouillah points (9.2-30.6% of microliths).

In contrast to the underlying horizons, the microliths in the Middle Phase at Taforalt are overwhelming retouched along the left lateral with much lower rates of marginal retouch and corresponding increases in direct semi-abrupt and abrupt retouch, including crossed abrupt retouch (Chapter 8). In addition, a feature that appears to mark out the microliths from those of underlying deposits at the site, is the increased number of microliths with basal truncations. Amara (1977, p. 65) gave few descriptive details of the assemblage at Es-Sayar, but stated that convex backed bladelets *sensu lato* were characterised by abrupt retouch and he recorded a number with basal retouch.

There are few other assemblages that can be assigned to this interval based on the available radiometric information or typological similarities. A notable exception might come from the *enlévements* (spits) at the Ifri n'Ammar (Moser, 2003). Here, there is gradual change from marginal (so-called Ouchtata) microliths from the bottom of the sequence, through to a peak in the proportion of La Mouillah points in *enlévements* 26-23 (8.3-9.6% of the microliths), which coincides with relatively high microburin indices. There are three radiocarbon determinations of 13,800±80 BP (UtC-6181), 13,590±70 BP (UtC-6180), and 12,640±90 BP (UtC-6178) associated with these *enlévements*, giving calibrated ages between 17,096-16,495 and 15,191-14,832 cal BP. However, the exact timing and nature is convoluted due to the excavation of the site using arbitrary spits, which based on the published literature clearly cut across natural stratigraphic boundaries.

The Early to Middle LSA transition is not fully understood. The appearance of these assemblages occurs after a chronological gap of at least a thousand years that is broadly synchronous with Heinrich event 1 at Grotte des Pigeons (Taforalt). However, radiocarbon determinations from the other sites might indicate its emergence during H1. In general, this climatic event is associated with a sudden drop in temperatures and increased aridity and is thought to have had a deleterious effect on hunter-gatherer populations in Northwest Africa. In either case, it seems quite reasonable to suggest distinct technological solutions might have been developed in response to the changing environmental conditions. If this were the case then one might look for evidence of so-called transitional industries. Unfortunately, there do not appear to be any strong contenders. The Unit Y2 sp1 at Grotte des Pigeons (Taforalt) shows characteristics of assemblages associated with the Early and Middle LSA, although taphonomic factors might best explain its mixed appearance (Chapter 7). As noted above, there appears to be gradual transition at Ifri n'Ammar, although this might be an artefact of the excavation methods used.

Many of changes encountered in the Middle LSA might reflect so-called stylistic variation, such as the working end of the tool, the lateralisation of retouch, and the retouch type on microliths. The recognition of a shift in retouch lateralisation and form contradicts Close's (2002, 1978, 1977) hypothesis of stylistic homogeneity within the Pleistocene LSA. The discordance between this study and previous research is almost certainly accounted for by the fact that the past studies were restricted to assemblages dating from the onset of the LSA until the Heinrich event 1, whilst, the research here includes assemblages through until the onset of the Younger Dryas. Thus, whilst this thesis supports an interpretation of homogeneity prior to the H1 event, it indicates that after this time there was a shift in emphasis towards the use of more intensive retouch at the left lateral margin, as seen particularly in the Middle and Upper LSA.

If these are so-called stylistic attributes, then variation in their presence might be indicative of different social groups. However, I find it hard to exclude many alternative functional explanations. For instance, retouch type may reflect the requirements of different hafts, and retouching the distal end may be more efficient, as it does not require removing the butt.

Nonetheless, whilst lateralisation may reflect handedness, a sudden shift across numerous sites is rather perplexing and it might after all be best understood as indicating a change in populations or innovation introduced by a different social group. Based on the ideas mentioned above it certainly seems plausible that new populations could have moved into the area following Heinrich event 1, and after a period when populations in Northwest Africa had been much diminished.

Here again, there may be some tantalizing evidence for connections with the European continent immediately before the onset of the Middle LSA. A number of authors have noted similarities between assemblages of the Pleistocene LSA and those of the Italian Peninsula and Sicily. In fact, Camps (1974) used the term "African Epigravettian" to describe assemblages from the Maghreb, including his Iberomaurusian *ancienne*, which I am now calling the Middle LSA based on the numerous microburins. A number of archaeologists have dismissed connections with Europe on chronological grounds, highlighting that the earliest dates for so-called Iberomaurusian assemblages came before the Epigravettian (Linstädter et al., 2012; Zampetti, 1989). However, this research indicates that Iberomaurusian *sensu stricto* does not occur until after the H1 event, which re-opens the idea of connections with Epigravettian. I will develop this idea a little further at the end of this chapter.

High proportions of convex backed bladelets, La Mouillah, and the intensive use of the microburin technique have also been used in the past to link the Iberomaurusian to the Mushabian of the Negev and the Sinai Penisula (Bar-Yosef, 1987). The Mushabian is now known to date between ~16.7 – 12.9 ka cal BP (Maher et al., 2011), which means that at least in chronological terms the techno-complex might be ancestral to the Middle LSA industries of Northwest Africa (cf. Bar-Yosef). However, the cultural markers (La Mouillah point and microburins) are known to exist, albeit in smaller proportions, in the preceding industries of both regions, which makes it difficult to exclude the alternative hypothesis of an internal development and separate evolution of this phase of the LSA in Northwest Africa and the Mushabian in the Near East (Maher et al., 2012). Furthermore, a separate development of these industries appears to be supported by the lack of similar assemblages in the intermediate zone between the Northwest Africa and the Near

East. For instance, in Libya, the 'Eastern Oranian' continues until 12.5 ka cal BP (Douka et al., 2014). This facies shows closer affinities to the Early LSA assemblages of Northwest Africa (see above). It therefore seems that if there was an external influence then it is most likely to have come from the Western Mediterranean.

9.5. The Upper Maghreb LSA ~14.6-11.2 ka cal BP

A more subtle change is recorded in the lithic assemblages with the development of the Upper Phase at Taforalt. Here, there is a general continuation of the typo-technological patterns that emerged during the Middle Phase, although there are also a number of more noticeable developments.

In the Upper Phase at Taforalt, production of robust short blades using hard hammer technique continues at the site. However, at the same time there is a more intensive use of the available blanks for the manufacture of microlithic tools. In addition, the use of coarse-grained limestone for the production of flakes is recorded and this technology appears to be more abundant than in the earlier assemblages at the site. This technology is basic and would have needed little time investment as the inhabitants had an essentially limitless supply of coarse-grained limestone available to them from a local river. It seems probable that these flakes would have been used in informal maintenance tasks (e.g. hide preparation, tool manufacture), rather than extractive tasks (e.g. hunting), whilst the inhabitants continued to select fine-grained siliceous materials from further afield for the production of microliths (Chapters 6-7). It should be noted that a similar pattern has been observed at Ghar Cahal (pers. obs).

Sari (2014) also recorded the manufacture of robust blade blanks using hard hammer at Columnata (1969 and 1971 excavations). Furthermore, she noted the presence of an additional scheme directed towards the production of flakes, which could not be recognised at the earlier sites in her sample (Tamar Hat IV-I; Rassel). However, both blade and flake blank schemes were manufactured on the same locally available siliceous rocks (*ibid,* p. 135). Interestingly, Hachi

(2003) recorded the increasing prevalence of coarse-grained local materials at Afalou Bou Rhummel in Algeria. However, few details are available about the use of these materials.

It is tempting to speculate that the increasing dependency on low-quality local raw materials, coupled with a more intensive use of the available high-quality fine-grained materials, at some sites during this time might be linked to a technological approach emphasising resource-maximisation in the Upper LSA. This technological approach might have favoured more sedentary populations with less frequent access to high-quality raw material sources during the course of day-to-day subsistence activities. A major issue is whether the occurrence of the Upper LSA marks a transition to all-year-around occupation of sites, as there is the first clear evidence for food storage from this time at Grotte des Pigeons (Taforalt)(Humphrey et al., 2014). It is tempting to speculate that reduced mobility might have led to relative isolation of hunter-gatherer groups and the emergence of specialised technology for exploiting the locally available resources, which would account for much greater variation recorded during the Holocene LSA of the Maghreb (Lubell et al., 1984). However, this has yet to be fully explored.

Returning now to other aspects of typo-technological variation, there is a noticeable reduction in the number of microburins in the Upper Phase at Taforalt. However, the regular use of the microburin technique is attested by the dominance of microlith forms usually produced by this technique, such as convex backed bladelets *sensu lato* and geometrics. Unfortunately, it is difficult to gauge the importance of the microburin technique as there are only a small number of microburins associated with the Upper Phase at Taforalt. Sari (2012; 2014) recorded that the majority of microburins were from the distal end of blades at Columnata and also thought the technique to have been involved in the manufacture of convex backed bladelets *sensu lato* and segments. Equally, Heddouche (1977, p. 77) noted briefly of the few microburins found at El Onçor all were from the distal end of the blank. Hachi (2003, p. 230) at Afalou Bou Rhummel also recorded that there were few true microburins and speculated that the Krukowski microburin was a by-product resulting from the intentional sectioning of the blank, which contrasts with the

conventional wisdom that considers them to be knapping accidents resulting from retouching of microliths.

Elsewhere this process has been discussed by Neeley & C. Barton (1994) who suggest that where it was necessary to conserve and intensify the use of available raw materials, the microburins (as well as trihedral points and La Mouillah points) could be modified into microliths giving low microburin indices and the impression that the technique was rare or even absent. This hypothesis might provide a reasonable explanation for the low frequencies of microburin debris described here in the Upper LSA. It is an attractive theory and is consistent with a number of other factors that show intensification in the use of raw material at this time. However, this hypothesis remains to be more fully tested by refitting studies at sites.

The CA shows the Upper Phase at Taforalt is similar to the chronologically contemporary assemblages from Afalou Bou Rhummel (*couche* V-I), Columnata (1969 and 1971 excavations), El Onçor, and Ifri el-Baroud (*écargotiere*). These can be distinguished from earlier assemblages in the overwhelming dominance of convex backed bladelets *sensu lato* and greater frequencies of geometrics, especially segments, and the immediately preceding assemblages, principally in the lower proportions of La Mouillah points. In addition, pointed straight backed bladelets *sensu lato* make up a relatively strong proportion of the microliths as compared to the immediately preceding assemblages, but nonetheless tend to be found in lower frequencies than those observed in assemblages associated with the Initial and Early LSA. It has to be noted that whilst these forms belong to the same 'type', this research indicates that the straight backed bladelets *sensu lato* associated with the Upper LSA tend to be more elongated and gracile than those of the earliest LSA (Chapter 7).

There is some evidence of internal chronological variation amongst these later assemblages of the Pleistocene LSA. In general, the frequency of segments increases throughout this period. For example in the Upper Phase at Taforalt, the highest frequencies of segments are found in the uppermost deposits (Layers 2-9), although they still only account for a small

proportion of microliths (5.8%)(Chapter 6). Similarly, there are clear increases in the number of segments in each successive archaeological horizon at Afalou Bou Rhummel (Hachi 2003), with this form accounting for 3.6% of microliths, in the lowermost *couche* V, and rising to 13.6% of microliths, in the uppermost *couche* I. There are also strong proportions of segments in the assemblages from Columnata (5.5-13.5%), which are thought to date towards the end of the Pleistocene (Chapter 8). The *escargotiere* at Ifri n'Ammar, which is associated with dates between 15,072-14,235 cal BP (12,480±80 BP, UtC-6177) and 11,931-11,249 cal BP (10,022±80 BP, Erl-4394), also shows increasing frequencies of segments in the uppermost *enlévements* (Moser, 2003) and it seems probable these relate to the later assemblages identified in the CA. The increase in geometrics, especially segments, towards the end of the Pleistocene LSA is consistent with other studies, and appears to affirm the idea of continuity into the Holocene. In crude terms there are similarities between the Upper LSA, as defined here, and the Iberomaurusian *classique* and *évoluée,* as defined by Camps (1974a), which differ principally in the proportions of segments.

Interestingly, Aïn Kéda points, a distinct sub-type of the pointed straight backed bladelets *sensu lato*, occur only in assemblages associated with the Upper LSA. Thus, it is this in particular that might serve as some sort of chronological marker. In fact, these occur only in the youngest deposits (L2-9) of the Upper Phase at Taforalt with modelled radiocarbon determinations between 13,473-13,299 and 12,709-12,544 cal BP. The Aïn Kéda point is also prolific at the site of Contrebandiers on the Atlantic coast of Morocco (Olszewski et al., 2011). This has site has yielded radiocarbon determinations of 14,460±200 BP (Gif-2579), 12,500±170 BP (Gif-2577), and 12,320±600 BP (Gif-2580), although all of these are considered unreliable (Olszewski et al., 2011; Roche, 1976). This microlith form is unsurprisingly common at the site of Aïn Kéda, which has been tentatively assigned to the Iberomaurusian *sensu lato* (Tixier, 1963, p. 102). However, typically the Aïn Kéda point is associated with Holocene facies of the LSA, such as observed at Mechta el-Arbi (Pond et al., 1928), the Aïoun Berriche localities (Pond et al., 1938), and Dakhlat es-Saâdane (Tixier, 1955). Thus, the presence of this form might give some indication that the

assemblages belong to the end of Pleistocene LSA with evident similarities to the Holocene LSA industries.

Irrespective of the differences and subtle changes in the types, there appear to be broad similarities in the shaping of microliths throughout the Upper LSA. In the Upper Phase at Taforalt the majority of microliths are retouched on the left edge. The back is most often formed with direct semi-abrupt or abrupt retouch, although there are increasing proportions of abrupt crossed retouch; marginal retouch is found only in negligible proportions (Chapters 6-7). Hachi (2003) also recorded the dominance of left lateral retouch on backed bladelets and noted strong proportions of abrupt and crossed abrupt retouch types throughout the sequence at Afalou Bou Rhummel (*couche* V-I). Likewise, Sari (2012; 2014) recorded high rates of left lateral retouch and crossed retouch on the microliths from Columnata (1969 and 1971 collections). Thus, whilst left lateral retouch continues to dominate, there is a further increase in the frequencies of microliths with crossed retouch from the Middle LSA facies; this appears to be expressed in the more regular shape of microliths in assemblages associated with the Upper LSA (Chapters 6-7).

An understanding of the timeframe of the Upper LSA is helped by the proliferation of sites with available radiocarbon determinations at this time. The larger number of sites dated to this period has been interpreted by some archaeologists as indicating an increase in the populations at this time (Linstädter et al., 2012). Unfortunately, few of the collections from these sites have been described. A number of other sites lack absolute dates, but have more detailed lithic studies and might relate to this era on typo-technological grounds, including Bou Aïchem (Goetz, 1967), Oued Yquem (Collina-Girard, 1988), Rhirane (Wengler and Wengler, 1980), Velozzo (Treinen, 1975).

Returning to the question of the possible relationship between the European Epipalaeolithic record and that of NW Africa, particularly after the Heinrich 1 event, I believe there are a number of compelling new factors that need to be taken into account and that will re-invigorate the debate. The first concerns the much larger sample of human fossil specimens

from North Africa and Europe that are now at our disposal and could be used as sources for examining physical, as well as genetic similarities between populations across these regions. Indeed, although it has been suggested that differences, such as the gross robusticity, mark the Mechta-Afalou populations as distinct from southern Europeans, a number of studies indicate that to some extent there are shared morphological characteristics between these populations (Briggs, 1955; Ferembach, 1985; Ferembach et al., 1962; Harvati and Hublin, 2012; Irish, 2000; Turbón et al., 1997; Vallois, 1969).

More significantly, it would be important now to re-explore the features of both the Upper LSA and the Final/Evolved Epigravettian. The latter facies comprises of end-scrapers, burins, numerous backed bladelets, trapezes made with a double truncation, and segments and triangles (Mussi, 2002, p. 288) There is a particular resemblance to the collections from Afalou Bou Rhummel, which is situated in eastern Algeria and might represent the earliest of assemblages associated with the Upper LSA of Northwest Africa. Here, the first clear evidence appears in *couche* IV that shows an unusual proliferation of triangles, segments, and some trapezes. Hachi (2003) considered this to mark a possible shift in population. The radiometric evidence from the site is not well understood, but three radiocarbon determinations from *couche* IV of 13,120±370 BP (Alger-0008), 12,400±230 BP (Ly-3228) and 12,400±230 BP (Gif-6532), indicate the appearance of these behaviours from possibly as early as 16,894-14,709 cal BP. Unfortunately, *couche* V is considered to be mixed (Hachi et al., 2003, p. 202) and the lithic collections from below these sediments have not been described, so no clear comparisons can be made with the immediately preceding industries. Nonetheless, it is tempting to speculate that the movement of Epigravettian peoples into the area and/or the exchange of ideas between groups might account for some of the apparent similarities in stylistic and other elements in the lithic collections.

A number of other lines of evidence may also point in this direction in support of this hypothesis. To begin with, although isolated earlier examples exist, the first clear evidence of cemetery activity can be dated to this post-Heinrich event 1 phase. Examples exist at both Afalou

Bou Rhummel from *couche* IV (Hachi, 2006, 2003, 1996) and at the site of Grotte des Pigeons (Taforalt, Morocco). At the latter site direct dates on human bone have given a tight set of radiocarbon ages from 15,086-14,189 ka cal BP (Humphrey et al., 2014). The earliest directly-dated human remains occur in Sicily from ~15,642-15,176 cal BP (KIA-36055, 12,890±60 BP) and are associated with the Epigravettian (Mannino et al., 2011). As noted above, the human skeletal evidence is thought to show some affinities between the North African and European specimens. Thus, this could be tentative evidence of step-wise spread of a burial tradition across the Strait of Sicily and westwards across the Maghreb.

The apparent similarities make connections between the cultures a particularly enticing scenario. Recent provenancing studies of obsidian artefacts indicate that hunter-gatherers were capable of navigating the Strait of Sicily during the early Holocene LSA (Mulazzani et al., 2010) and it is tempting to speculate, given the reduced distances between the two continents during the Last Glacial Maximum, that Pleistocene LSA hunter-gatherers would also have been able to make the same journey. A major problem that limits our ability to test this hypothesis is the lack of sites due to coastal inundation. However, these are all areas for future research, which I will discuss in the following chapter.

Chapter 10.

Conclusions and Future Directions

The central aim of this thesis has been to re-evaluate to what extent variation occurs within Pleistocene LSA assemblages of Northwest Africa. In general, the traditionally held view has been that whilst there might be variation within and between lithic assemblages of this type, this can all be accommodated within a single definable industry, known as the Iberomaurusian (N.Barton & Bouzouggar 2013; Bouzouggar et al., 2008; Camps, 1974a; Linstädter, 2012; Lubell, 2001; Lubell et al., 1984). The most recent work has suggested that the principal differences between assemblages reflect technological adaptations of the same hunter-gatherer populations to different ecological conditions at the coast and in the hinterland (Sari, 2014, 2012). In contrast, this thesis proposes an alternative model.

Based on my analysis of lithic collections from Grotte des Pigeons (Taforalt) and the re-analysis of published data using the multivariate statistical approach of correspondence analysis (CA), it has been possible to show that there was greater variation than previously proposed within the Pleistocene LSA. This is unlikely to be due solely to local ecological factors as previously thought (Sari, 2014, 2012), but may be more chronologically constrained while also allowing for some major external environmental influences. Accordingly, my thesis indicates that the lithic industries can be sub-divided into four chronologically distinct variants, which has wide-reaching implications for understanding the origins and development of the Pleistocene LSA.

The first variant is the *Initial LSA* dating from ~25 ka cal BP. This variant is currently only observed in the lowermost horizons at the site of Tamar Hat (Algeria) and, as such, it cannot yet be fully explored or developed in detail to see if it is more widely applicable. Nonetheless, it is now securely dated and its early appearance places it as a candidate for the origin of Mode 5 technology in North Africa. The appearance of Mode 5 assemblages can now be shown to be from around the onset of the Heinrich event 2 (H2) associated with some of the most cool and arid conditions of the last 30,000 years. This contrasts with previous models that have suggested that a later emergence of the

LSA during the relatively warm and moist conditions of the Last Glacial Maximum (LGM)(e.g. N.Barton et al., 2013, 2007; Linstädter et al., 2012).

The second variant is the *Early LSA* that occurs after Heinrich event 2 from ~22 ka cal BP. The research here indicates that the LGM was an era of population expansion and movement from the relative refugium of the coast and into the hinterland of the Maghreb with evidence for the spread of populations throughout the Maghreb and eastwards into Libya, although there are as yet no clear connections with the Nile Valley. This is diametrically opposed to the westwards spread of Mode 5 technology specified by some scholars (e.g. Close and Wendorf, 1990; Roche, 1976). Whilst there are developments in technology at this time there is also evidence of continuity from the Initial LSA. Furthermore, whilst variation was observed relating to local adaptations (potentially to ecological conditions), the research indicates that there are strong similarities in the lithic collections between coastal and hinterland assemblages.

The third variant is the *Middle LSA* that occurs around Heinrich event 1 from at least ~16 ka cal BP. The appearance of these assemblages is marked by a significant shift in the manufacture of microlithic tools and it is thought that this relates to the movement of new hunter-gatherer groups into the area following a period of de-population. This contrasts with other work that indicates continuity throughout the Pleistocene LSA (Close, 2002, 1978, 1977). It has been argued here that these assemblages mark the appearance of the Iberomaurusian *sensu stricto*. This also re-ignites the debate over connections with the European continent and indicates that the industry might be related to the Epi-gravettian; a hypothesis that had been dismissed (Linstädter et al., 2012; Zampetti, 1989).

The fourth variant is the *Upper LSA* that occurs with climatic amelioration associated with Bølling-Allørod at ~14.5 ka cal BP. There is a general continuation of the typo-technological patterns that emerged during the Middle LSA, and these assemblages also fit within the definition of the Iberomaurusian *sensu stricto*. There are also a number of observable similarities with assemblages associated with the Epi-gravettian and this indicates continued connections with Europe. Nonetheless, a number of changes were recorded that might be linked to resource intensification and increased sedentism, however, this has yet to be fully explored.

Interestingly, whilst variation was observed relating to local adaptations to ecological conditions, the research indicates that the greatest similarities can be found between contemporary assemblages irrespective of the ecological setting. This strongly indicates that broader temporal factors, such as climate change and/or culture evolutionary processes, were the primary driving force behind variation. Importantly, irrespective of the causal factors, the sub-divisions outlined here serve as a preliminary framework for understanding variation within the Pleistocene LSA of Northwest Africa. Clearly, there is a need for further research to validate the model of chronological variation offered here.

This thesis illustrates the value of the excavation and re-evaluation of deeply stratified sites using modern field techniques with high chronostratigraphic resolution in order to give a more detailed account of variation within the Pleistocene LSA. There is a clear need to extend this work to other deeply stratified LSA sequences in order to test the model constructed in this thesis. An especially promising direction for future research might be a re-investigation of the site of Afalou Bou Rhummel. Here, the few available radiocarbon determinations indicate habitation of the site from before ~18 until after ~13 ka cal BP. The earliest assemblages at the site have not been described and it would be interesting to know how similar (or different) these are to contemporary assemblages in Morocco, such as at Grotte des Pigeons (Taforalt). Importantly, this would provide an opportunity to better understand the causes of variation between coastal and hinterland sites. Another major issue that has yet to be resolved is a better understanding of the lithic assemblages associated with human burial activity at these sites. A preliminary description has been given here of those from Grotte des Pigeons (Taforalt), although further research is needed to establish what sort of artefacts might be specifically linked to practices surrounding the interment of the dead. In addition, there are a number of questions to be answered relating to the origins and development of the ceramic figurine tradition at Afalou Bou Rhummel.

There is a particular need to investigate in much greater detail the Pleistocene LSA archaeological record of Tunisia. Most of the fieldwork in this area was conducted prior to the 1960s, there are few sites with radiocarbon determinations, and most of the excavations have focused on open-air sites. The lack of research in this area limits work to construct a better understanding of

regional variation within the LSA. Furthermore, the lack of work in this area restricts our ability to assess hypotheses linking the cultures of Northwest Africa with those of Europe via the Strait of Sicily. Thus, there is an urgent need for fieldwork in this area. A particularly interesting avenue would be investigations of the now submerged coastal areas, which presumably would have been the most attractive areas for hunter-gatherer populations and served as migration routes during the Last Glacial Maximum.

This thesis also demonstrates that statistical procedures, such as correspondence analysis (CA), can be used to interpret published data and categorise variation within lithic assemblages. The work in this thesis was focused on assemblages with absolute dates in order to construct a more robust model of variation within the Pleistocene LSA. However, future work might use the same or similar techniques to better understand variation within undated assemblages. For instance, there is a need to test the available data from Tunisia. An alternative avenue would be to investigate the proposed connections between the Pleistocene and the Holocene LSA industries of Northwest Africa. Likewise, CA might be utilised to test connections with the Near East, Europe, and elsewhere in Africa.

Unfortunately, a major issue that limits this work is the lack of standardisation in the recording methods between areas, with different local traditions having developed for the analysis of lithic artefacts. For instance, whilst an unmodified version of Tixier's (1963) typology is largely utilised in Morocco, Algeria, and Tunisia, it has been extensively modified for recording collections from Libya and Egypt. The absence of a standardised methodology limits our ability to make robust wide-ranging comparisons of lithic assemblages and therefore restricts our ability to construct reliable hypotheses relating to important topics, such as the origins, development, and connections between different cultures.

There is a critical need for scholars working in different areas to agree on a standardised set of methodological procedures so that we can advance our knowledge of human demography, which is in turn a vital aspect in the discipline of archaeology. This goal might be attained through a review of the current approaches in use and an effort to reconcile disparate methodologies. Much greater knowledge of the relationships between the different cultures of the Mediterranean Basin will be provided by a

re-evaluation of museum collections, using standardised methodologies as suggested here, and allow for the use of statistical methods, such as CA, to construct more robust archaeological models.

Whilst further work is needed, the chronological model described and defined here, serves as a preliminary framework for categorising variation, and offers a mechanism of relative dating, which has been lacking for the Pleistocene LSA of Northwest Africa. This gives us an opportunity to re-organise undated assemblages into meaningful temporal units, whilst also providing the necessary structure for testing the accuracy of a number of rather dubious radiocarbon determinations from sites throughout the Maghreb. Critically the work here contributes towards a better understanding of variation within the Pleistocene LSA, which is a necessary pre-requisite for addressing wider anthropological and archaeological issues such as reasons for shifts in subsistence and settlement through time.

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Table I.1. Published radiocarbon determinations for the Pleistocene LSA of Northwest Africa

	Lab No.	^{14}C	±	$\delta^{13}C$‰	cal BP[1]				Type[2]	Record	References
					68.2%		95.4%				
					from	to	from	to			
Morocco											
Chaâba Bayda 1	Gif-6497	11290	160		13316	13000	13446	12809			Wengler & Vernet, 1992; Wengler et al., 1994
Chaâba Bayda 2	Gif-6187	11200	160		13215	12871	13344	12733			Wengler & Vernet, 1992; Wengler et al., 1994
Contrebandiers	Gif-2577	12500	170	-24.7	15045	14348	15261	14089	B	Level 8	Roche, 1976
Contrebandiers	Gif-2579	14460	200		17888	17382	18095	17071	B	Level 9	Roche, 1976
Contrebandiers	Gif-2580	12320	600	-30.8	15300	13595	16331	13086	B	Level 10	Roche, 1976
Ghar Cahal	OxA-11323	11125	65	-24.9	13076	12917	13102	12810	C	Layer 12	Bouzouggar et al., 2006
Ghar Cahal	OxA-11322	11180	65	-25.5	13116	12990	13165	12840	C	Layer 12	Bouzouggar et al., 2006
Ghar Cahal	OxA-11321	9470	55	-24	11056	10589	11071	10573	C	Layer 10	Bouzouggar et al., 2006
Hassi Ouenzga	Erl-9992	10643	73	-21.7	12684	12563	12720	12426	C	Level 4	Linstädter et al., 2012
Hassi Ouenzga	Erl-9990	12424	87	-23.2	14745	14260	14998	14149	C	Level 11	Linstädter et al., 2012
Ifri Armas	Erl-12417	11712	70	-20.6	13590	13450	13728	13421	B		Linstädter et al., 2010
Ifri Armas	Erl-12421	11769	69	-19.6	13710	13491	13744	13462	B	P 215	Linstädter et al., 2010
Ifri el-Baroud	Bln-4755	9677	60	-22.42	11200	10875	11223	10785	C	III, IB96-B	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4926	11027	49	-22.43	12975	12815	13030	12747	C	IV, IB96-4	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4750	11508	60	-22.4	13416	13296	13469	13230	C	II, IB95-L	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4871	11639	58	-22.92	13546	13423	13578	13336	C	III, IB96-A	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4754	11895	64	-22.76	13769	13606	13952	13554	C	III, IB95-R	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4928	11926	68	-22.61	13822	13605	13970	13569	C	IV, IB96-21	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4933	11946	52		13941	13715	13977	13592	C	IV, IB96-94	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4931	12083	61	-21.92	14024	13825	14103	13766	C	IV, IB96-51	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4752	12128	70		14101	13855	14167	13775	C	III, IB95-P	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4929	12172	61	-22.78	14150	13971	14231	13825	C	IV, IB96-38	Eiwanger & Görsdorf, 1999

	Lab No.	^{14}C	±	$\delta^{13}C$‰	cal BP[1]				Type[2]	Record	References
					68.2%		95.4%				
					from	to	from	to			
Ifri el-Baroud	Bln-4753	12198	65	-22.23	14180	13994	14315	13830	C	III, IB95-Q	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4749	12253	67	-22.49	14275	14040	14570	13960	C	II, IB95-H	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4927	12294	49	-22.65	14318	14096	14571	14043	C	IV, IB96-5	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4934	12309	58	-22.59	14399	14107	14659	14060	C	IV, IB96-96	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4747	12481	57	-23.05	14905	14460	15037	14275	C	II, IB95-E	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4748	12574	65	-23.07	15089	14763	15178	14472	C	II, IB95-F	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4932	12607	75		15131	14804	15242	14521	C	IV, IB96-83	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4746	12626	59	-23.09	15146	14883	15225	14711	C	II, IB95-D	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4930	12841	80		15453	15171	15633	15092	C	IV, IB96-49	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4873	12932	78		15594	15304	15738	15204	C	IV, IB96-C	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4745	13359	72	-22.6	16195	15960	16287	15826	C	II, IB95-A	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4751	14299	72		17546	17302	17635	17161	C	II, IB95-M	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4911	16485	68	-21.89	20014	19774	20099	19645	C	IV, IB96-68	Eiwanger & Görsdorf, 1999
Ifri el-Baroud	Bln-4744	16777	83	-22.09	20366	20108	20488	20003	C	II, IB95-A	Eiwanger & Görsdorf, 1999
Ifri n'Ammar	Erl-4394	10022	80		11702	11337	11931	11249	C	Spit 4	Moser, 2003
Ifri n'Ammar	Erl-4399	11009	144		13003	12750	13134	12690	B	Spit 11	Moser, 2003
Ifri n'Ammar	UtC 6182	11370	70	-21.6	13279	13139	13352	13077	C	Spit 6	Moser, 2003
Ifri n'Ammar	Erl-4396	11519	105		13460	13265	13556	13146	C	Spit 9	Moser, 2003
Ifri n'Ammar	Erl-4398	11526	110		13467	13263	13565	13140	B	Spit 10	Moser, 2003
Ifri n'Ammar	Erl-4395	11595	103		13541	13314	13706	13207	C	Spit 8	Moser, 2003
Ifri n'Ammar	UtC-6183	11610	100	-21.3	13546	13340	13711	13252	C	Spit 14	Moser, 2003
Ifri n'Ammar	UtC-6175	11670	60	-23.5	13555	13448	13699	13352	C	Spit 7	Moser, 2003
Ifri n'Ammar	UtC-6179	11760	60	-23.2	13705	13482	13733	13462	C	Spit 10	Moser, 2003
Ifri n'Ammar	Erl-4400	11853	105		13775	13555	13956	13462	B	Spit 16	Moser, 2003

	Lab No.	^{14}C	±	$\delta^{13}C‰$	cal BP[1]				Type[2]	Record	References
					68.2%		95.4%				
					from	to	from	to			
Ifri n'Ammar	Erl-4406	11949	104		13958	13627	14069	13556	C	Spit 12	Moser, 2003
Ifri n'Ammar	Erl-4401	12290	133		14608	14041	14935	13836	B	Spit 18	Moser, 2003
Ifri n'Ammar	Erl-4397	12374	108		14682	14175	14990	14069	C	Spit 15	Moser, 2003
Ifri n'Ammar	Erl-4407	12384	100		14686	14195	14977	14090	C	Spit 18	Moser, 2003
Ifri n'Ammar	UtC-6176	12430	70	-20.9	14732	14290	14966	14175	C	Spit 18	Moser, 2003
Ifri n'Ammar	UtC-6177	12480	80	-22.7	14925	14417	15072	14235	C	Spit 18	Moser, 2003
Ifri n'Ammar	UtC-6178	12640	90	-21.5	15191	14832	15311	14516	C	Spit 23	Moser, 2003
Ifri n'Ammar	UtC-6180	13590	70		16497	16249	16651	16148	C	Spit 26	Moser, 2003
Ifri n'Ammar	UtC-6181	13880	80	-21.7	16975	16663	17095	16495	C	Spit 25	Moser, 2003
Kehf el Hammar	OxA-11926	13345	50	-24.1	16159	15960	16243	15856	C	Layer 3	N. Barton et al., 2005
Kehf el Hammar	OxA-11927	13805	55	-21.9	16839	16565	16959	16450	C	Layer 4a	N. Barton et al., 2005
Kehf el Hammar	OxA-11929	14110	60	-21	17290	17045	17422	16944	C	Layer 5	N. Barton et al., 2005
Kehf el Hammar	OxA-11928	14005	55	-23.4	17129	16899	17238	16730	C	Layer 6	N. Barton et al., 2005
Kehf el Hammar	OxA-11417	15940	80	-22.9	19362	19089	19488	18987	C	63-72 cm	N. Barton et al., 2005
Kehf el Hammer	OxA-11872	21920	110	-24.7	26239	25985	26427	25902	C	Layer 9	N. Barton et al., 2005
Kehf That el Ghar	Ly-7289	13300	180		16249	15737	16519	15398	C	Level 4	Daugas & El Idrissi, 2008
Oued Charef	GrN-5570	11360	75		13275	13130	13354	13071	S-T		Wengler & Vernet, 1992
Oued Charef	Ly-7002	12120	170		14249	13745	14734	13567	OM		Wengler & Vernet, 1992
Pointe d'El Majni	Gif-3620	27700	110		31255	31057	31355	30956	S-M	2a	Delibrias et al., 1976
Pointe d'El Majni	Gif-3621	13900	250		17206	16460	17557	16158	S-T	2b	Delibrias et al., 1976
Rhafas	Gif-6489	14060	150		17350	16866	17524	16595	B	Unit II, 2	Mercier et al., 2007
Taforalt (1951-1955 exc.)	Sa-13	10800	400		13105	12142	13474	11406	C	Level 2	Roche, 1976
Taforalt (1951-1955 exc.)	Sa-14	12070	400		14680	13487	15359	13140	C	Level 6	Roche, 1976
Taforalt (1951-1955 exc.)	Sa-15	10500	400		12756	11653	13162	11197	C	Level 8	Roche, 1976

	Lab No.	^{14}C	±	$\delta^{13}C‰$	cal BP[1]				Type[2]	Record	References
					68.2%		95.4%				
					from	to	from	to			
Taforalt (1951-1955 exc.)	L-399E	11900	240		14041	13471	14639	13257	C	Necropolis	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2267	13140	150		16021	15541	16186	15290	C	Level 10	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2268	13500	150		16489	16041	16755	15826	C	Level 10	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2269	14020	160		17294	16770	17500	16515	C	Level 11	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2269	14130	160		17445	16970	17627	16662	C	Level 11	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2270	15240	180		18709	18313	18860	18065	C	Level 11	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2271	15700	180		19171	18770	19440	18610	C	Level 11-12	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2272	15460	180		18904	18541	19127	18326	C	Level 12	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2273	15500	180		18935	18575	19174	18368	C	Level 12	Roche, 1976
Taforalt (1969-1972 exc.)	Kn-1559	16420	190		20040	19582	20316	19343	C	Level 12	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2586	21100	400		25855	24970	26135	24388	CE	Level 14	Roche, 1976
Taforalt (1969-1972 exc.)	Gif-2587	21900	400		26608	25780	27167	25495	CE	Level 15-16	Roche, 1976
Taforalt (2003-2010 exc.)	OxA-24111	10680	45	-19.33	12696	12614	12713	12568	B	0.22m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-23404	10870	45	-24.17	12769	12708	12813	12693	C	0.36-0.48m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-13480	10950	45	-23.3	12835	12732	12950	12711	C	0.36-0.48m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-13479	10935	40	-23.8	12810	12734	12900	12705	C	0.36m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-13516	11065	45	-23.9	13006	12854	13059	12799	C	0.48m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-24112	11165	45	-19.73	13087	13007	13125	12905	B	0.53m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-13517	10990	45	-26.8	12911	12757	12990	12730	C	0.54m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-24113	11540	50	-19.04	13430	13325	13468	13281	B	0.69-0.61m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-23405	11615	50	-22.28	13535	13386	13562	13329	C	0.69-0.61m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-23406	11445	55	-21.93	13358	13219	13420	13151	C	0.94m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-23407	11465	50	-21.88	13383	13261	13435	13193	C	0.94m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-23408	11545	55	-22.27	13436	13326	13476	13275	C	1.14m	Barton et al., 2013

	Lab No.	^{14}C	±	$\delta^{13}C‰$	cal BP[1]				Type[2]	Record	References
					68.2%		95.4%				
					from	to	from	to			
Taforalt (2003-2010 exc.)	OxA-23409	11890	55	-24.57	13764	13607	13828	13555	C	1.56m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-23410	12405	55	-22.64	14660	14277	14855	14156	C	2.96m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-13477	12675	50	-21.4	15205	15005	15271	14829	C	3.50m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-23411	13060	65	-20.34	15795	15515	15895	15345	C	3.51m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-13478	12495	50	-21.2	14946	14531	15052	14314	C	3.88m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22902	12370	50	-22.38	14547	14199	14740	14129	C	3.97-3.88m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22904	12490	50	-22.03	14926	14508	15042	14303	C	3.97-3.88m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22785	12500	55	-22.79	14966	14543	15066	14313	C	3.97-3.88m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22787	12545	55	-22.36	15047	14718	15131	14443	C	3.97-3.88m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22784	12660	70	-23.94	15204	14929	15285	14731	C	3.97-3.88m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-24109	12605	55	-18.56	15118	14850	15199	14684	B	3.98m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22786	12200	55	-21.86	14168	14011	14292	13910	C	4.02m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22903	13045	50	-21.14	15759	15515	15838	15356	C	4.05m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22905	12665	50	-23.35	15193	14984	15256	14806	C	4.08m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-14349	12690	55		15226	15027	15299	14844	O	4.08m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22788	12850	55	-23.65	15425	15203	15576	15144	C	4.12m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-16267	14005	60	-21.1	17135	16891	17256	16716	C	4.16m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22907	14230	55	-21.34	17444	17223	17523	17120	C	4.17m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22906	14135	55	-20.67	17318	17089	17437	16996	C	4.18m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22908	14110	55	-22.68	17281	17050	17413	16954	C	4.25m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-16268	14515	60	-22.5	17801	17587	17903	17500	C	4.26m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-13519	13905	55	-20.9	16992	16736	17075	16585	C	4.30m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-22909	14140	55	-21.4	17326	17096	17443	17004	C	4.35m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-16272	14630	60	-23.3	17912	17713	17995	17621	C	4.36m	Barton et al., 2013

	Lab No.	^{14}C	±	$\delta^{13}C$‰	cal BP[1]				Type[2]	Record	References
					68.2%		95.4%				
					from	to	from	to			
Taforalt (2003-2010 exc.)	OxA-16269	15790	60	-21.1	19118	18940	19217	18882	C	4.55m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-14350	16660	70		20211	19990	20337	19880	O	4.55m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-14351	16695	70		20252	20028	20378	19925	O	4.63m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-16270	16285	65	-23.6	19760	19545	19908	19477	C	4.68m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-13518	17085	65	-20.8	20703	20505	20835	20404	C	4.72m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-16242	16630	75	-24.8	20182	19952	20315	19826	C	4.77m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-16273	17515	75	-23.6	21297	21017	21430	20894	C	4.90m	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-16260	18005	75	-20.7	21925	21686	22058	21559	C	S9 Layer 1	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-16240	18185	75	-21.7	22169	21909	22292	21825	C	S9 Layer 2	Barton et al., 2013
Taforalt (2003-2010 exc.)	OxA-16663	12470	100		14900	14346	15086	14189	B	S10	Humphreys et al., 2014
Taforalt (2003-2010 exc.)	OxA-23660	12380	55	-18.62	14600	14222	14783	14130	B	S10	Humphreys et al., 2014
Taforalt (2003-2010 exc.)	OxA-23778	12265	50	-18.92	14256	14076	14468	14005	B	S10	Humphreys et al., 2014
Taforalt (2003-2010 exc.)	OxA-23779	12255	50	-19.01	14238	14068	14431	13993	B	S10	Humphreys et al., 2014
Taforalt (2003-2010 exc.)	OxA-23780	12355	50	-18.81	14504	14172	14712	14116	B	S10	Humphreys et al., 2014
Taforalt (2003-2010 exc.)	OxA-23781	12410	50	-19.01	14664	14292	14846	14168	B	S10	Humphreys et al., 2014
Taforalt (2003-2010 exc.)	OxA-23782	12460	55	-19.01	14810	14378	14995	14242	B	S10	Humphreys et al., 2014
Taghit Haddouch	KIA 30145a	12890	170	-25.01	15680	15160	15970	14820	B	TH6	Linstädter et al., 2012
Algeria											
Afalou Bou Rhummel	Ly-3227	11450	230		13540	13076	13753	12824	C	Layer III	Hachi, 1996; Hachi et al., 2002
Afalou Bou Rhummel	Unknown	11560	90		13466	13302	13570	13216	C	Layer III	Hachi, 1996; Hachi et al., 2002
Afalou Bou Rhummel	Unknown	11900	140		13930	13563	14080	13456	C	Layer III	Hachi, 1996; Hachi et al., 2002
Afalou Bou Rhummel	Gif-6532	12020	170		14105	13630	14477	13461	C	Layer IV	Hachi, 1996; Hachi et al., 2002
Afalou Bou Rhummel	Ly-3228	12400	230		14952	14127	15268	13788	C	Layer IV	Hachi, 1996; Hachi et al., 2002
Afalou Bou Rhummel	Alger-0008	13120	370		16279	15164	16894	14409	C	Layer IV	Hachi, 1996; Hachi et al., 2002

	Lab No.	^{14}C	±	$\delta^{13}C‰$	cal BP[1]				Type[2]	Record	References
					68.2%		95.4%				
					from	to	from	to			
Afalou Bou Rhummel	Gif-9637	14910	180		18350	17930	18568	17715	C	Layer VII	Hachi, 1996; Hachi et al., 2002
Columnata	Alg-97	10800	425		13133	12105	13544	11394	S-F		Brahimi, 1972; Rahmouni et al., 1972
El Haouita	Alg-28	8220	820		10238	8210	11710	7576	C		Estorges et al., 1969
El Hamel	Unknown	9540	120		11091	10700	11201	10560		Layer E	Camps, 1968
El Onçor	Gif-4433	10040	190		11939	11264	12390	11161	O		Heddouche, 1977
Es Sayar	Gif-4349	13100	250		16044	15317	16491	14955	O		Amara, 1977
Gueldaman 1	Gif-12882	13980	70		17109	16834	17226	16646	C	S2 -172 cm	Kerbouche et al., 2014
M'Doukal	Alg-88	12740	315		15684	14547	16081	14057			Heddouche, 1998
Oued Guettara II	Gif 882	10190	230		12373	11400	12564	11230	C	Layer 5	Camps, 1968
Rassel	Alg-3	14270	59		17497	17274	17581	17156	S-T	Lower level	Brahimi, 1970; Rahmouni et al., 1970
Rolland	Alg-47	13330	280		16258	15125	16750	14283	S		Rahmouni et al., 1972
Tamar Hat (1967 exc.)	Alg-5	10350	375		12653	11614	13031	11105	C	0-30 cm	Brahimi, 1969; Rahmouni et al., 1970
Tamar Hat (1967 exc.)	Alg-4	12450	480		15315	13852	16140	13441	C	30-50 cm	Rahmouni et al., 1970
Tamar Hat (1973 exc.)	MC-817	16100	360		19847	18999	20337	18689	C	Layer 9	Saxon et al., 1974
Tamar Hat (1973 exc.)	MC-812	17040	400		21075	20055	21665	19623	C	Layer 15	Saxon et al., 1974
Tamar Hat (1973 exc.)	MC-818	18750	500		23267	22085	23914	21538	C	Layer 44	Saxon et al., 1974
Tamar Hat (1973 exc.)	MC-820	19800	500		24435	23199	25194	22723	C	Layer 50	Saxon et al., 1974
Tamar Hat (1973 exc.)	MC-822	20600	500		25408	24245	25895	23710	C	Layer 84/5	Saxon et al., 1974
Taza I (1971 exc.)	Gif-2110	11340	220		13434	13010	13580	12740	C	4	Camps, 1974a, 1974b
Taza I (1971 exc.)[3]	Alg-52	12075	220		13712	13239	13977	12984	S-M		Camps, 1974a, 1974b, Delibrias et al., 1974
Taza I (1987-1990 exc.)	Gif-2111	12700	220		15516	14642	15759	14181	C	5	Camps, 1974a, 1974b, Delibrias et al., 1974
Taza I (1987-1990 exc.)	Gif-6799	13800	130		16926	16485	17101	16281	C	Upper level	Medig et al., 1996
Taza I (1987-1990 exc.)	Gif-6800	16100	1400		21446	17951	23717	16390	B	Upper level	Medig et al., 1996
Wadi Mezeraa	SMU-655	11590	100		13538	13308	13698	13201	C		Lubell et al., 1984

	Lab No.	^{14}C	±	$\delta^{13}C‰$	cal BP[1]				Type[2]	Record	References
					68.2%		95.4%				
					from	to	from	to			
Wadi Mezeraa	SMU-738	11870	290		14107	13395	14765	13120	C		Lubell et al., 1974
Tunisia											
Bir Oum Ali	Gif-5115	14370	110		17674	17349	17842	17178	O		Delibrias et al., 1986
Bir Oum Ali	C-3568	15117	199		18590	18134	18777	17923	O		Vernet & Aumassip, 1992
Bir Oum Ali	C-3569	17470	315		21530	20699	21945	20325	O		Vernet & Aumassip, 1992
El Oghrab	Unknown	10296	386		12564	11408	12988	10813	S-T		Aouadi-Abdeljaouad & Belhouchet, 2008

1. All cal BP determinations were corrected using IntCal13 and (Reimer et al. 2013) and OxCal 4.2 (Bronk-Ramsey 2009), excluding cal BP determinations on marine molluscs corrected using Marine13 with averaged values ($\Delta R = 85$; $\sigma = 71$) from the Marine Reservoir Database (Reimer & McCormac, 2002; Siani et al., 2002).

2. Type of sample: charcoal (C); carbonaceous earth (CE); bone (B); ostrich eggshell (O); organic matter (OM); shell of marine and terrestrial molluscs (S); shell of freshwater molluscs (S-F); shell of marine molluscs (S-M); shell of terrestrial molluscs (S-T).

Appendix II – Classification Procedures

Fig. II.1. Schematic representation of types for the LSA of Northwest Africa (Tixier, 1963)

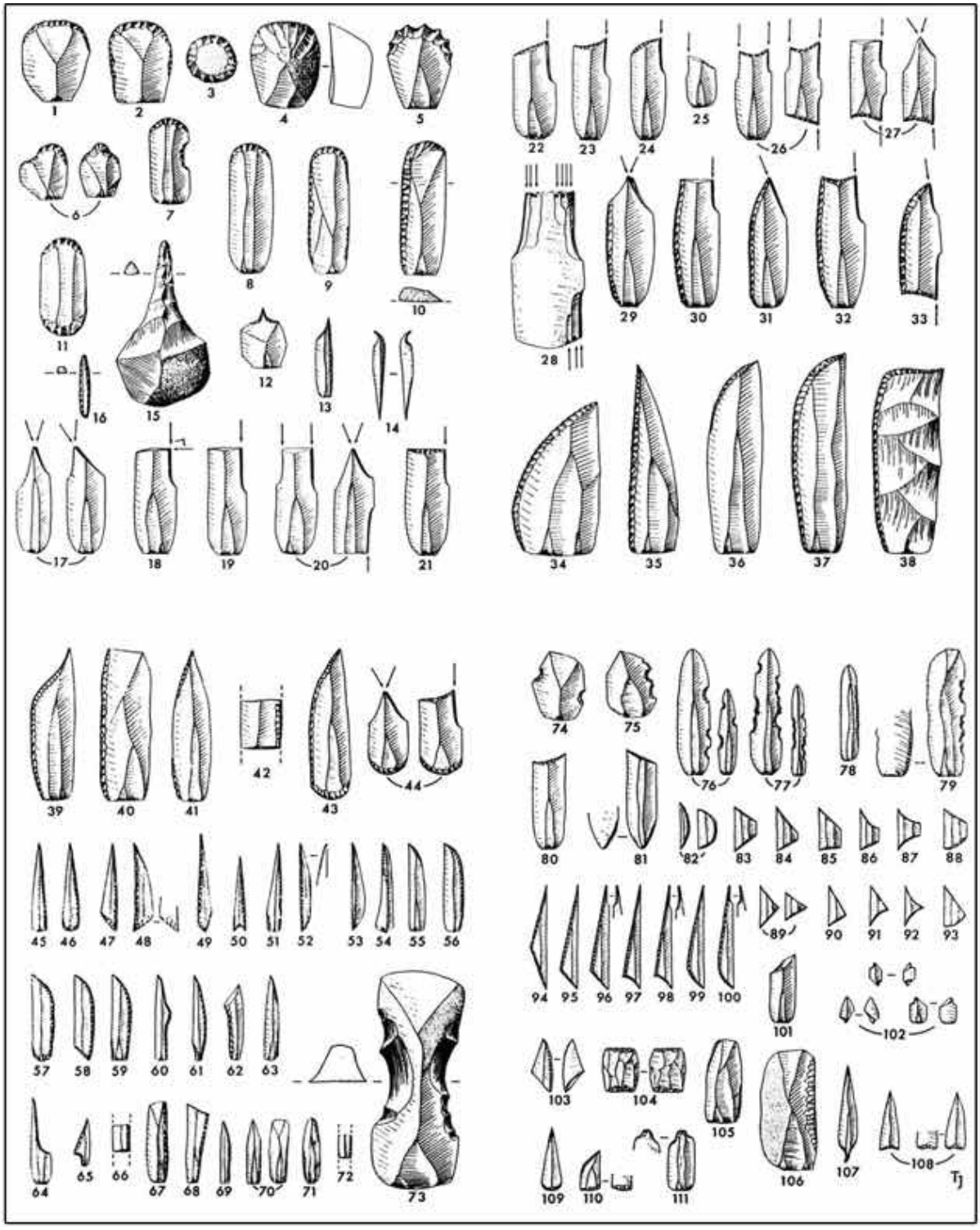


Table II.1. List of types for the LSA of Northwest Africa (Tixier, 1963, author's own translation)

End-scrapers - I		**Backed bladelets – VI (continued)**	
1	End-scraper on a flake	58	Convex backed bladelet with truncated base
2	End-scraper on a retouched flake	59	Convex backed bladelet with retouched base
3	Circular scraper	60	Backed bladelet with gibbosity
4	Nucleiform scraper or rabot	61	Backed bladelet with narrowed base
5	Denticulated end-scraper	62	La Mouillah point
6	Nosed or shouldered end-scraper	63	Partially backed bladelet
7	End-scraper on a notched piece	64	Shouldered bladelet
8	End-scraper on a blade or bladelet	65	Shouldered point
9	End-scraper on a retouched blade or bladelet	66	Fragment of a backed bladelet
10	End-scraper on a backed blade	67	Obtuse backed bladelet
11	Double end-scraper	68	Scalene bladelet
Perforators - II		69	Pointed bladelet with Ouchtata retouch
12	Simple perforator	70	Ouchtata bladelet
13	Perforator on a backed bladelet	71	Bladelet with Ouchtata retouch
14	Aïn Khanga perforator	72	Fragment of a bladelet with Ouchtata retouch
15	Large Capsian perforator	**Notches - VII**	
16	Drill (Mèche de foret)	73	Large notched or strangulated piece
Burins - III		74	Notched flake
17	Dihedral burin	75	Denticulated flake
18	Dihedral angle burin	76	Notched blade or bladelet
19	Burin on a break	77	Denticulated blade or bladelet
20	Multiple dihedral burin	78	Saw
21	Burin on a straight normal truncation	79	Notched or denticulated piece with continous retouch
22	Burin on a straight oblique truncation	**Truncations - VIII**	
23	Burin on a concave truncation	80	Truncated piece
24	Burin on a convex	81	Truncated piece with ogival retouched base
25	Burin on a trihedral point	**Geometric microliths - IX**	
26	Multiple burin on truncation(s)	82	Segment or semi-circle
27	Multiple mixed burin	83	Isosceles trapeze
28	Nucleiform burin	84	Asymmetrical trapeze
29	Dihedral burin on a backed blade	85	Trapeze rectangle
30	Burin on a break of a backed blade	86	Trapeze with one side concave
31	Burin on the back of backed blade	87	Trapeze with two sides concave
32	Burin on a truncation of a backed blade	88	Trapeze with one side convex
33	Multiple burin on a backed blade	89	Isosceles or equilateral triangle
Backed flakes and blades - IV		90	Scalene triangle
34	Backed flake	91	Triangle with one concave side
35	Straight backed blade	92	Triangle with two concave sides
36	Blade with convex backed end	93	Triangle with convex side
37	Convex backed blade	94	Elongated scalene triangle
38	Guentis knife	95	Elongated scalene triangle with one short truncation
39	Concavo-convex backed blade	96	Scalene-perforator
40	Obtuse ended backed blade	97	Elongated scalene triangle with short concave truncation
41	Partially backed blade	98	Scalene-perforator with short concave truncation
42	Fragment of a backed blade	99	Elongated scalene triangle with rounded angle
Composite tools - V		100	Scalene-perforator with rounded angle
43	Endscraper-Backed blade	**Microburin technique - X**	
44	Endscraper-Burin	101	Blade or bladelet with trihedral point
Backed bladelets – VI		**102**	Microburin
45	Pointed straight backed bladelet	103	Krukowski microburin
46	Pointed straight backed bladelet with rounded base	**Varia - XI**	
47	Pointed straight backed bladelet with truncated base	104	Scaled piece
48	Mechta el-Abri point	105	Piece with continuous retouch
49	Chacal point	106	Side-scraper
50	Aïoun Berriche point	107	Ounan point
51	Pointed straight backed bladelet with retouched base	108	Bou-Saâda point
52	Aïn Kéda point	109	Pointed bladelet with rounded base
53	Aiguillon droit	110	Columnata point
54	Burin spall with abrupt retouch	111	Tongued piece
55	Convex ended bladelet	112	Varia
56	Convex backed bladelet		
57	Convex backed bladelet with rounded base		

Table II.2. List of variables recorded on the retouched tools at Grotte des Pigeons (Taforalt)

Variable	Attribute	Code
Type	After Tixier (1963)	
Burning	Present	1
	Unidentifiable	2
	No answer	-1 to -4
Cortex	Present	1
	Absent	2
	No answer	-1 to -4
Raw material	Chert	1
	Chalcedony	2
	Limestone	3
	Basalt	4
	Sandstone	5
	No answer	-1 to -4
Colour	Black	1
	Dark grey	2
	Grey/light grey	3
	Pale brown/yellowish brown	4
	Brown/strong brown	5
	Reddish brown	6
	Dusky red/weak read	7
	White	8
	Black	9
	No answer	-1 to -4
Blank	Flake	1
	Blade	2
	Bladelet	3
	Spall	4
	Core-trimming element	5
	Core	6
	No answer	-1 to -4
Length		
Width		
Thickness		
Retouched margin	Left distal	1
	Left mesial	2
	Left proximal	3
	Left	4
	Right distal	5
	Right mesial	6
	Right proximal	7
	Right	8
	Both laterals- continuous	9
	Left distal & mesial	10
	Left mesial & proximal	11
	Right distal & mesial	12
	Right mesial & proximal	13
	Both laterals - partial	14
	Left distal & proximal	15
	Right distal & proximal	16
	No answer	-1 to -4
Retouch type	Ouchtata	1
	Ouchtata & normal	2
	Normal	3
	Normal & anvil	4
	Anvil	5
	Low	6
	No answer	-1 to -4

Variable	Attribute	Code
Retouch direction	Alternate	1
	Alternating	2
	Bifacial	3
	Crossed	4
	Direct	5
	Inverse	6
	No answer	-1 to -4
Point count	Single	1
	Double	2
	No answer	-1 to -4
Point localisation	Distal	1
	Proximal	2
	Both	3
	No answer	-1 to -4
End retouch delineation	Acute	1
	Oblique	2
	Straight	3
	Arched	4
	Convex	5
	Concave	6
	Nosed/shouldered	7
	Cran	8
	Denticulated	9
	Irregular	10
	No answer	-1 to -4
Natural distal shape	Pointed	1
	Blunt	2
	No answer	-1 to -4
Retouched tip	Present	
	Absent	
	No answer	-1 to -4
Retouched tip direction	Alternate	1
	Alternating	2
	Bifacial	3
	Crossed	4
	Direct	5
	Inverse	6
	No answer	-1 to -4
Butt	Present	1
	Absent	2
	No answer	-1 to -4
No answer	Missing	-1
	Indeterminate	-2
	Not applicable	-3
	Recorder error	-4

Table II.3. List of variables recorded on cores at Grotte des Pigeons (Taforalt)

Variable	Attribute	Code
Type	Single platform	1
	Opposed platform	2
	90˚ single platform	3
	90˚ opposed platform	4
	Multiple platform	5
	Discoidal	6
	Levallois	7
	On flake	8
	Bipolar	9
	Pièces esquillée	10
	Tested	11
	No answer	-1 to -4
Blank	Flake	1
	Bladelet	2
	Blade	3
	No answer	-1 to -4
Scars	Unidirectional	1
	Bidirectional opposed	2
	Bidirectional crossed	3
	Multiple	4
	No answer	-1 to -4
Preservation	Complete	1
	Broken	2
	Fragment	3
	No answer	-1 to -4
Cortex	Present	1
	Absent	2
	No answer	-1 to -4
Cortex %	None	1
	Less than 25%	2
	Between 25-50%	3
	Above 50%	4
	Complete	5
	No answer	-1 to -4
Burning	Present	1
	Unidentifiable	2
	No answer	-1 to -4
Raw material	Chert	1
	Chalcedony	2
	Limestone	3
	Basalt	4
	Sandstone	5
	No answer	-1 to -4
Colour	Black	1
	Dark grey	2
	Grey/light grey	3
	Pale brown/yellowish brown	4
	Brown/strong brown	5
	Reddish brown	6
	Dusky red/weak read	7
	White	8
	Black	9
	No answer	-1 to -4
Length		
Width		
Thickness		
Mass		

Variable	Attribute	Code
1st Platform	Cortical	1
	Plain	2
	Dihedral	3
	Facetted	4
	No answer	-1 to -4
2nd Platform	Cortical	1
	Plain	2
	Dihedral	3
	Facetted	4
	No answer	-1 to -4
Abrasion	Present	1
	Absent	2
	No answer	-1 to -4
Last scar termination	Feathered	1
	Hinged	2
	Overshot	3
	Step	4
	Cortical	5
	No answer	-1 to -4
No answer	Missing	-1
	Indeterminate	-2
	Not applicable	-3
	Recorder error	-4

Table II.3. List of variables recorded on the debitage at Grotte des Pigeons (Taforalt)

Variable	Attribute	Code
Type	Flake	1
	Blade	2
	Indeterminate blade/flake	3
	Burin spall	4
	Crested	5
	Platform rejuvenation	6
	Core tablet	7
	Flance de nucleus	8
	Pièces esquillée	9
	True microburin	10
	Krukowski microburin	11
	No answer	-1 to -4
Preservation	Complete	1
	Distal	2
	Central	3
	Proximal	4
	Shatter	5
	No answer	-1 to -4
Cortex	Present	1
	Absent	2
	No answer	-1 to -4
Cortex %	None	1
	Less than 25%	2
	Between 25-50%	3
	Above 50%	4
	Complete	5
	No answer	-1 to -4
Burning	Present	1
	Unidentifiable	2
	No answer	-1 to -4
Raw material	Chert	1
	Chalcedony	2
	Limestone	3
	Basalt	4
	Sandstone	5
	No answer	-1 to -4
Colour	Black	1
	Dark grey	2
	Grey/light grey	3
	Pale brown/yellowish brown	4
	Brown/strong brown	5
	Reddish brown	6
	Dusky red/weak read	7
	White	8
Length		
Width		
Thickness		
Dorsal Scars	Cortical/natural surface	1
	Unidirectional	2
	Bidirectional opposed	3
	Bidirectional crossed	4
	Multiple	5
	No answer	-1 to -4
Striking platform	Cortical	1
	Plain	2
	Dihedral	3
	Facetted	4
	en chapeau de gendarme	5
	Winged	6
	Pecked	7
	Spur "*en éperon*"	8
	Linear	9
	Punctiform	10

Variable	Attribute	Code
Abrasion	Present	1
	Absent	2
	No answer	-1 to -4
Termination	Feathered	1
	Hinged	2
	Overshot	3
	Step	4
	No answer	-1 to -4
Microburin	Distal	1
	Proximal	2
	Double	3
	No answer	-1 to -4
Notch localization	Left	1
	Right	2
	No answer	-1 to -4
No answer		
	Missing	-1
	Indeterminate	-2
	Not applicable	-3
	Recorder error	-4