12. LATER STONE AGE LITHIC ARTEFACTS

J. HOGUE · A. BOUZOUGGAR

12.1 RAW MATERIALS

The raw materials described come from Sectors 8 and 10, which provided the majority of finds from the Iberomaurusian units. The descriptions of the raw materials are given in **table 12.1**. Those in Sector 8 are grouped into four different successive phases separated on techno-typological criteria (Upper, Middle, Mixed/transitional and Lower); these are treated separately from the finds in Sector 10 (**tab. 12.1**).
In total, the lithic artefacts described here comprise mainly microcrystalline and crypto-crystalline rocks classified as cherts (Luedtke 1992). There are also moderate amounts of limestone and a few other raw materials including small quantities of quartzite, silicified limestone and a metamorphic rock similar to basalt (**tab. 12.1**).
The cherts form the largest group and were sub-divided according to colour. A major group consisted of grey to brownish coloured cherts (Munsell colours 5YR 6/1 – 10YR 3/6), that were extremely fine-grained with excellent fracture properties for knapping. They often had pale grey inclusions that gave the material a slightly mottled appearance. A second group, also of high quality for knapping, consisted of light grey to brown col-

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Chert	8605	1002	1697	2699	470	1980	2377	16,131
	83.7 %	89.8 %	95.6 %	93.4 %	92.2 %	96.6 %	94.1 %	88.4 %
Black	10	4	11	15	1	24	12	62
Dark grey	14	6	4	10	2	7	9	42
Grey/light grey	28	2	17	20	7	13	27	94
Greyish brown	27	16	35	51	7	21	40	146
Pale brown/yellowish brown	165	58	101	159	44	177	76	621
Brown/strong brown	108	25	68	93	26	114	122	463
Reddish brown	15	9	20	29	5	5	12	66
Dusky red/weak red	18	9	12	21	1	3	2	45
White	16	5	15	20	3	9	39	87
Intermediate/unclassified	8204	868	1413	2281	375	1606	2038	14,504
Limestone	1665	114	77	191	40	59	144	2099
	16.2 %	10.2 %	4.3 %	6.6 %	7.8 %	2.9 %	5.7 %	11.5 %
Basalt	0	0	0	0	0	4	0	4
	-	-	-	-	-	0.2 %	-	>0.1 %
Quartzite	5	0	1	1	0	7	3	16
	0.1 %	-	0.1 %	>0.1 %	-	0.3 %	0.1 %	0.1 %
Other	1	0	0	0	0	0	1	2
	>0.1 %	-	-	-	-	-	>0.1 %	>0.1 %
Total	10279	1116	1775	2891	511	2050	2525	18,256
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.1 Absolute and relative frequencies of raw materials.

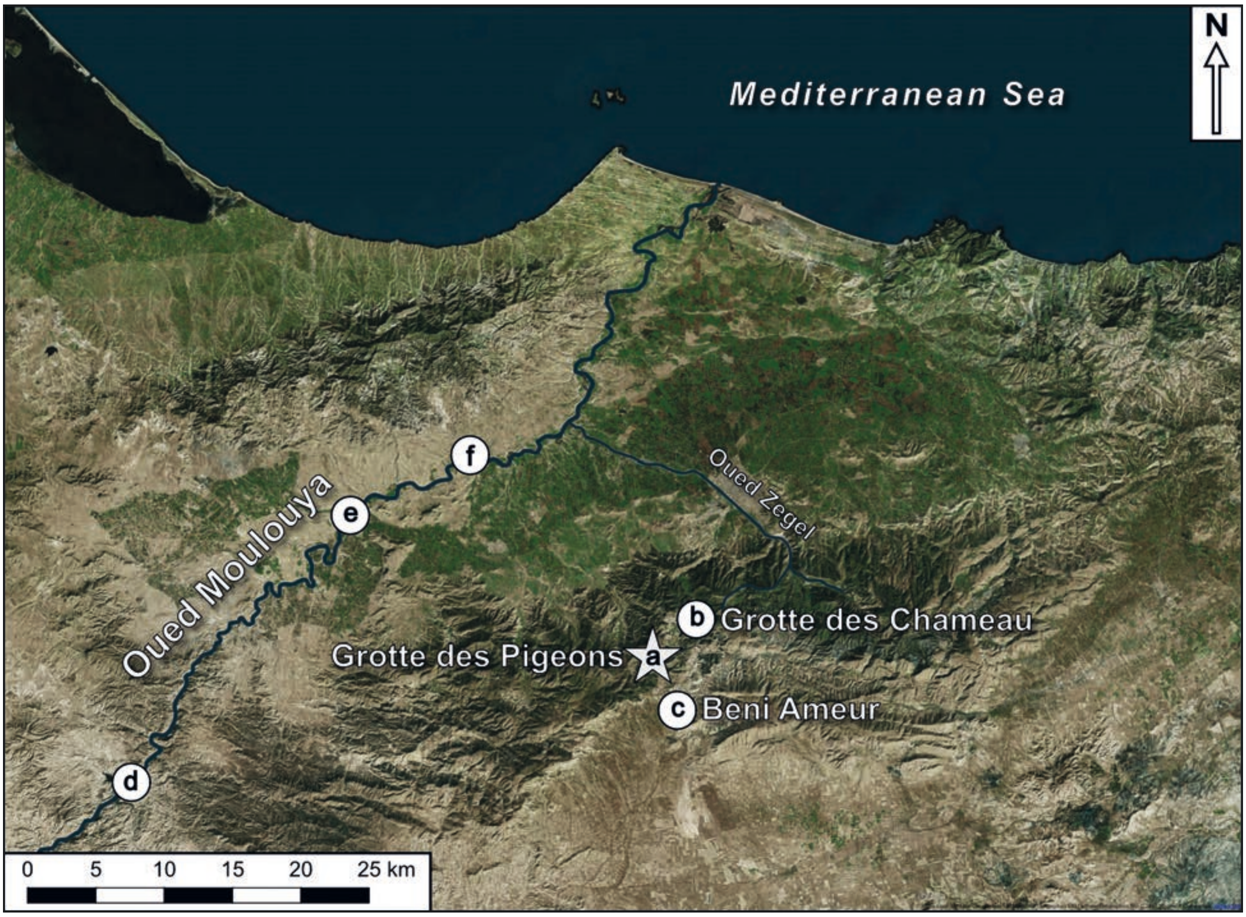

Fig. 12.1 Raw material sources in relation to Taforalt (**a**); silicified black limestone in side valley near Grotte du Chameau (**b**); Domerian limestone at Beni Ameur (**c**); grey to brownish cherts sampled at various locations in the Oued Moulouya (**d-f**).

oured cherts (Munsell colours 7.5YR 7/1 – 6/4). Although there was a noticeable overlap in colour with the first group, the second did not contain many inclusions. A third group was made up of good quality white to grey cherts (Munsell colours White N 9.5 – Grey 2 6/1), which included at one end of the spectrum a translucent material akin to chalcedony. A small number of artefacts of a silicified black limestone were also recovered, as well as a grey lithographic limestone. All of the cherts range in size from a few centimetres to 10 cm in maximum dimension. Most of them display a smooth outer rind which is often stained, weathered and showing the typical chatter-marked alteration seen on water transported material. There are no obvious examples with true cortex as typical of material gathered from near primary sources just below geological outcrops.

Since the great majority of the raw material used at the site is derived from waterworn pebbles and cobbles, modern exploration was undertaken of the surrounding river valley systems for possible sources (fig. 12.1). The streambed of the Zegzel valley below the cave was searched upstream and as far downstream as Tghasroutte (fig. 1.6) but failed to produce any significant quantities of cherts or quartzites. However, it is possible that that now more deeply buried deposits with these materials were once available closer to the surface. A more obvious source of raw material is that of the Moulouya River which at its closest point lies 16.7 km from Taforalt as the crow flies. The river covers an enormous catchment area in keeping with its status as the second largest river system in North Africa. The main valley lies north and west of Taforalt and cuts through Jurassic rocks that contain cherts and quartzites (Bartz et al. 2018). Our searches revealed a heterogeneous range of coloured and textured cherts along its gravel banks (fig. 1.12d-f), although these gravels are today overlain and, in most locations largely obscured, by up to c. 10 m of fine over-bank deposits that formed during the Holocene (Ibouhouten et al. 2010). The raw material recovered from the gravel banks is similar to that classified as 'Moulouya Brown' and 'Moulouya White' by Linstädter et al. (2015), utilised in the Ibero-maurusian levels at Ifri Oudadane. The Brown contains brownish to greyish varieties that fall within our first and second groups of chert and the White is a more homogeneous chert probably akin to our third group. In addition Linstädter et al. (2015, 161) note that their Moulouya Brown sometimes has a reddish tinge and can be translucent which is also typical of the Taforalt lithics.

Of the other raw materials represented at Taforalt, the nearest source of silicified black limestone comes from near Grotte du Chameau, about 5 km downstream from Taforalt in a tributary of the Zegzel (**fig. 1.12b**). Here large boulders of local bedrock contain small pebbles of the raw material and also dark grey cherts, dull and opaque in colour (Munsell N4) with a thick outer cortex. The chert contains numerous internal fissures making it hard to knap. The majority of these raw materials were found embedded in the rock and extraction of anything sizeable was near impossible despite the aid of a modern rock hammer. The grey lithographic limestone used for knapping at Taforalt could have come from Domerian outcrops which include a source at Beni Ameur, 5 km southeast of Taforalt (**fig. 1.12c**). It is also possible that other outcrops were exploited within the Zegzel valley and just downstream of the cave (see **Chapter 2**). We note that the 'calc-limestone' rocks used in the pyrolithics is of similar material to the Domerian and would suggest, on grounds of sheer volume, that this mostly derived from within a short distance of the cave. Finally, it should be remembered that the cave deposits themselves could have been mined for raw materials. It is certainly plausible that knappable cherts were grubbed up from the floor of the cave and re-used (see below).

J. HOGUE with R. N. E. BARTON

12.2 METHODOLOGY

This study is mainly based on the long archaeological sequence in Sector 8 with additional observations on the artefacts from Sectors 3 and 9. Sector 10 is treated separately, partly because at present it cannot be correlated directly with the main stratigraphic sequence. Standard non-parametric statistical tests (Krukal-Wallis Test and Fisher's Exact Test) were used throughout to analyse the assemblages.

All lithic finds discussed in this chapter come from the 2003-2010 phase of the excavations. Due to some minor disparities in excavation methods between these sectors (particularly with Sector 10), the lithic assemblages were first size-sorted to create a level of standardisation, with material dry-sieved through a 4 mm mesh and artefacts less than this size omitted from classification. The largest collection of artefacts is from Sector 8 (S8) and consists of 12,709 lithic artefacts from 44 stratigraphic units of the Grey and Yellow Series (**tab. 12.2** and see **Chapter 2**). Techno-typological criteria were used to separate them into four Phases in S8 (see below and **tab. 12.2**). The 191 lithic artefacts from Sector 3 were excavated from 22 spits, grouped into two intervals (0-29 cm and 29-44 cm on the AOH 2008 log), broadly equivalent to the two lower Phases in Sector 8. The 1263 lithic artefacts from Sector 9 come from three units (U1, U2 and U3) that are believed to broadly correlate with the Lower Phase in Sector 8 (**tab. 12.2**). The 2526 lithic artefacts from Sector 10 are treated as a single assemblage that derives mainly from the Grey Series. However, it should be noted that the artefact taphonomy is likely to be complex since the origin of these Grey Series sediments is thought to be largely secondary, being imported from other parts of the cave, and there is also the possibility of localised mixing with the underlying deposits.

	Sector 3	Sector 8			Sector 9(W)[b]
		2003-08	2009-10 L-units	2009-10 MMC[a]	
Upper Phase		G88-96	L2-L27	MMC1-c. MMC96	
Middle Phase		G97-Y1	L28-L30	c. MMC97-MMC110	
Intermediate/Mixed Phase	0-6cm	Y2spit1	L31-L32	MMC111-MMC114	
Lower Phase	6-44cm	Y2spits2-5 Y3-Y4spits1-2		MMC115-MMC130	U1-U3

Tab. 12.2 Stratigraphic contexts assigned to artefact Phases.
[a] lithic assemblage from mollusc column not included in study by Hogue (2014).
[b] After Ward 2007.

The method for categorising finds is based principally upon that devised by Tixier (1963) and later expanded by Inizan/Reduron-Ballinger/Roche/Tixier (1999). A "flake" is any removal with a length to width ratio of <2:1. A "small flake" is a flake measuring between 10-20mm that retains its butt. The term "blade/let" is used to refer to all blanks with length at least twice the width. Here the distinction between blades and bladelets is seldom made, but when utilised follows the criteria outlined by Tixier (1963). The term "debris" has been used to refer to fragments and smaller knapping flakes (<20mm) and larger chunks (≥20mm). The core typology follows that outlined by Close (1977, 54-55), with the addition of the term "core-on-flake" (after Olszewski/Schurmans/Schmid 2011). All splintered pieces have been categorised separately, as these objects were originally thought to be intentional retouched tools (Tixier 1963) but have also been interpreted as the exhausted remnants of bipolar reduction (Olszewski/Schurmans/Schmidt 2011).

Retouched tools have been classified following the terminology of Tixier (1963) and Inizan/Roche/Tixier (1992), with some slight modifications. For convenience, all of the laterally backed and retouched material in the Taforalt collection has been grouped under the category of "microlithic and related forms" (**fig. 12.2**). This covers a spectrum of retouched forms ranging from true microliths (those made using the microburin technique) to small backed or retouched bladelets with their butts present. Within this broad grouping are identified sub-categories such as non-geometric backed bladelets (types 45-71) and geometric forms (types 82-100), and the term "microlithic fragment" has been used to classify other objects too fragmentary to be identified to a specific type (types 66 & 72). '*Mèches de foret*' or 'drill bits' (type 16) have been classified within microlithic forms to reflect observed technological similarities (e.g. backing, manufacture on blades, etc.); in contrast, Tixier (1963, 63-66) originally grouped this type, with a diverse range of other types, as perforators, based on assumed function. In a further divergence from Tixier, the term "pointed straight-backed bladelets *sensu lato*" has been used to refer to an amalgamation of his type 45 (all pointed straight-backed bladelets *sensu stricto*) and his types 46-52 (seven sub-variants identified by the morphology of the base and/or additional retouch). In addition, the term "convex-backed bladelet *sensu lato*" has been used to merge his type 56 (convex-backed bladelets *sensu stricto*) with types 57-59 (variants identified by the morphology of the base). A distinction has also been made between typical convex-backed bladelets *sensu stricto* (type 56a) and those tending towards the form of a typical segment (type 56b), which, although not reflected in his formal type-list numbers, follows observations made by Tixier (1963, 104).

Tixier (1963, 103-104. 110) also defined specific types with partial backing (e.g. bladelets with a convex-backed end [type 55], shouldered bladelets [type 64]), but also used the general term 'partially backed bladelets' (type 63) to refer to a diverse variety of other forms not included within these more specifically defined types. In describing the Taforalt microlithic forms, a new subdivision has been introduced between partially backed bladelets with an acutely pointed truncation at one end (type 63a) and other partially backed forms lacking a truncation (type 64b). In addition, a scalene bladelet (type 68) is defined as a blade-

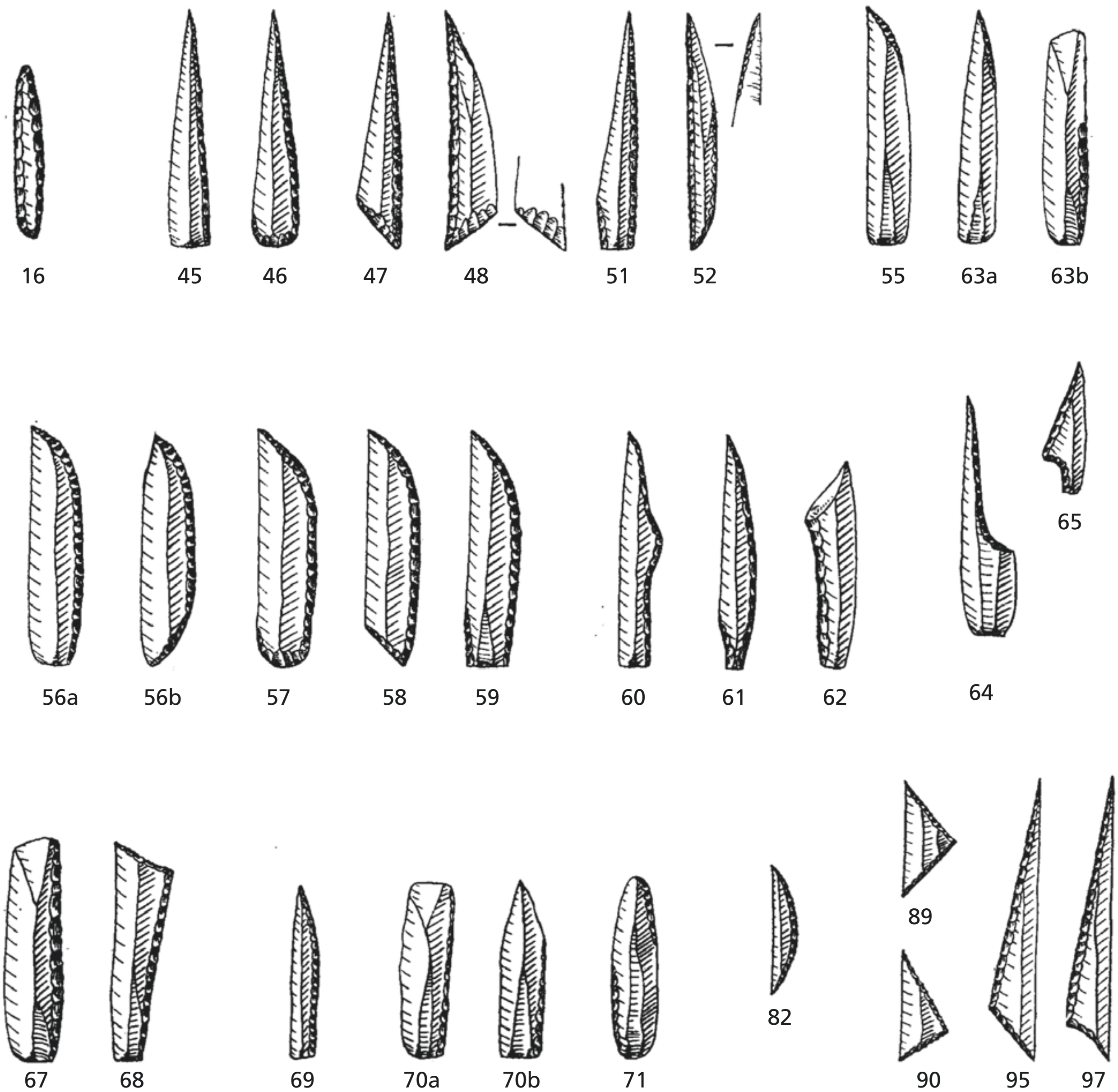

Fig. 12.2 Microlithic and related types at Taforalt (modified after Tixier 1963): **16** Drill bit; **45** Pointed straight-backed bladelet; **46** Pointed straight-backed bladelet with rounded base; **47** Pointed straight-backed bladelet with truncated base; **48** Mechta el-Arbi point; **51** Pointed straight-backed bladelet with retouched base; **52** *Aïn Kéda* point; **55** Bladelet with convex backed end; **56a** Convex backed bladelet; **56b** Convex backed bladelet tending towards segment; **57** Convex backed bladelet with rounded base; **58** Convex backed bladelet with truncated base; **59** Convex backed bladelet with retouched base; **60** Backed bladelet with gibbosity; **61** Backed bladelet with narrowed base; **62** *La Mouillah* point; **63a** Partially backed bladelet with pointed ends; **63b** Partially backed bladelet with unmodified ends; **64** Shouldered bladelet; **65** Shouldered point; **67** Obtuse ended backed bladelet; **68** Scalene bladelet; **69** Pointed bladelet with Ouchtata retouch; **70a** Ouchtata bladelet retouched along entire lateral margin; **70b** Ouchtata bladelet retouched on proximal portion of one edge; **71** Bladelet with Ouchtata retouch; **82** Segment or semi-circle; **89** Isosceles or equilateral triangle; **90** Scalene triangle; **95** Elongated scalene triangle with short truncation; **97** Elongated triangle with concave short truncation.

let with one continuously retouched margin and an oblique truncation removing either the distal end or butt (after Close 1977, 27-38) (**fig. 12.2**).

Finally, there has been some confusion over the use of the term "Ouchtata retouch". Tixier used it specifically to describe a distinctive form of fine, marginal retouch, usually found along one edge of a bladelet, leaving the butt intact and tending to weaken towards the distal end leaving the latter unmodified (Tixier

1963, 115). These he termed bladelets with Ouchtata retouch or 'Ouchtata bladelets' (type 70) (Tixier 1963, 115-116). Unfortunately, the term Ouchtata bladelet has also been used elsewhere to refer to a more variable group of tools rather than a single type (e.g. Olszewski/Schurmans/Schmidt 2011). To reflect this variability, in this volume Ouchtata bladelets are 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). In passing, it should be stated that a conscious decision was made by JH, the main author of this chapter, not to refer directly to the earlier work on the lithic assemblages by Roche (1963). This was partly because it was based on a microlithic tool typology that was at odds with the versions used here but also due to perceived problems over his interpretation of the main chronostratigraphic units (Chapter 2). In hindsight, some of the insights provided by Roche in fact strongly support our findings and are referred to briefly later in this chapter.

12.3 DEFINITION OF ASSEMBLAGE GROUPS IN THE IBEROMAURUSIAN SEQUENCE

Preliminary examination of the lithic assemblages revealed broad technological and typological trends. Based on initial observations in Sector 8 (the richest and most complete Iberomaurusian sequence in the cave), three sub-divisions were identified by JH (Barton et al. 2013):

> IB1 (Yellow Series Units Y2 to Y4) – microburins were uncommon throughout and the toolkit consisted principally of types not requiring the use of microburin technique (e.g. obtuse-ended backed bladelets and Ouchtata bladelets);
>
> IB2 (Yellow Series Unit Y1) – microburins were prolific at the top of the YS and associated with novel tool forms (e.g. *La Mouillah* points);
>
> IB3 (Grey Series) – microburins were relatively underrepresented, although the toolkit consisted of types generally produced using the microburin technique (e.g. curved-backed bladelets).

Subsequent more detailed analysis of the lithics showed that this division needed to be more nuanced (Hogue 2014). Going back to the full set of units as excavated, the process involved systematic pairwise comparisons of the original assemblages in order to examine variation in the attribute and metrical data. Stratigraphic units were systematically collapsed where limited variation was observed, respecting basic stratigraphic principles. In total, three or possibly four groups emerged from these analyses, which were most different from each other, whilst minimising in-group variation. Firstly, the basal GS deposits S8-L28-L29 (and equivalents) were distinct from the upper GS deposits, in the proliferation of the microburin discards and details in the toolkit (e.g. occurrence of *La Mouillah* points) and, as such, on techno-typological grounds were more like the uppermost S8-Y1. Secondly, S8-Y2spit1 did not fit within the initially observed trends: specifically it included a relatively high frequency of microburins technologically similar to those observed in Y1 but a toolkit broadly consistent with that of the underlying Y2spits2-5 and Y3-Y4spits1-2. Interestingly, the sedimentological evidence from S8-Y2spit1 shows plastic deformation consistent with wetness and possible transient ground freezing, which is likely to have resulted in displacement of artefacts and mixing of finds from older and younger levels. Nevertheless, it is conceivable (yet considered very unlikely) that this grouping represents a genuine transition. Due to these factors, the groups were refined and a revised nomenclature is adopted here. Four instead of three Phases could be recognised in the main Sector 8 sequence (and for the equivalents in other Sectors; see also tab. 12.2):

Lower Phase (Yellow Series: Y4spits2-1, Y3, Y2spits5-2, MMC130-MMC115)

Transitional/Mixed Phase (Yellow Series: Y2spit1, L32-L31, MMC114-MMC111)

Middle Phase (lower Grey and upper Yellow Series: Y1-G97, L30-L28, MMC110-c. MMC97)

Upper Phase (Grey Series: G96-G88, L27-L2, c. MMC96-MMC1)

A further series of systematic pairwise comparisons were undertaken, comparing attribute occurrence (e.g. butt types) using Fisher's Exact Test and metrical variables (e.g. blank size) using Mann-Whitney U Tests, on artefacts in adjacent stratigraphic units within each recognised group; none showed consistent in-group variation. In part, this may have been a factor of sample size, with many of the units yielding few artefacts, increasing the chance of statistical indeterminacy. Nonetheless, given the available information, there was little evidence to suggest that these broad groups could be further sub-divided. As such, this archaeological phasing was adopted and formed the basis of subsequent analysis. A description of each Phase is given in the following section.

12.4 DESCRIPTION OF LITHIC ASSEMBLAGES

Lower Phase

The Lower Phase assemblage consists of 2050 lithic artefacts, of which a relatively low frequency is undiagnostic knapping debris (51.5 %). Of the classifiable artefacts, small flakes and flakes are most common (58.1 %), but there are also relatively high proportions of blade/lets (20.2 %), low proportions of cores (1.7 %) and core-trimming elements (1.1 %), infrequent microburin products (1.0 %) and moderate numbers of tools (17.4 %) (**tab. 12.3**). The productivity in total artefacts (that is, estimated abundance in a standard sediment volume, weighted by estimated sedimentation rate) is 260 in the Lower Phase, which is the lowest of any Phase (**tab. 12.4**; see table caption for a full explanation of this effectively dimensionless productivity metric).

Cores

In total, 17 cores and core fragments have been recovered. Single platform cores are prevalent (**fig. 12.3a-c**) followed by opposed platform cores (**fig. 12.3d-e**). However, a strict distinction between these types seems to be misleading, as often only a couple of removals have been struck from the opposing striking platform and many of the cores seem to have been abandoned soon after being rotated (see Discussion). There is little evidence for the concurrent exploitation of two or more striking platforms. One multidirectional core has been identified. One discarded tested nodule is recorded, which would have been suitable for further working. There are also three core fragments (**tab. 12.5**).

Most cores are made of chert, although one is made of limestone. All the cores and core fragments retain elements of the original outer surfaces (see raw materials), whereas, in the later Phases, many of the cores are entirely 'decorticated'. Half the cores have recognisable blade/let removals, with the remainder having either mixed removals or solely flake removals (**tab. 12.6**).

Overall, the sizes of cores are not significantly different from those of the later Phases (**tab. 12.7**). However, one is a particularly large core, and is an outlier in terms of length, width and thickness. It is a multidirectional flake core made of limestone, is approximately twice the size of the average core, and measures 57.1 × 47.4 × 30.2 mm.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	All sectors
		GS	YS	Total				
Small flake	833	105	192	297	54	352	202	1738
	37.5 %	25.9 %	25.2 %	25.5 %	24.1 %	35.4 %	13.3 %	28.4 %
Flake	533	106	168	274	58	226	642	1733
	24.0 %	26.1 %	22.1 %	23.5 %	25.9 %	22.7 %	42.2 %	28.3 %
Blade	274	61	129	190	45	201	295	960
	12.3 %	15.0 %	17.0 %	16.3 %	20.1 %	20.2 %	19.4 %	16.4 %
Core-trimming elements	47	11	17	28	3	11	50	139
	2.1 %	2.7 %	2.2 %	2.4 %	1.3 %	1.1 %	3.3 %	2.3 %
Microburins & related products	11	47	103	150	20	10	25	216
	0.5 %	11.6 %	13.5 %	12.9 %	8.9 %	1.0 %	1.6 %	3.5 %
Cores	56	20	29	49	6	17	74	202
	2.5 %	4.9 %	3.8 %	4.2 %	2.7 %	1.7 %	4.9 %	3.3 %
Splintered pieces	4	1	1	2	0	4	20	30
	0.2 %	0.3 %	0.1 %	0.2 %	-	0.4 %	1.3 %	0.5 %
Tools	462	55	122	177	38	173	215	1065
	20.8 %	13.6 %	16.0 %	14.2 %	17.0 %	17.4 %	14.1 %	17.4 %
Subtotals	2220	406	761	1167	224	994	1523	6128
	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Chips	(7592)	(651)	(945)	(1596)	(261)	(1015)	(713)	(11,177)
	(73.9 %)	(58.3 %)	(53.2 %)	(55.2 %)	(51.1 %)	(49.5 %)	(28.2 %)	(61.2 %)
Chunks	(467)	(59)	(69)	(128)	(26)	(41)	(289)	(951)
	(4.5 %)	(5.3 %)	(3.9 %)	(4.4 %)	(5.1 %)	(2.0 %)	(11.5 %)	(5.2 %)
Overall Totals	10279	1116	1775	2891	511	2050	2525	18,256

Tab. 12.3 Absolute and relative frequencies of artefact classes. (Counts in brackets contribute to "Overall Totals" on the bottom line but not to previous "Subtotals" involving only better classified pieces.)

Fig. 12.3 Lower Phase cores: **a-c** single platform cores; **d-e** opposed platform cores.

		Volume	Sedim Rate	Debris			Debitage			Tools			Total		
		m³	m/^{14}C cal ka	n	/m³	prod	n	/m³	prod	n	/m³	prod	n	/m³	prod
Upper Phase		1.67	1.65	7445	4458	7356	1595	955	1576	432	259	427	9472	5672	9359
Middle Phase	GS	0.41	4.00	710	1732	6928	351	856	3424	55	134	536	1116	2723	10892
	YS	0.47	0.17	1014	2157	367	639	1360	231	122	260	44	1775	3777	642
	Total	0.88	0.67	1724	1959	1313	990	1125	754	177	201	135	2891	3285	2201
Intermediate/ Mixed Phase		0.28	0.17	287	1025	174	186	664	113	38	136	23	511	1825	310
Lower Phase		1.34	0.17	1056	789	134	821	613	104	173	129	22	2050	1530	260
Overall		4.17	-	10512	2520	-	3592	861	-	820	197	-	14924	3579	-

Tab. 12.4 Lithic artefact productivity. The objective of this table is to show estimates of lithic artefact productivity ("productivity") based upon counts (excluding lithics from MMC001-056). – Bulk density is given as number/cubic metre. Most bulk densities have been calculated using estimated volumes for the total volume of sediment (with varying proportions of mineral sands, stones, ash, etc.) excavated. Estimated volumes have been calculated in the QGIS software package using 3D data recorded in the field and digitised section/profile drawings. In the case of MMC080-130, the volume of sediment was measured in the field and has been used instead of estimated volumes when calculating bulk densities. No data are available for the volumes of sediment recovered from MMC001-056 or from Sector 10. – Bulk density on its own is not a sufficient proxy for productivity, since the sediment matrix of the different Phases accumulated at different rates. Thus, sedimentation rate estimates (see **Chapter 2**, relying heavily upon Sector 8) have next been used (in thickness metres per calibrated radiocarbon millennia) to weight the bulk density calculations. The resulting productivity figures ("prod" in the table, expressed as effectively a dimensionless but approximately linear metric) are still only estimates (due to differences in sediment, such as variations in texture/composition, that still constrain the possible lithic numbers) but the figures are considered sufficiently reliable at least to indicate gross contrasts between Phases. Note that "overall productivity" has not been calculated, since the lithostratigraphic representation in different sectors is too disparate to allow a meaningful estimate of average LSA-period sedimentation rate.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Single platform	18	8	12	20	1	7	22	68
	32.1 %	40.0 %	41.4 %	40.8 %		41.2 %	29.7 %	33.7 %
Opposed platform	12	3	5	8	2	5	19	46
	21.4 %	15.0 %	17.2 %	16.3 %		29.4 %	25.7 %	22.8 %
90° platform	3	0	0	0	0	0	2	5
	5.4 %	0.0 %	0.0 %	0.0 %		0.0 %	8.1 %	2.5 %
Multiplatform	4	4	2	6	0	1	6	17
	7.1 %	20.0 %	6.9 %	12.2 %		5.9 %	2.7 %	8.4 %
Discoidal	1	0	1	1	0	0	1	3
	1.8 %	0.0 %	3.5 %	2.0 %		0.0 %	1.4 %	1.5 %
Core-on-flake	6	1	2	3	0	0	8	17
	10.7 %	5.0 %	6.9 %	6.1 %		0.0 %	10.8 %	8.4 %
Prepared/tested	0	2	1	3	1	1	1	6
	0.0 %	10.0 %	3.5 %	6.1 %		5.9 %	1.4 %	3.0 %
Fragment	12	2	6	8	2	3	15	40
	21.4 %	10.0 %	20.7 %	16.3 %		17.6 %	20.3 %	19.8 %
Total	56	20	29	49	6	17	74	202
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.5 Absolute and relative frequencies of cores.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Flake	26	8	15	23	5	5	36	95
	52.0 %	42.1 %	57.7 %	51.1 %		31.3 %	58.1 %	53.4 %
Blade	0	0	0	0	0	0	2	2
	-	-	-	-	-	-	3.2 %	1.1 %
Bladelet	19	9	10	19	0	8	19	65
	38.0 %	47.4 %	38.5 %	42.2 %	-	50.0 %	30.7 %	36.5 %
Mixed	5	2	1	3	0	3	5	16
	10.0 %	10.5 %	3.9 %	6.7 %	-	18.8 %	8.1 %	8.9 %
Total	50	19	26	45	5	16	62	178
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.6 Absolute and relative frequencies of diagnostic scars on cores.

	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Upper Phase				
N	44	44	44	44
Mean	27.4	19.7	14.0	9.7
Std. Deviation	5.2	5.2	5.2	5.2
Minimum	16.5	10.4	7.2	3.5
Maximum	40.8	34.7	31.3	22.0
Median	27.6	18.8	12.6	8.8
Middle Phase				
N	41	41	41	41
Mean	26.3	21.1	15.1	11.1
Std. Deviation	5.5	5.8	4.2	6.1

Tab. 12.7 Dimensions of cores.

	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Minimum	17.8	11.4	8.7	2.5
Maximum	43.2	38.5	24.6	32.6
Median	26.8	19.6	14.0	9.4
Transitional/Mixed Phase				
N	4	4	4	4
Mean	31.2	21.5	13.4	11.1
Std. Deviation	12.3	5.8	3.0	7.2
Minimum	23.0	14.5	10.5	5.0
Maximum	49.6	27.9	17.5	21.4
Median	26.2	21.8	12.8	8.9
Lower Phase				
N	14	14	14	14
Mean	31.4	22.5	16.3	18.8
Std. Deviation	10.3	9.6	6.0	26.2
Minimum	18.0	10.9	8.1	3.2
Maximum	57.1	47.4	30.2	105.7
Median	29.4	19.5	14.6	10.2
Sector 10				
N	59	59	59	59
Mean	33.7	25.0	17.3	24.6
Std. Deviation	8.0	8.8	7.5	50.3
Minimum	19.6	15.2	8.4	4.9
Maximum	69.3	68.8	58.0	386.9
Median	33.1	22.5	15.9	14.1

Tab. 12.7 (continued)

Debitage

In total, 201 blade/lets including fragments have been recovered. All the blade/lets are made of chert and the overwhelming majority have no outer rind (**tab. 12.8**). Most have unidirectional dorsal scars and relatively few have bidirectional opposed dorsal scars (**tab. 12.9**). An overwhelming number have punctiform/linear butts and the other butt types are found only in small numbers (**tab. 12.10**). None is a blade *sensu stricto*, all being bladelet-sized. On average the blade/lets are relatively narrow and thin in comparison to the Middle and Upper Phases (**tab. 12.11**).

A total of 578 small flakes and flakes have also been recovered. Most are made of chert (93.8 %), with smaller frequencies made of limestone (4.7 %), quartzite (1.0 %) and basalt (0.5 %). All complete and almost complete flakes have been selected for further attribute analysis (n = 134). Around a third have no outer rind (**tab. 12.12**). Just over half have unidirectional dorsal scars and over a quarter have multidirectional dorsal scars (**tab. 12.13**). Around two fifths have plain butts and those with 'cortical' butts also make up a strong proportion of the assemblage (**tab. 12.14**). Overall, the average size of flakes is not significantly different from that in the Transitional/Mixed Phase (**tab. 12.15**).

Eleven core-trimming elements have been recovered from the Lower Phase. All are made on chert. Most are crested pieces, relating to the initial shaping of a blade or bladelet core in which a crest, or ridge, is formed that is then used to guide subsequent blade removals. The two faces of a crest are known as versants. In the Lower Phase the crested pieces include eight crested blade removals with one prepared versant, one crested blade removal with both versants prepared and two fragments. The median dimensions are 26.0 × 8.6 × 3.8 mm (**tab. 12.16**). There is also one example measuring 14.7 × 8.1 × 2.7 mm.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
None	43	16	35	51	15	53	75	237
	43.0 %	69.6 %	60.3 %	68.2 %	68.2 %	73.6 %	49.7 %	55.6 %
Less than 25 %	27	4	13	17	7	8	46	105
	27.0 %	17.4 %	22.4 %	21.0 %	31.8 %	11.1 %	30.5 %	24.7 %
Between 25-50 %	20	1	6	7	0	6	15	48
	20.0 %	4.3 %	10.3 %	8.6 %	0.0 %	8.3 %	9.9 %	11.3 %
More than 50 %	7	2	4	6	0	3	12	28
	7.0 %	8.7 %	6.9 %	7.4 %	0.0 %	4.2 %	8.0 %	6.6 %
Complete	3	0	0	0	0	2	3	8
	3.0 %	0.0 %	0.0 %	0.0 %	0.0 %	2.8 %	2.0 %	1.9 %
Total	100	23	58	81	22	72	151	426
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.8 Absolute and relative percentage of outer rind retained on the dorsal surface of blade/lets.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Unidirectional	117	37	65	102	27	111	150	507
	60.6 %	74.0 %	64.4 %	67.6 %	79.4 %	73.4 %	66.1 %	67.1 %
Bidirectional opposed	50	10	18	28	3	19	41	141
	25.9 %	20.0 %	17.8 %	18.5 %	8.8 %	12.6 %	18.1 %	18.7 %
Bidirectional crossed	6	1	9	10	0	12	8	36
	3.1 %	2.0 %	8.9 %	6.6 %	0.0 %	8.0 %	3.5 %	4.8 %
Multidirectional	20	2	9	11	4	9	28	72
	10.4 %	4.0 %	8.9 %	7.3 %	11.8 %	6.0 %	12.3 %	9.5 %
Total	193	50	101	151	34	151	227	756
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.9 Absolute and relative frequencies of diagnostic dorsal scar patterns on blade/lets and blade/lets fragments.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
'Cortical'	9	1	6	7	0	5	9	30
	6.8 %	5.0 %	9.7 %	8.5 %	0.0 %	4.6 %	4.8 %	5.7 %
Plain	52	8	24	32	4	16	82	186
	39.4 %	40.0 %	38.7 %	39.0 %	21.1 %	14.7 %	44.1 %	35.2 %
Dihedral	5	0	1	1	1	2	7	16
	3.8 %	0.0 %	1.6 %	1.2 %	5.3 %	1.8 %	3.8 %	3.0 %
Faceted	22	2	1	3	0	0	5	30
	16.7 %	10.0 %	1.6 %	3.7 %	0.0 %	0.0 %	2.7 %	5.7 %
Puncti-form/ Linear	44	9	30	39	14	86	83	266
	33.3 %	45.0 %	48.4 %	47.5 %	73.7 %	78.9 %	44.6 %	50.4 %
Total	132	20	62	82	19	109	186	528
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.10 Absolute and relative frequencies of diagnostic butt types on blade/lets and blade/let fragments.

	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Upper Phase				
N	67	101	101	67
Mean	27.3	10.1	4.0	1.4
Std. Deviation	6.7	3.2	1.8	1.3
Median	27.0	9.6	3.7	1.1
Minimum	16.9	4.1	1.1	0.2
Maximum	45.1	18.2	8.8	5.6
Middle Phase				
N	45	81	81	45
Mean	27.0	9.7	3.7	1.4
Std. Deviation	6.6	2.8	1.7	1.1
Median	26.1	9.5	3.1	1.3
Minimum	15.1	4.5	1.2	0.1
Maximum	40.7	16.8	8.6	3.9
Transitional/Mixed Phase				
N	16	22	22	16
Mean	30.3	9.7	3.3	2.2
Std. Deviation	11.7	5.6	2.1	4.9
Median	29.4	8.1	3.0	1.0
Minimum	18.0	4.7	1.4	0.1
Maximum	66.8	31.0	10.9	20.2
Lower Phase				
N	53	72	72	53
Mean	25.0	8.7	3.0	0.9
Std. Deviation	7.1	2.8	1.2	0.9
Median	24.0	8.1	2.7	0.6
Minimum	13.2	4.6	1.2	0.1
Maximum	43.4	16.6	5.7	4.4
Sector 10				
N	117	158	158	117
Mean	34.0	12.5	4.4	2.7
Std. Deviation	8.2	3.6	1.7	2.5
Median	33.8	12.2	4.2	2.1
Minimum	17.0	5.0	1.3	0.2
Maximum	62.6	25.9	11.4	17.0

Tab. 12.11 Dimensions of blade/lets by Phase.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
None	89	19	26	45	9	41	114	298
	29.9 %	31.7 %	30.6 %	31.0 %	23.7 %	30.6 %	29.4 %	29.7 %
Less than 25 %	70	17	16	33	12	35	115	265
	23.5 %	28.3 %	18.8 %	22.8 %	31.6 %	26.1 %	29.6 %	26.4 %
Between 25-50 %	43	6	15	21	6	22	58	150
	14.4 %	10.0 %	17.7 %	14.5 %	15.8 %	16.4 %	15.0 %	15.0 %
More than 50 %	54	8	13	21	7	16	58	156
	18.1 %	13.3 %	15.3 %	14.5 %	18.4 %	11.9 %	15.0 %	15.6 %
Complete	42	10	15	25	4	20	43	134
	14.1 %	16.7 %	17.7 %	17.2 %	10.5 %	14.9 %	11.3 %	13.4 %
Total	298	60	85	145	38	134	388	1003
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.12 Absolute and relative frequencies of diagnostic dorsal rind* on flakes. * Includes natural exterior surfaces on limestone flakes.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Unidirectional	78	15	33	48	16	49	111	350
	48.4 %	41.7 %	60.0 %	52.7 %	61.5 %	51.6 %	44.2 %	
Bidirectional opposed	17	4	3	7	0	10	24	65
	10.6 %	11.1 %	5.5 %	7.7 %	0.0 %	10.5 %	9.6 %	
Bidirectional crossed	10	2	2	4	1	8	27	54
	6.2 %	5.6 %	3.6 %	4.4 %	3.8 %	8.4 %	10.6 %	
Multidirectional	56	15	17	32	9	28	89	246
	34.8 %	41.7 %	30.9 %	35.2 %	34.6 %	29.5 %	35.5 %	
Total	161	36	55	91	26	95	251	715
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	

Tab. 12.13 Absolute and relative frequencies of diagnostic dorsal scar patterns on flakes.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
'Cortical'*	64	15	17	32	5	27	92	220
	24.8 %	28.9 %	22.1 %	24.8 %	17.2 %	23.5 %	26.4 %	25.0 %
Plain	146	28	36	64	13	49	178	450
	56.6 %	53.9 %	46.8 %	49.6 %	44.8 %	42.6 %	51.2 %	51.1 %
Dihedral	9	4	8	12	5	12	22	60
	3.5 %	7.7 %	10.4 %	9.3 %	17.2 %	10.4 %	6.3 %	6.8 %
Faceted	26	4	10	14	3	10	27	80
	10.1 %	7.7 %	13.0 %	10.9 %	10.3 %	8.7 %	7.7 %	9.1 %
Punctiform/Linear	13	1	6	7	3	17	30	70
	5.0 %	1.9 %	7.8 %	5.4 %	10.3 %	14.8 %	8.6 %	8.0 %
Total	258	52	77	129	29	115	349	880
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.14 Absolute and relative frequencies of diagnostic butts types on flakes. * Includes natural exterior surfaces on limestone flakes.

	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Upper Phase				
N	223	295	298	223
Mean	24.5	21.2	5.1	4.4
Std. Deviation	8.8	7.9	3.2	9.5
Median	22.6	19.9	5.2	2.2
Minimum	12.1	9.3	1.3	0.1
Maximum	77.3	59.1	24.4	105.0
Middle Phase				
N	119	145	145	119
Mean	23.9	19.3	5.8	3.9
Std. Deviation	5.9	6.0	2.6	6.9
Median	22.9	19.3	5.5	2.3
Minimum	12.8	9.3	1.3	0.5
Maximum	52.7	45.1	16.8	64.0
Transitional/Mixed Phase				
N	31	38	38	31
Mean	25.0	20.4	5.4	3.6

Tab. 12.15 Dimensions of flakes.

	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Std. Deviation	7.4	7.4	3.3	4.6
Median	23.1	18.1	4.7	1.9
Minimum	14.0	10.6	1.7	0.6
Maximum	41.4	41.2	15.1	19.9
Lower Phase				
N	117	134	134	117
Mean	24.2	19.6	5.6	3.3
Std. Deviation	6.4	6.7	3.1	4.2
Median	23.1	19.1	4.9	1.9
Minimum	11.4	7.1	1.1	0.3
Maximum	50.8	39.6	19.2	27.0
Sector 10				
N	319	398	398	319
Mean	28.5	22.7	6.7	6.5
Std. Deviation	9.4	8.9	3.5	13.4
Median	26.5	20.7	6.0	3.3
Minimum	11.6	10.1	1.3	0.5
Maximum	74.4	78.4	27.8	159.4

Tab. 12.15 (continued)

	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Upper Phase				
N	14	25	25	14
Mean	27.5	10.6	5.7	1.6
Std. Deviation	7.2	3.8	2.1	1.3
Minimum	17.1	5.6	3.0	0.4
Maximum	37.9	17.9	10.6	4.5
Median	29.0	9.5	5.1	1.0
Middle Phase				
N	8	15	15	8
Mean	30.5	10.1	5.6	2.2
Std. Deviation	4.9	4.2	2.2	2.2
Minimum	24.6	3.9	3.3	0.3
Maximum	37.5	16.8	11.9	7.3
Median	28.9	8.0	5.4	1.6
Transitional/Mixed Phase				
N	1	2	2	1
Mean	41.3	12.0	5.7	4.5
Std. Deviation		2.5	0.6	
Minimum	41.3	10.3	5.2	4.5
Maximum	41.3	13.8	6.1	4.5
Median	41.3	12.0	5.6	4.5
Lower Phase				
N	5	7	7	5
Mean	27.4	8.9	3.9	0.7
Std. Deviation	5.6	1.2	0.9	0.2
Minimum	19.9	7.6	2.6	0.5
Maximum	34.7	10.9	5.5	0.9
Median	26.0	8.6	3.8	0.6

Tab. 12.16 Dimensions of crested pieces.

	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Sector 10				
N	26	35	35	26
Mean	40.0	13.5	7.5	4.2
Std. Deviation	9.4	3.8	2.1	2.4
Minimum	26.2	7.6	3.9	0.8
Maximum	60.8	24.4	12.6	8.3
Median	41.6	13.4	7.2	3.8

Tab. 12.16 (continued)

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Left	4	35	74	109	12	2	20	147
		77.8 %	74.2 %	75.7 %	60.0 %		80.0 %	72.4 %
Right	1	10	25	35	8	7	5	56
		22.2 %	25.3 %	24.3 %	40.0 %		20.0 %	27.6 %
Total	5	47	99	144	20	9	25	203
			100.0 %	100.0 %	100.0 %		100.0 %	100.0 %

Tab. 12.17 Absolute and relative frequencies of diagnostic microburin retouch lateralisation.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Distal	2	35	75	110	7	2	21	148
		77.8 %	75.8 %	76.4 %	35.0 %		84.0 %	72.9 %
Proximal	3	10	24	34	13	7	4	55
		22.2 %	24.2 %	23.6 %	65.0 %		16.0 %	27.1 %
Total	5	45	99	144	20	9	25	203
					100.0 %		100.0 %	100.0 %

Tab. 12.18 Absolute and relative frequencies of diagnostic microburin location.

	Length (mm)	Width (mm)	Thickness (mm)
Upper Phase			
N	5	5	5
Mean	9.4	7.0	2.3
Std. Deviation	3.8	2.4	0.8
Median	7.8	7.2	2.4
Minimum	5.7	3.7	1.2
Maximum	15.3	10.3	3.4
Middle Phase			
N	148	148	148
Mean	18.1	10.7	3.8
Std. Deviation	5.4	3.5	1.3
Median	17.5	10.2	3.6
Minimum	8.1	4.1	1.5
Maximum	32.3	22.6	8.1

Tab. 12.19 Dimensions of microburins.

	Length (mm)	Width (mm)	Thickness (mm)
Transitional/Mixed Phase			
N	20	20	20
Mean	19.9	10.2	3.9
Std. Deviation	6.4	2.7	1.3
Median	18.2	10.0	3.5
Minimum	10.1	6.2	2.1
Maximum	32.9	15.0	6.4
Lower Phase			
N	9	9	9
Mean	11.6	6.9	2.4
Std. Deviation	4.4	1.8	0.8
Median	11.0	6.7	2.1
Minimum	5.5	4.3	1.2
Maximum	18.9	10.0	3.4
Sector 10			
N	25	25	25
Mean	24.6	13.5	5.0
Std. Deviation	7.4	3.4	2.1
Median	23.8	13.6	4.6
Minimum	9.3	7.2	2.0
Maximum	40.5	21.2	10.1

Tab. 12.19 (continued)

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
End-scrapers	13	7	2	9	2	4	33	61
	2.8 %	12.7 %	1.6 %	5.1 %	5.3 %	2.3 %	15.4 %	5.7 %
Perforators	0	0	0	0	0	0	1	1
	-	-	-	-	-	-	0.5 %	0.1 %
Backed flakes and blades	3	0	0	0	0	0	8	11
	0.7 %	-	-	-	-	-	3.7 %	1.0 %
Composite tools	1	0	0	0	0	0	1	2
	0.2 %	-	-	-	-	-	0.5 %	0.2 %
Microlithic and related	199	25	66	91	21	57	105	473
	43.1 %	45.6 %	54.1 %	51.4 %	55.3 %	33.0 %	48.8 %	44.4 %
Microlithic fragments	201	17	42	59	11	91	43	405
	43.5 %	30.9 %	34.4 %	33.3 %	29.0 %	52.6 %	20.0 %	38.0 %
Notches and denticulates	14	1	1	2	2	8	17	43
	3.0 %	1.8 %	0.8 %	1.1 %	5.3 %	4.6 %	7.9 %	4.0 %
Truncations	7	1	2	3	1	5	2	18
	1.5 %	1.8 %	1.6 %	1.7 %	2.6 %	2.9 %	0.9 %	1.7 %
Varia	24	4	9	13	1	8	5	51
	5.2 %	7.3 %	7.4 %	7.3 %	2.6 %	4.6 %	2.3 %	4.8 %
Total	462	55	122	177	38	173	215	1,065
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.20 Absolute and relative frequencies of tool classes.

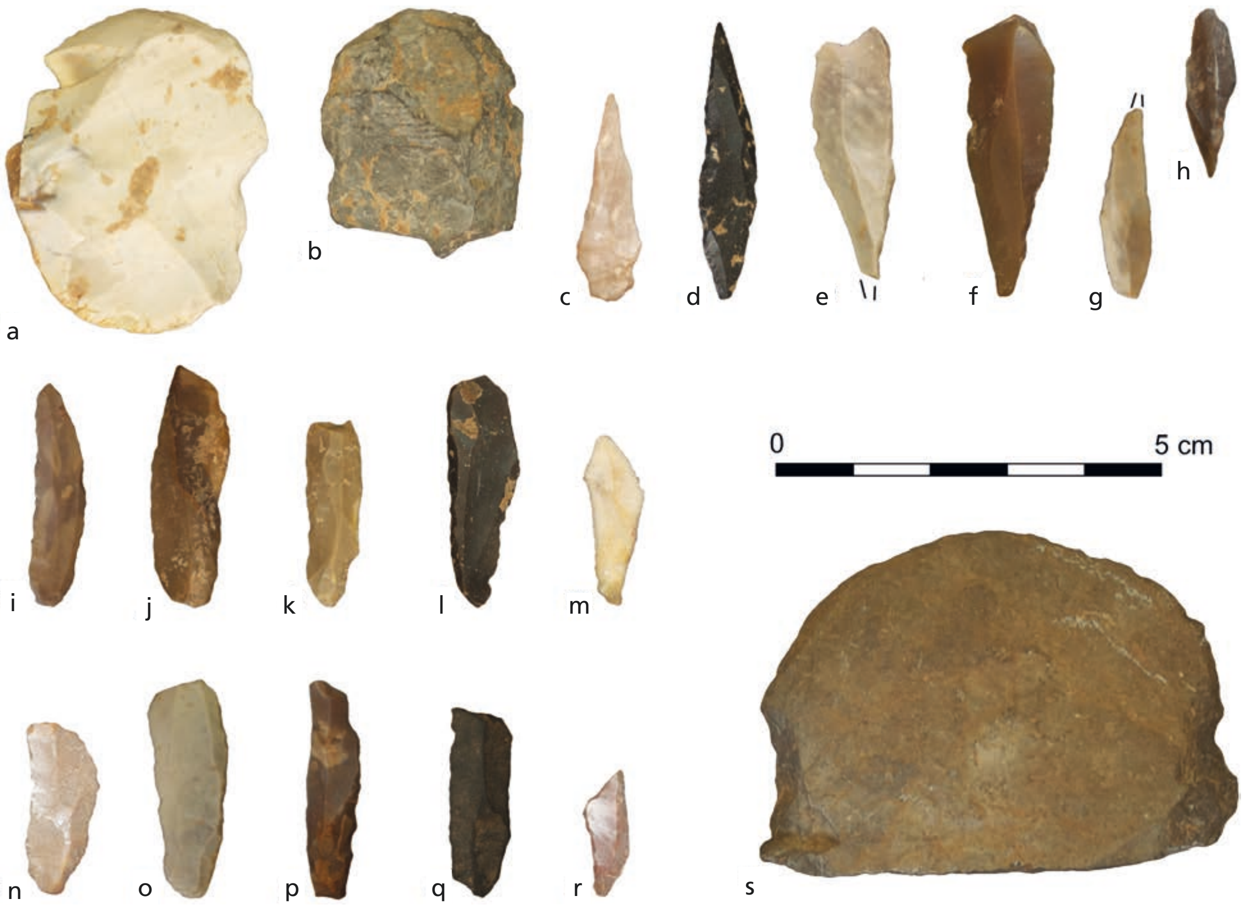

Fig. 12.4 Lower Phase retouched tools: **a** end-scraper on retouched flake; **b** fragment with end-scraper retouch; **c-e** pointed straight-backed bladelets; **f-h** partially backed bladelets with pointed ends; **i** convex-backed bladelet; **j** partially backed bladelet with unmodified end; **k** obtuse-ended backed bladelet; **l-p** Ouchtata bladelets; **q-r** scalene bladelets; **s** large strangulated piece.

Microburins and Related Products

One Krukowski microburin and nine true microburins have been recovered from the Lower Phase. The Krukowski is an accidental by-product of retouch, as opposed to a true microburin which is a deliberate waste product of microlith manufacture. Of the latter, most have been detached from the proximal end of the blank and have the notch on the left side (**tabs 12.17-12.18**). In general, the microburins are relatively restricted in size, indicating that a short section has been removed from relatively narrow, thin blades/lets (**tab. 12.19**).

Retouched Tools (**fig. 12.4**)

The Lower Phase assemblage includes 173 retouched tools. These are dominated by microlithic and related forms, with relatively few other tool-types (**tab. 12.20**).

End-Scrapers

An end-scraper on a flake, an end-scraper on a retouched flake (**fig. 12.4a**), a denticulated end-scraper and a fragment of an end-scraper have been recovered from the Lower Phase. All are made on chert flakes apart

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
16. Drill (*Mèche de foret*)	1	0	0	0	0	0	0	1
	0.5 %	-	-	-	-	-	-	0.2 %
34. Backed flake	2	0	0	0	0	0	0	2
	1.0 %	-	-	-	-	-	-	0.4 %
45. Pointed straight backed bladelet	13	2	0	2	0	8	11	34
	6.5 %	8.0 %	-	2.2 %	-	14.0 %	10.5 %	7.2 %
46. Pointed straight backed bladelet with rounded base	3	0	0	0	0	1	0	4
	1.5 %	-	-	-	-	1.8 %	-	0.9 %
47. Pointed straight backed bladelet with truncated base	9	1	0	1	0	0	13	23
	4.5 %	4.0 %	-	1.1 %	-	-	12.4 %	4.9 %
48. Mechta el-Arbi point	0	0	0	0	0	0	1	1
	-	-	-	-	-	-	1.0 %	0.2 %
51. Pointed straight backed bladelet with retouched base	1	0	0	0	0	0	1	2
	0.5 %	-	-	-	-	-	1.0 %	0.4 %
52. *Aïn Kéda* point	4	0	0	0	0	0	1	5
	2.0 %	-	-	-	-	-	1.0 %	1.1 %
55. Bladelet with convex backed end	4	0	0	0	0	2	1	7
	2.0 %	-	-	-	-	3.5 %	1.0 %	1.5 %
56. Convex backed blade-let								
a. typical	50	6	11	17	1	3	24	95
	25.1 %	24.0 %	16.7 %	18.7 %	4.8 %	5.3 %	22.9 %	20.1 %
b. tending towards seg-ment	44	2	11	13	1	0	13	71
	22.1 %	8.0 %	16.7 %	14.3 %	4.8 %	-	12.4 %	15.0 %
57. Convex backed blade-let with rounded base	2	0	2	2	0	2	4	10
	1.0 %	-	3.0 %	2.2 %	-	3.5 %	3.8	2.1 %
58. Convex backed blade-let with truncated base	26	2	5	7	1	0	22	56
	13.1 %	8.0 %	7.6 %	7.7 %	4.8 %	-	21.0 %	11.8 %
59. Convex backed blade-let with retouched base	4	1	1	2	0	0	1	7
	2.0 %	4.0 %	1.5 %	2.2 %	-	-	1.0 %	1.5 %
60. Backed bladelet with gibbosity	1	0	1	1	0	0	0	2
	0.5 %	-	1.5 %	1.1 %	-	-	-	0.4 %
61. Backed bladelet with narrowed base	5	0	0	0	0	0	2	7
	2.5 %	-	-	-	-	-	1.9 %	1.5 %
62. *La Mouillah* point	0	4	22	26	2	0	2	30
	-	16.0 %	33.3 %	28.6 %	9.5 %	-	1.9 %	6.3 %

Tab. 12.21 Absolute and relative frequencies of microlithic and related types.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
63. Partially backed bladelet								
a. with pointed end	0	0	2	2	0	6	0	8
	-	-	3.0 %	2.2 %	-	10.5 %	-	1.9 %
b. with unmodified end(s)	0	1	0	1	1	2	2	6
	-	4.0 %	-	1.1 %	4.8 %	3.5 %	1.9 %	1.3 %
64. Shouldered bladelet	0	0	0	0	0	1	0	1
	-	-	-	-	-	1.8 %	-	0.2 %
65. Shouldered point	0	0	1	1	0	0		1
	-	-	1.5 %	1.1 %	-	-		0.2 %
67. Obtuse backed bladelet	1	0	2	2	4	7		14
	0.5 %	-	3.0 %	2.2 %	19.1 %	12.3 %		3.0 %
68. Scalene bladelet	1	2	1	3	1	5		10
	0.5 %	8.0 %	1.5 %	3.3 %	4.8 %	8.8 %		2.7 %
69. Pointed bladelet with Ouchtata retouch	6	0	0	0	0	2	0	8
	3.0 %	-	-	-	-	3.5 %	-	1.7 %
70. Ouchtata bladelet								
a. retouched along entire lateral margin	1	0	1	1	6	9	0	17
	0.5 %	-	1.5 %	1.1 %	28.6 %	15.8 %	-	3.6 %
b. retouched on proximal portion of one edge	0	0	2	2	3	5	1	11
	-	-	3.0 %	2.2 %	14.3 %	8.8 %	1.0 %	2.3 %
71. Bladelet with Ouchtata retouch	5	0	3	3	1	1	1	11
	2.5 %	-	4.6 %	3.3 %	4.8 %	1.8 %	1.0 %	2.3 %
82. Segment or semi-circle	10	3	0	3	0	0	1	14
	5.0 %	12.0 %	-	3.3 %	-	-	1.0 %	3.0 %
89. Isosceles or equilateral triangle	2	1	0	1	0	0	0	3
	1.0 %	4.0 %	-	1.1 %	-	-	-	0.6 %
90. Scalene triangle	3	0	0	0	0	1	0	4
	1.5 %	-	-	-	-	1.8 %	-	0.9 %
95. Elongated scalene triangle with short truncation	0	0	0	0	0	0	1	1
	-	-	-	-	-	-	1.0 %	0.2 %
97. Elongated scalene triangle with concave short truncations	0	0	0	0	0	0	1	1
	-	-	-	-	-	-	1.0 %	0.2 %
112. *Varia*	1	0	1	1	0	1	0	3
	0.5 %	-	1.5 %	1.1 %	-	1.8 %	-	0.6 %
Total	199	25	66	91	21	57	105	473
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.21 (continued)

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Continuous	196	24	64	88	16	39	102	442
	98.5 %	96.0 %	97.0 %	96.7 %	76.2 %	68.4 %	97.2 %	93.3 %
Partial	3	1	2	3	5	18	3	32
	1.5 %	4.0 %	3.0 %	3.3 %	23.8 %	31.6 %	2.8 %	6.8 %
Distal	2	0	0	0	0	6	0	8
Mesial	0	1	0	1	1	0	0	2
Proximal	1	0	2	2	4	12	3	22
Total	199	25	66	91	21	57	105	474
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.22 Absolute and relative frequencies of retouch distribution on microlithic and related types.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Left	109	19	49	68	7	21	56	261
	61.9 %	76.0 %	81.7 %	80.0 %	33.3 %	36.8 %	57.1 %	59.7 %
Right	66	6	11	17	14	36	42	175
	37.5 %	24.0 %	18.3 %	20.0 %	66.7 %	63.2 %	42.9 %	40.1 %
Both	1	0	0	0	0	0	0	1
	0.6 %	-	-	-	-	-	-	0.2 %
Total	176	25	60	85	21	57	98	427
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.23 Absolute and relative frequencies of diagnostic retouch lateralisation on microlithic and related types.

from the last that is on a limestone flake. A couple have been retouched distally (including one with retouch extending down the right edge), one has been retouched at the proximal end, and one has been retouched at an indeterminate end. Excluding the fragment, the medium size is 31.2 × 29.5 × 8.7 mm.

Microlithic and Related Forms

This category is prolific, only exceeded in number by microlithic fragments. A diverse range of microlithic types has been identified and the assemblage is largely distinct from those found in the later Phases in the dominant forms recorded (**tab. 12.21**).

The most frequent type is the Ouchtata bladelet (type 70) in which the butt is retained. Ouchtata bladelets (**fig. 12.4l-p**) with retouch along the entire lateral margin (subtype 70a) are almost twice as common as those with only partial retouch (subtype 70b). The former are morphologically similar, differing only in the extent of retouch, to the obtuse-ended backed bladelets (type 67), which also occur in relatively high proportions in the Lower Phase.

Pointed straight-backed bladelets (types 45-52) also make up a relatively strong proportion of the tools (**fig. 12.4c-e**). Most have been classified as pointed straight-backed bladelets *sensu stricto* (type 45). A few of this type have marginal retouch along one edge that becomes more intensive towards the tip producing a tapered outline. These tapering forms are largely similar to the partially backed bladelets with a pointed end (type 63a), differing only in the extent of retouch along the edge. Partially backed bladelets with pointed ends (**fig. 12.4f-h**) also account for a relatively high proportion of microlithic types from the Lower Phase.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Ouchtata	12	0	3	3	8	17	2	42
	6.0 %	-	4.6 %	3.3 %	38.1 %	29.8 %	1.9 %	8.9 %
Direct	114	19	53	72	10	38	62	296
	57.3 %	76.0 %	80.3 %	79.1 %	47.6 %	66.7 %	59.1 %	62.6 %
Inverse	1	0	0	0	0	0	1	2
	0.5 %	-	-	-	-	-	1.0 %	0.4 %
Direct/crossed	30	3	3	6	2	1	22	61
	15.1 %	12.0 %	4.6 %	6.6 %	9.5 %	1.8 %	21.0 %	12.9 %
Inverse/crossed	0	1	0	1	1	0	0	2
	-	4.0 %	-	1.1 %	4.8 %	-	-	0.4 %
Crossed	37	2	6	8	0	1	18	64
	18.6 %	8.0 %	9.1 %	8.8 %	-	1.8 %	17.1 %	13.5 %
Alternating	5	0	1	1	0	0	0	6
	2.5 %	-	1.5 %	1.1 %	-	-	-	1.3 %
Total	199	25	66	91	21	57	105	473
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.24 Absolute and relative frequencies of diagnostic retouch type on microlithic and related types.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
None	4	0	5	5	15	25	3	50
	2.0 %	-	7.6 %	5.5 %	71.4 %	40.3 %	2.9 %	10.6 %
Single	126	19	47	66	5	31	86	314
	63.3 %	76.0 %	71.2 %	72.5 %	23.8 %	54.4 %	81.9 %	66.4 %
Distal	89	18	36	54	3	23	65	234
Proximal	22	1	7	8	2	8	15	55
Intermediate	15	0	4	4	0	0	6	25
Double	69	6	14	20	1	3	16	109
	34.7 %	24.0 %	21.2 %	22.0 %	4.8 %	5.3 %	15.2 %	23.0 %
Total	199	25	66	91	21	57	105	473
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	

Tab. 12.25 Absolute and relative frequencies of points on microlithic and related types.

	Length (mm)	Width (mm)	Thickness (mm)
Upper Phase			
N	78	199	199
Mean	21.5	7.1	3.4
Std. Deviation	5.3	1.6	1.0
Median	20.9	7.0	3.3
Minimum	11.7	3.5	1.4
Maximum	41.2	12.3	7.2
Middle Phase			
N	39	91	91
Mean	22.2	6.6	3.5
Std. Deviation	3.8	1.1	0.9

Tab. 12.26 Dimensions of microlithic and related types.

	Length (mm)	Width (mm)	Thickness (mm)
Median	21.6	6.5	3.3
Minimum	16.3	4.6	1.4
Maximum	31.3	9.6	6.0
Transitional/Mixed Phase			
N	9	21	21
Mean	29.3	8.2	3.2
Std. Deviation	5.9	2.2	1.3
Median	30.8	7.7	2.8
Minimum	19.9	5.8	1.8
Maximum	38.7	15.8	6.9
Lower Phase			
N	38	57	57
Mean	26.6	8.5	3.0
Std. Deviation	5.4	2.2	0.9
Median	27.0	8.1	3.0
Minimum	14.8	4.8	1.3
Maximum	39.5	14.4	5.6
Sector 10			
N	48	105	105
Mean	25.9	7.1	3.5
Std. Deviation	5.4	1.4	1.0
Median	25.2	6.8	3.5
Minimum	16.4	4.5	1.8
Maximum	40.4	13.2	6.5

Tab. 12.26 (continued)

Scalene microliths (type 68) are relatively well-represented compared to the later Phases (**fig. 12.4q-r**). A relatively irregular-shaped scalene triangle (type 90) was also recovered from the Lower Phase. Beyond this irregular scalene triangle, no other 'geometrics' have been recorded in the Lower Phase.

One of the most notable features is that convex-backed bladelets *sensu lato* (types 56-59) make up only a relatively small proportion of the assemblage from the Lower Phase (**fig. 12.4i**). None of the other microlithic forms is well represented.

Most of the microlithic and related forms are retouched along the entirety of one edge, although a relatively high proportion are only partially retouched (**tab. 12.22**). Just less than two thirds are retouched along the right edge (**tab. 12.23**). The majority have been modified by direct semi-abrupt/abrupt retouch, but a relatively high proportion have been modified by marginal (so-called Ouchtata) retouch (**tab. 12.24**). A notable proportion have not been modified to form a point(s) and instead retain the butt and distal termination (**tab. 12.25**). Overall, the microliths and backed blade/lets are significantly longer and wider, yet thinner, than in both the Middle and Upper Phases (**tab. 12.26**).

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Left	89	8	24	32	2	22	16	161
	61.4 %	61.5 %	64.9 %	64.0 %	22.2 %	26.5 %	53.3 %	50.8 %
Right	56	5	13	18	7	61	13	155
	38.6 %	38.5 %	35.1 %	36.0 %	77.8 %	73.5 %	43.3 %	48.9 %
Both	0	0	0	0	0	0	1	1
	-	-	-	-	-	-	3.3 %	0.3 %
Total	145	13	37	50	9	83	30	317
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.27 Absolute and relative frequencies of diagnostic retouch lateralisation on microlithic fragments.

Microlithic Fragments

Microlithic fragments are the most common retouched tools in the Lower Phase. As with the classifiable microlithic forms, the overwhelming majority are retouched along the right edge (**tab. 12.27**) and have been modified by marginal (so-called Ouchtata) or direct semi-abrupt/abrupt retouch (**tab. 12.28**). A relatively high proportion, just over a quarter, retain the butt (**tab. 12.29**). It does not appear that they were deliberately segmented.

Notches and Denticulates

Five notched blades/lets, a notched flake, a notched or denticulated piece with additional retouch, and a large strangulated or notched piece (**fig. 12.4s**) have been recovered from the Lower Phase. Only one is complete, with one being a fragment and the others broken laterally. Some might have broken as a result of manufacturing failures and microburin mishits. The objects in this class are retouched along the right edge in half the cases, the left edge in one instance, both lateral margins in two cases, and at the distal end in one case. These tools are quite varied in size, the largest measures 38.1 × 17.0 × 4.6 mm. The laterally

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Ouchtata	4	2	2	4	4	45	6	63
	2.0 %	11.8 %	4.9 %	6.9 %	36.4 %	49.5 %	13.6 %	15.8 %
Direct	127	13	33	46	6	44	28	251
	64.5 %	76.5 %	80.5 %	79.3 %	54.6 %	48.6 %	65.1 %	62.8 %
Inverse	4	0	0	0	0	1	0	5
	2.0 %	-	-	-	-	1.1 %	-	1.3 %
Direct/crossed	12	0	2	2	1	0	1	16
	6.1 %	-	4.9 %	3.5 %	9.1 %	-	2.3 %	4.0 %
Inverse/crossed	0	0	0	0	0	0	0	0
	-	-	-	-	-	-	-	-
Crossed	44	2	4	6	0	1	6	57
	22.3 %	11.8 %	9.8 %	10.3 %	-	1.1 %	14.0 %	14.3 %
Alternating	6	0	0	0	0	0	2	8
	3.1 %	-	-	-	-	-	4.7 %	2.0 %
Total	197	17	41	58	11	91	43	400
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.28 Absolute and relative frequencies of diagnostic retouch types on microlithic fragments.

	Upper Phase	Middle Phase			Transitional/ Mixed Phase	Lower Phase	Sector 10	Total
		GS	YS	Total				
Yes	25	1	8	9	1	24	3	62
	12.4 %	5.9 %	19.1 %	15.3 %	9.1 %	26.4 %	7.0 %	15.3 %
No	176	16	34	50	10	67	40	343
	87.6 %	94.1 %	80.9 %	84.8 %	90.9 %	73.6 %	93.0 %	84.7 %
Total	201	17	42	59	11	91	43	405
	100.0 %			100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Tab. 12.29 Absolute and relative frequencies of microlithic fragments retaining the butt.

broken examples have widths of 7.4-62.6 mm and thicknesses of 2.5-17.1 mm. One of these is a distinctive strangulated or notched piece made on limestone, measuring ≥44.4 × 62.6 × 17.1 mm.

Truncations

There are five truncations. Each is made of chert, retouched distally, and broken. Most appear to have been made on small bladelets, but one is more substantial and may have originally been part of a larger blade *sensu stricto*. The latter has additional inverse Ouchtata retouch along the left edge. The sizes ranged for width between 7.8-16.0 mm and thickness 2.2-4.2 mm.

Varia

This group consist of eight non-standardised retouched pieces all made of chert. There are three made on blades, a couple on flakes, one made on a core-trimming element and a couple on indeterminate debitage. The four unbroken tools range in length from 23.6-46.5 mm, in width from 7.3-20.1 mm and in thickness from 2.7-6.4 mm.

Transitional / Mixed Phase

The Transitional/Mixed Phase is a relatively small assemblage. It consists of 511 lithic artefacts, of which 56.2 % are undiagnostic knapping debris. Most of the classifiable assemblage is made up of small flakes and flakes (50.0 %), but also contains blade/lets (20.1 %), low proportions of cores (2.7 %) and core-trimming elements (1.3 %), high numbers of microburin products (8.9 %) and moderate numbers of tools (17.0 %). Overall, the assemblage is most like the Lower Phase, although the relative proliferation of microburin products and presence of *La Mouillah* points would be more consistent with the Middle Phase (**tab. 12.3**). The productivity in artefact numbers is 310 in the Transitional/Mixed Phase, a relatively similar metric (showing only about a 20 % increase) to that identified in the Lower Phase (**tab. 12.4**; see table caption for a full explanation of this productivity metric).

Cores

There are only six cores: a single platform flake core, two opposed platform flake cores, a tested nodule, and a couple of core fragments (**fig. 12.5a-b**). Each is made of chert. Five retain rind on their exteriors. Median size values are given in **table 12.7**.

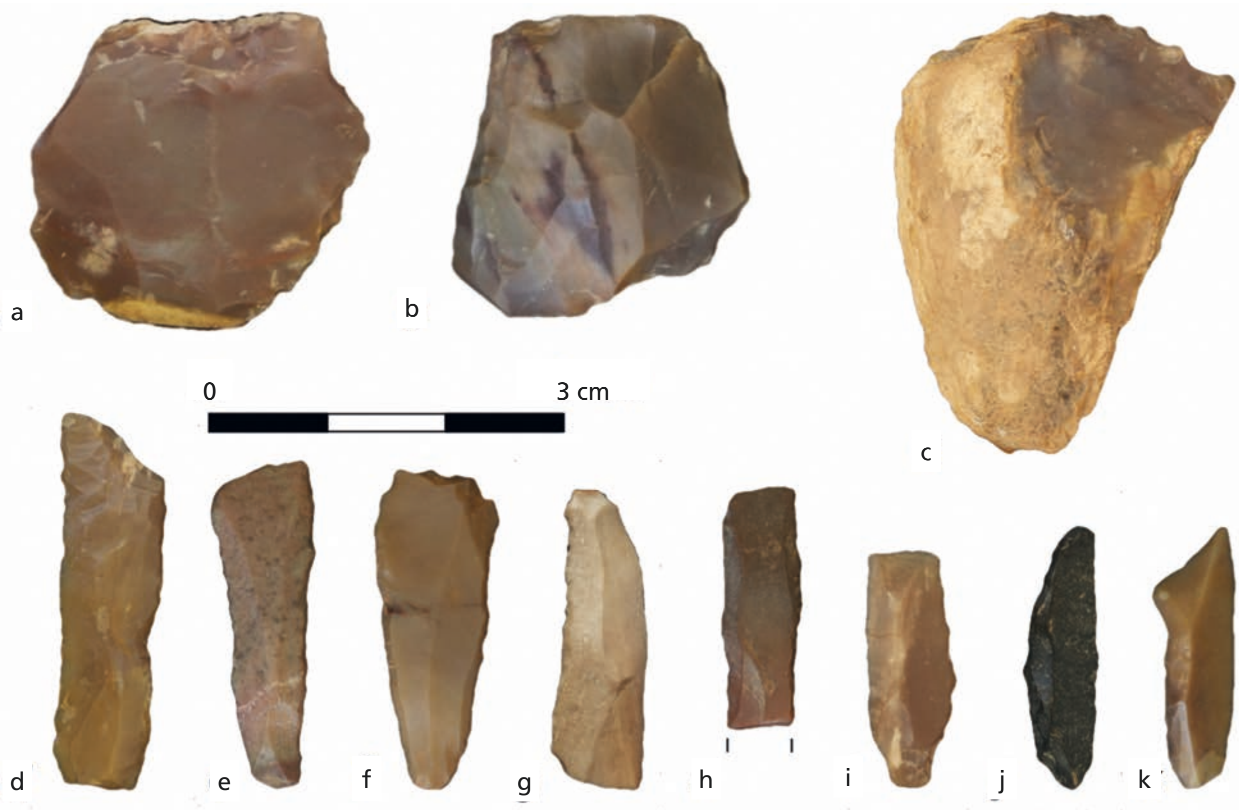

Fig. 12.5 Transitional/Mixed Phase debitage and retouched tools: **a** single platform core; **b** opposed platform core; **c** denticulated end-scraper; **d-f** obtuse-ended backed bladelets; **g-i** Ouchtata bladelets; **j** convex-backed bladelet; **k** *La Mouillah* point.

Debitage

In total, 45 blade/lets including fragments have been recovered (**tab. 12.3**). The blade/lets closely resemble those from the Lower Phase. All are made on chert, generally lacking rind (**tab. 12.8**), most frequently with unidirectional dorsal scars (**tab. 12.9**) and with small punctiform/linear butts (**tab. 12.10**). One is a blade *sensu stricto*, but the others are all bladelet-sized (**tab. 12.11**).

Of the 112 small flakes and flakes, most are made of chert, with only three made of limestone. The majority of the whole flakes (n=38) retain outer rind (**tab. 12.12**), have unidirectional dorsal scars (**tab. 12.13**) and plain butts (**tab. 12.14**). The median size values are presented in **table 12.15**.

The core-trimming elements recovered include a couple of primary crests with a single prepared versant and a platform rejuvenation flake. One of the crested pieces is unbroken and measures 41.3 × 10.3 × 6.1 mm (**tab. 12.16**).

Microburins and Related Products

Twenty true microburins, accounting for a relatively high proportion of the diagnostic artefacts, have been recovered from the Transitional/Mixed Phase. The majority of microburins are proximal examples with the notch on the left side (**tabs 12.17-12.18**). They are generally substantial in size, with a relatively long section of the blank having been removed using the microburin technique (**tab. 12.19**). In general, the morphology and size of the microburins are broadly consistent with those from the Middle Phase.

Retouched Tools

The Transitional/Mixed Phase comprises only 38 tools, but at a similar relative frequency to that observed in the Lower Phase. The retouched tools are dominated by microlithic and related forms (55.3 %) and fragments (29.0 %). The other tool classes occur infrequently (**tab. 12.20**).

End-Scrapers

Only two end-scrapers have been recovered: an end-scraper on a flake (36.4 × 35.7 × 15.2 mm) and a denticulated end-scraper (37.2 × 30.3 × 10.2 mm) (**fig. 12.5c**). Both are made on chert flakes and retouched distally.

Microlithic and Related Forms

This tool class (**fig. 12.5d-l**) consists of 21 tools, accounting for 55.3 % of the tool assemblage. There is a diversity of microlithic or related types (**tab. 12.21**). As is the case in the Lower Phase, the most frequent objects are Ouchtata bladelets (type 70). Often these have retouch along the entire lateral margin (subtype 70a) and they are twice as common as those retouched towards the butt (subtype 70b). The obtuse-ended backed bladelets (type 67) also occur in relatively high proportions in this Phase.

The convex-backed bladelets *sensu lato* (types 56-58) are slightly more common than in the underlying units but, nevertheless, are relatively infrequent in comparison to the later Phases. *La Mouillah* points (type 62) make up a relatively high proportion of the microliths and are found only elsewhere in substantial numbers in the Middle Phase. This point type, illustrated in **figure 12.6**, often shows abrupt backing down one edge with a microburin facet at the distal end. Other microlithic types are uncommon in this Phase.

Like the Lower Phase, most microlithic and related forms are retouched along the entirety of one edge, although partially retouched forms are still relatively common (**tab. 12.22**). Most are retouched along the right edge (**tab. 12.23**), and are typically modified by marginal (so-called Ouchtata) or direct semi-abrupt/abrupt retouch (**tab. 12.24**). Many have retained an unmodified distal termination (**tab. 12.25**). The median dimensions are most like those of the Lower Phase (**tab. 12.26**).

Microlithic Fragments

This is the largest category after classifiable microlithic types, accounting for 29.0 % of the tool assemblage. Most fragments are retouched along the right edge (**tab. 12.27**) and have been modified by Ouchtata or direct semi-abrupt/abrupt retouch (**tab. 12.28**). There are relatively few retaining the butt (**tab. 12.29**).

Notches and Denticulates

This class includes only two tools: a mesial fragment with the remnants of a retouched notch at the left margin (type 74) and a fragment with a single-blow notch at the left edge and additional inverse retouch along the right lateral margin (type 79).

Truncations

There is one bladelet, with an irregular, slightly oblique, truncation removing the distal end (type 80). It measures 31.4 × 11.8 × 1.6 mm.

Varia

A single tool has been assigned to this tool class. It is on an unusually thick blank with abrupt preparation forming a 'retouched' margin (cf. type 55). It measures 52.1 × 8.4 × 8.8 mm.

Middle Phase

The Middle Phase consists of 2891 lithic artefacts, of which 59.6 % are unclassifiable knapping debris. An internal breakdown of the assemblage into the YS (Y1) and GS (G100-G97) components shows that that there are increasing frequencies of indeterminate knapping debris associated with the GS units. Nevertheless, there is little difference across the important YS/GS boundary in the frequencies of the diagnostic artefact classes. Overall, the assemblage is dominated by small flakes and flakes (49.0 %), relatively moderate numbers of blade/lets (16.3 %), high proportions of cores (4.2 %) and core-trimming elements (2.4 %), numerous microburin products (12.9 %) and relatively low frequencies of retouched tools (14.2 %) (**tab. 12.3**). The average productivity in total artefact numbers is 2201 in the Middle Phase, although an internal breakdown of these figures highlights differences between the YS and GS components (**tab. 12.4**; see table caption for a full explanation of this productivity metric): there is notably higher productivity in the basal GS units (10892) than in the YS units (642) associated with the Middle Phase. An important point here is that the increase in unclassifiable knapping debris across the YS/GS boundary is a real effect and not simply caused by pieces being rendered unclassifiable by burning. Thus, at least in S8, the GS starts with greater concentrations of knapping debris.

Beyond the differences in artefact productivity and the numbers of classifiable objects, few differences are observable in the lithic technology of the subdivided YS and GS Middle Phase assemblages. As such, in the following the overall characteristics of the Middle Phase are described and only where relevant are internal differences between YS and GS components highlighted.

Cores

In the Middle Phase, single platform cores are prevalent and opposed platform cores are the second most common (**figs 12.7-12.8**). There are a relatively high proportion of multidirectional cores and a discoidal core. A small number of cores-on-flake has also been recorded for the first time in this Phase. Discarded tested nodules suitable for further working are observed in similar frequencies to those in the Lower Phase. A few core fragments are also recorded (**tab. 12.5**).

All of the cores are made of chert. Around a fifth of cores and core fragments are entirely 'decorticated' (in contrast to the typical retention of some outer surface rind in the Lower Phase). Just over half the cores have recognisable flake removals, although blade/let removals are also observed in significant numbers (**tab. 12.6**). Many of flake cores are heavily reduced and might once have been blade/let cores where the negative scars have subsequently been obliterated. Overall, the length, width and thickness values of the cores are not significantly different from the other Phases (**tab. 12.7**). However, looking at the weight statistics there is an observable trend showing a steady decrease in mean core weights up the whole sequence which might reflect an increasingly economic use of raw material, reaching its peak in the upper GS (**tab. 12.7**).

Debitage

In total, 190 blade/lets including fragments have been recovered from the Middle Phase, which accounts for a moderate proportion of the assemblage (**tab. 12.3**). All the blade/lets are made of chert and the majority have no outer rind, although there is a slight increase in the proportion retaining outer rind compared to

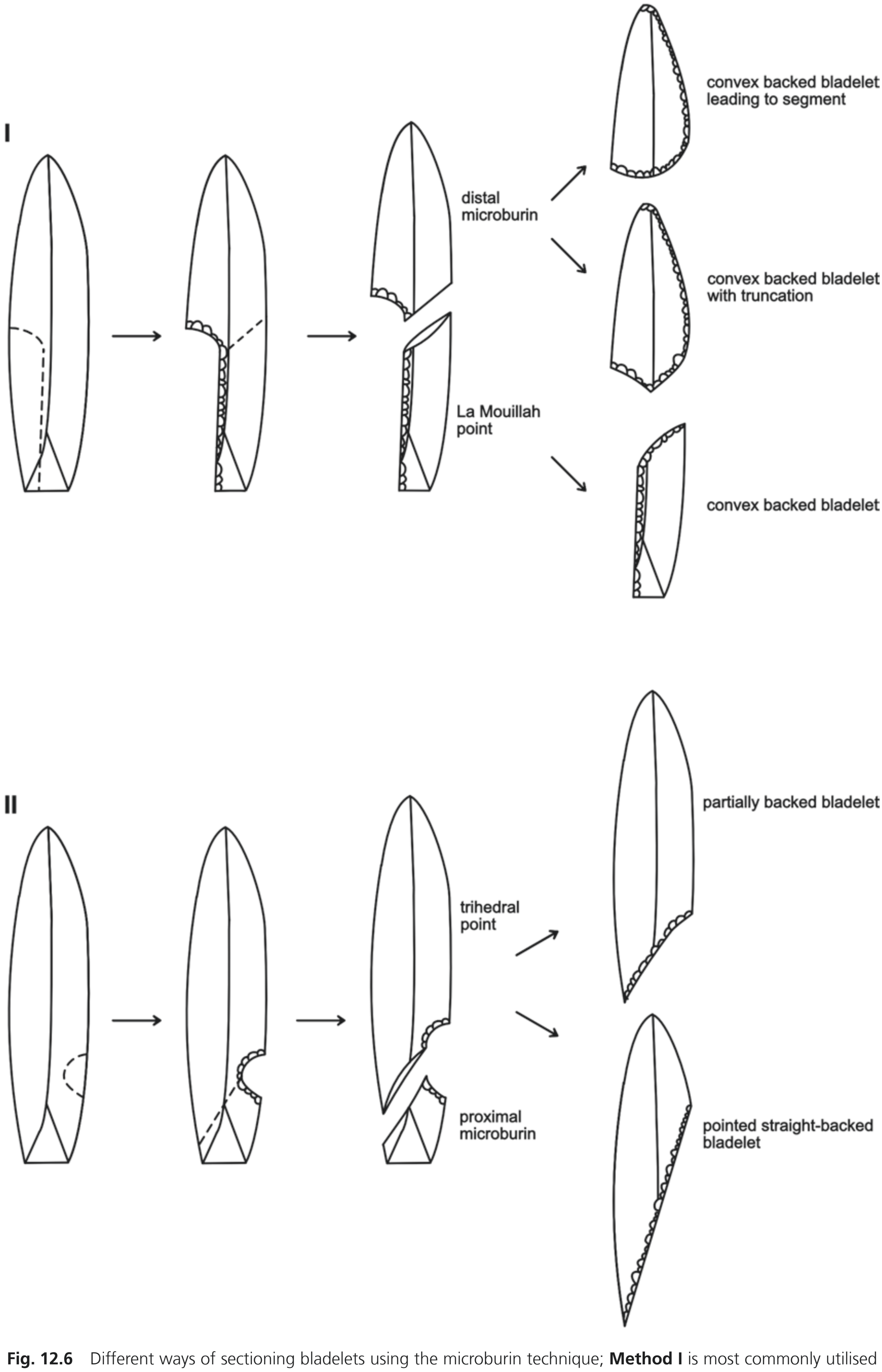

Fig. 12.6 Different ways of sectioning bladelets using the microburin technique; **Method I** is most commonly utilised for the manufacture of *La Mouillah* points (type 62) and subsequent retouch into convex backed bladelets (types 56-59) in the Upper and Middle Phases; **Method II** is thought to be more commonly associated with the manufacture of pointed straight-backed bladelets (type 45) and pointed partially backed bladelets (type 63a) in the Lower Phase.

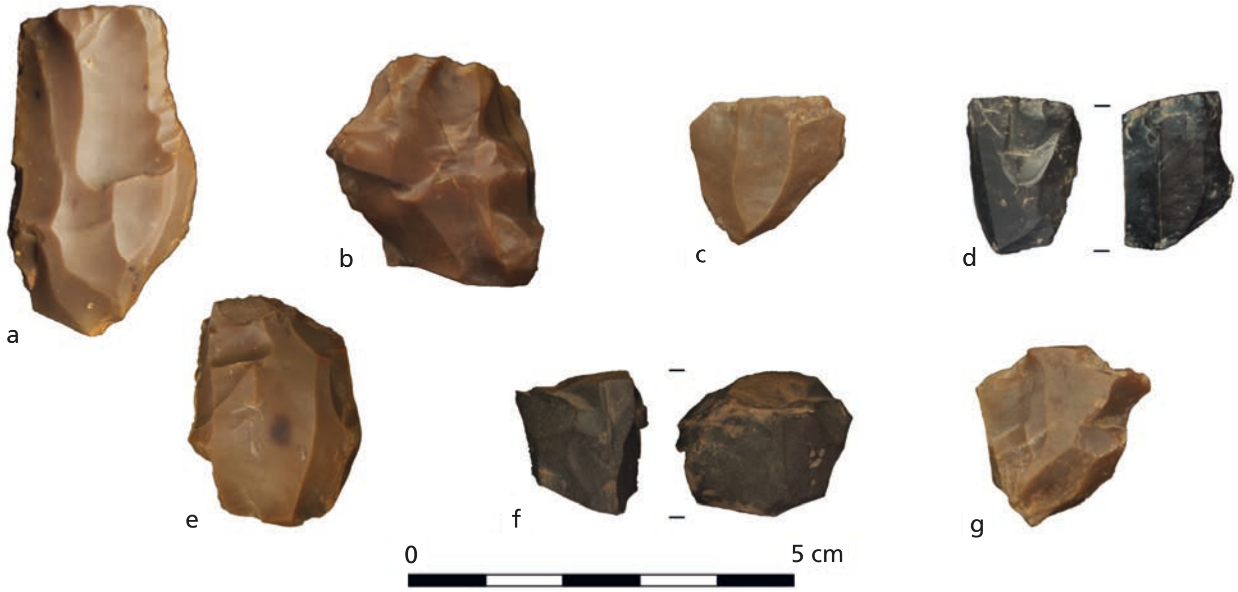

Fig. 12.7 Middle Phase Grey Series cores: **a-d** single platform cores; **e** opposed platform core; **f-g** multiple platform cores.

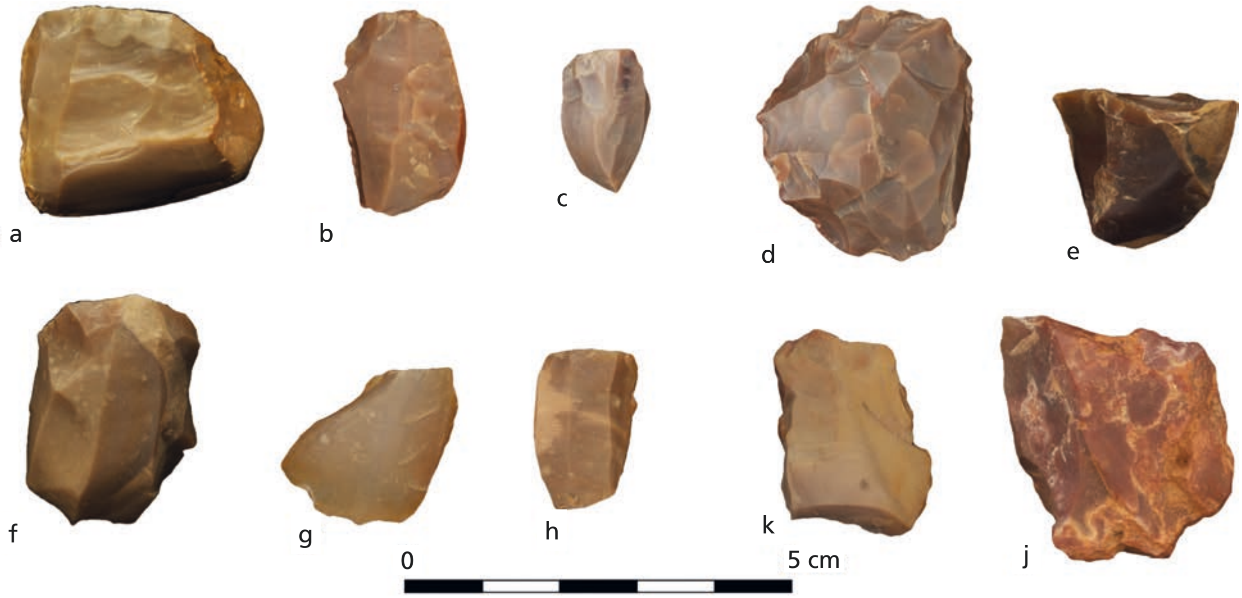

Fig. 12.8 Middle Phase Yellow Series cores: **a-c** single platform cores; **d** discoidal core; **e** multiplatform core; **f-h** opposed platform cores; **j** core-on-flake; **k** splintered piece.

the earlier levels (**tab. 12.8**). Most have unidirectional dorsal scars, although there is a small, yet significant, increase in the proportion with bidirectional opposed dorsal scars (**tab. 12.9**). Those with punctiform/linear butts are most frequent; however, there are twice as many with plain butts compared to the underlying levels (**tab. 12.10**). There are no blades *sensu stricto*, with all these pieces being bladelet-sized. On average the blade/lets are relatively wide and thick compared to the Lower Phase (**tab. 12.11**).
In total, 571 small flakes and flakes have also been recovered. Most are made of chert (95.7 %), with a smaller frequency made of limestone (4.4 %). All whole flakes have been selected for further attribute analysis (n = 145). The flakes closely resemble those from the other Phases, generally retaining outer rind (**tab. 12.12**). Those with unidirectional dorsal scars are dominant, multidirectional scars also being com-

mon amongst the 'decorticated' flakes (**tab. 12.13**), and many have plain or 'cortical' butts (**tab. 12.14**). Overall, the average size of flakes is not significantly different from that in each of the other Phases (**tab. 12.15**).

Twenty-eight core-trimming elements were recovered, twice the frequency found in the Lower Phase (**tab. 12.3**). All are made of chert. Most are crested pieces, including ten primary first removals with one prepared versant, four first removals with both versants prepared, one secondary removal and seven fragments. The median dimensions are 28.9 × 8.0 × 5.4 mm (**tab. 12.16**). There are also two platform rejuvenators or core tablets. One is complete and measures 16.0 × 18.9 × 4.3 mm. There are also four *flancs de nucléus* with median dimensions of length, width, and thickness, respectively, of 28.5 mm (range 15.7-35.8 mm), 21.7 mm (range 20.2-29.5 mm) and 9.0 mm (range 5.0-11.3 mm).

Microburins and Related Products

A total of 148 true microburins, one trihedral point (bladelet fragment with a microburin facet) and one Krukowski microburin have been recovered. Of the true microburins, the majority are distal examples notched on the left side (**tabs 12.17-12.18**). This contrasts with the Transitional/Mixed and Lower Phases where the microburins are generally proximal examples with the notch of the left side.

Retouched Tools

End-Scrapers

This class (**figs 12.9-12.10**) comprises nine tools: four single end-scrapers on flakes, two denticulated end-scrapers, a double end-scraper, an end-scraper on a retouched flake and a fragment of an end-scraper. Each was made on a chert flake. Most are retouched distally (including one with retouch extending down the right edge), with only one retouched at the proximal end (which also has retouch extending down the right edge) and one retouched at both ends. Excluding the fragment, the median size is 30.9 × 25.4 × 9.9 mm.

Microlithic and Related Forms

This tool class (**figs 12.9-12.10**) is the most prolific. It consists of 91 microlithic and related forms, accounting for 51.7 % of the tool assemblage. There is a diversity of types representing a clear departure from the Transitional/Mixed and Lower Phases (**tab. 12.21**).

The most common types, accounting for just less than half of this category, are convex-backed bladelets *sensu lato* (types 56-59). There are broadly similar proportions of typical convex-backed bladelets (subtype 56a) and those tending towards segments (subtype 56b). Each of the convex-backed bladelet *sensu lato* subtypes have been found in smaller frequencies, although convex-backed bladelets with truncated bases (type 58) make up a relatively strong proportion.

One of the most distinctive features is the presence and relatively high proportions of *La Mouillah* points (type 62) (**fig. 12.6**), which account for a third of the microlithic forms from the Middle Phase (**fig. 12.10m-s**). In contrast, this form is absent in both the Upper and Lower Phases.

None of the other microlith forms is particularly well represented in the Middle Phase (**tab. 12.21**).

The microlithic forms in the Middle Phase are overwhelmingly retouched on the entirety of one lateral margin (96.7 %; **tabs 12.22-12.23**), which is usually the left edge (**tab. 12.23**). This is in contrast to the

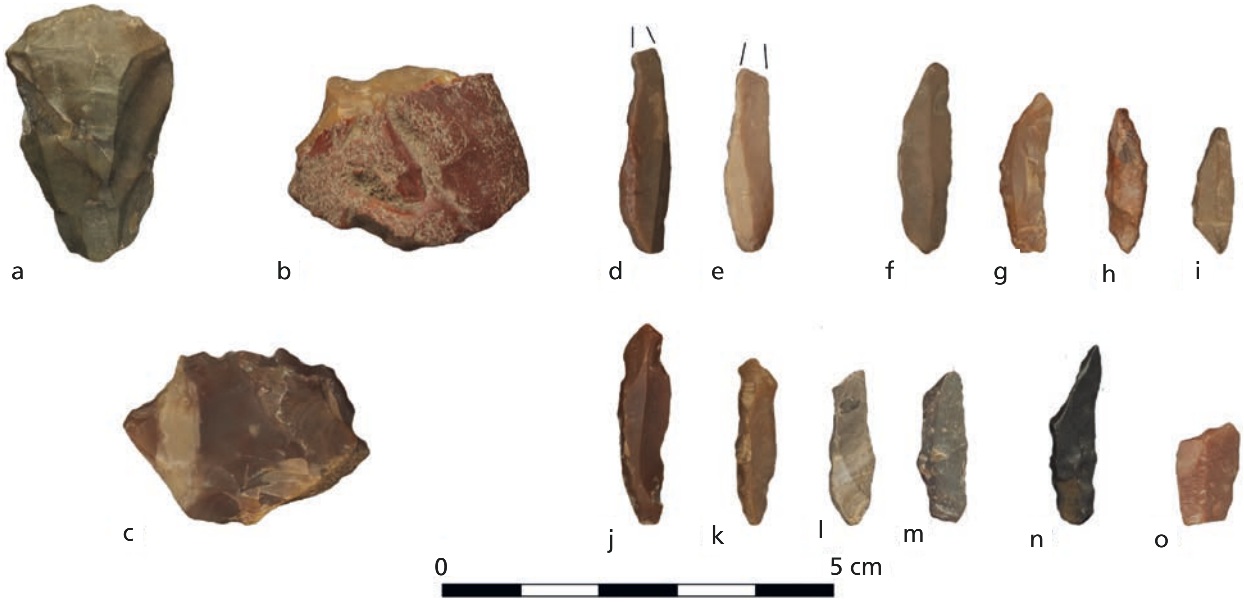

Fig. 12.9 Middle Phase Grey Series retouched tools: **a-b** single end-scrapers on flakes; **c** denticulated end-scraper; **d-e** pointed straight-backed bladelets; **f-g** convex-backed bladelets; **h** convex-backed bladelet with truncated base; **i** convex-backed bladelet tending towards segment; **j-m** *La Mouillah* points; **n** scalene bladelet; **o** truncation.

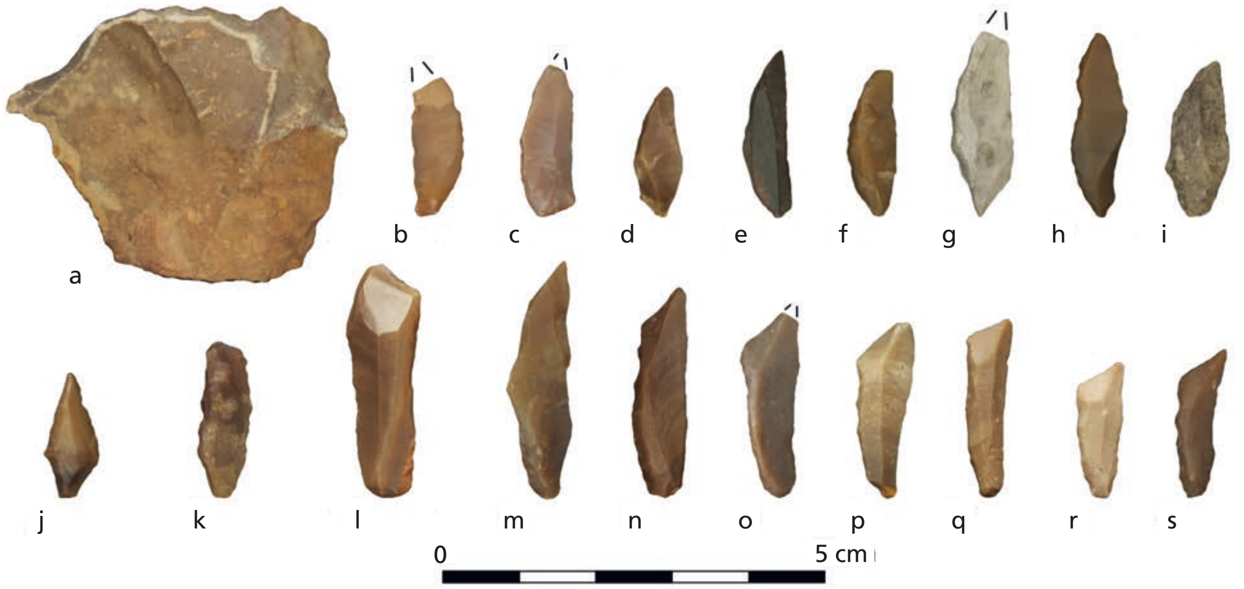

Fig. 12.10 Middle Phase Yellow Series retouched tools: **a** denticulated end-scraper; **b-d** convex-backed bladelets; **e-f** convex backed bladelets tending towards segments; **g-h** convex-backed bladelets with truncated bases; **i** convex-backed bladelet with retouched base; **j** shouldered point; **k** obtuse-ended backed bladelet; **l** Ouchtata bladelet; **m-s** *La Mouillah* points.

Lower Phase where only 68.4 % have continuous retouch and 31.6 % are partially retouched (**tabs 12.22-12.23**). The retouch is typically direct semi-abrupt/abrupt, largely to the exclusion of other types of retouch (**tab. 12.24**), and most pieces are truncated to form a point(s) (**tab. 12.25**). On average, the tools are significantly shorter and narrower, yet thicker, than in the Lower Phase (**tab. 12.26**).

Microlithic Fragments
This is the most common category after classifiable microlithic types, accounting for 33.5 % of the tool assemblage in the Middle Phase (**tab. 12.20**). As with the classifiable microlithic forms, most fragments are modified along the left edge, with direct semi-abrupt/abrupt retouch (**tabs 12.27-12.28**) (see later discussion on lateralisation). Few microlithic fragments retain the butt (**tab. 12.29**).

Notches and Denticulates
This class includes only two tools: a bladelet (31.7 × 10.9 × 5.5 mm) with a retouched notch on the right edge (type 76) and a denticulated flake (29.9 × 15.4 × 4.9 mm) with contiguous notches along the entire left and partly along the right edge (type 75).

Truncations
There are four truncations, accounting for 2.3 % of the tool assemblage in the Middle Phase. Each is made of chert. A couple are retouched at the distal end, one is retouched at an indeterminate end, and another is retouched at both ends. A couple are made on indeterminate debitage, one is made on a flake, and another is made on a bladelet. Median size values are 18.5 mm (range 12.9-19.8 mm), 9.3 mm (range 8.1-21.4 mm) and thickness 3.5 mm (range 1.9-9.9 mm).

Varia
This group consists of 12 non-standardised retouched pieces. All are made of chert. Half are made on indeterminate blanks, with two of each made on blades *sensu stricto*, bladelets and core-trimming elements. Many are complete (41.7 %), with smaller numbers of laterally broken (33.3 %) and other fragments (25.0 %). The median size values are length 27.0 mm (25.0-39.4 mm, n = 5), width 13.5 mm (range 6.5-21.1 mm, n = 9) and thickness 5.4 mm (range 1.7-9.2 mm, n = 9).

Upper Phase

A total of 10,279 lithic artefacts were recovered from the Upper Phase, of which a very high proportion (78.4 %) consisted of undiagnostic knapping debris. Most of the classifiable assemblage is made up of flakes and small flakes (61.5 %), with relatively low proportions of blade/lets (12.3 %), moderate proportions of cores (2.5 %) and core-trimming elements (2.1 %), low frequencies of microburin products (0.5 %) and a relatively high percentage of retouched tools (20.8 %) (**tab. 12.3**). The average productivity in total artefact numbers is 9359 in the Upper Phase (**tab. 12.4**; see table caption for a full explanation of this productivity metric); as an average, this is a little lower than for the Middle Phase but, since approximately half of the Upper Phase is composed of extremely stony, clast-supported, sediment, the bulk density figure for the upper, finer-grained portion would be much over-estimated, such that the real productivity in lithic artefact numbers in this portion is probably very much higher (perhaps by as much as 50 %), certainly making this upper interval the most productive in the whole LSA sequence. In passing, we can discount trampling (cf. lack of stoniness in half this deposit) and burning as the only, or even the dominant, causes of the proliferation of small debitage; in large part, the increase is very likely also to reflect the more exhaustive core reduction processes including the 'heavier' retouching of tools in these layers.

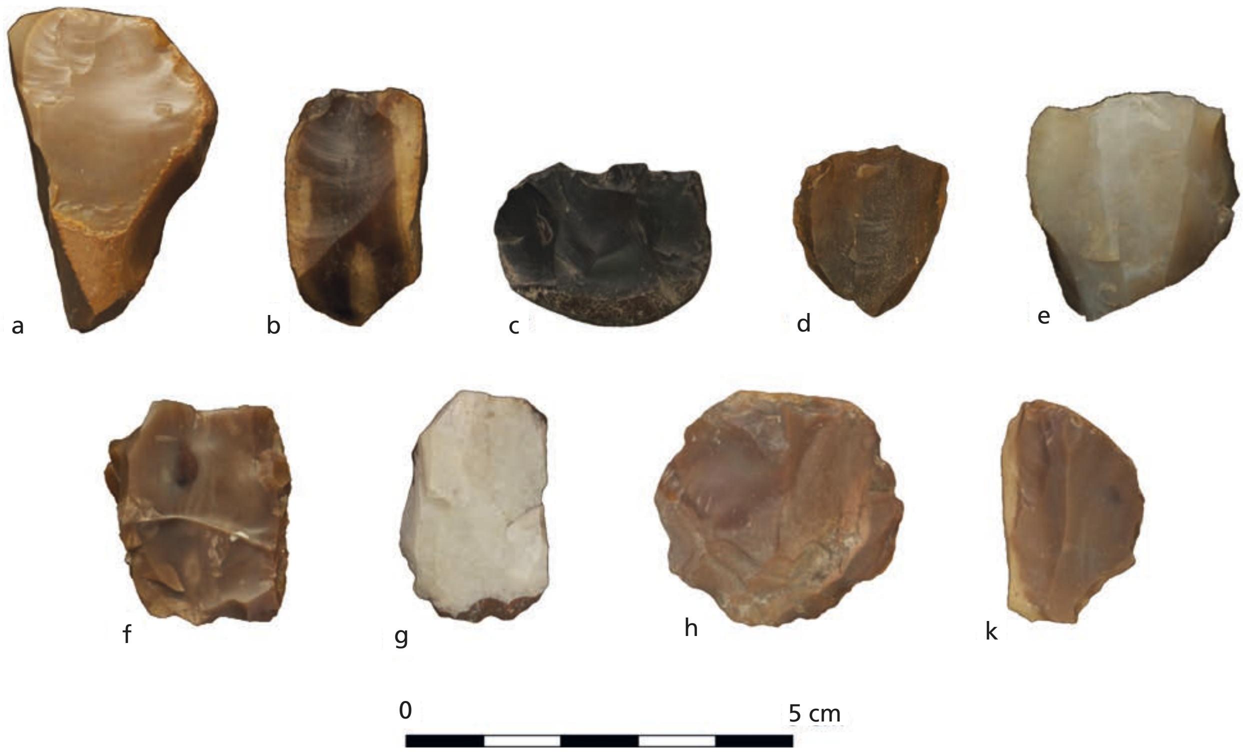

Fig. 12.11 Upper Phase cores: **a-d** single platform cores; **e-g** opposed platform cores; **h** discoidal core; **k** core-on-flake.

Cores

In total 56 cores and core fragments have been recovered from the Upper Phase. Most common are single platform cores (**fig. 12.11a-d**) but these are found in relatively small numbers in comparison with the earlier Phases. A relatively moderate frequency of opposed platform cores (**fig. 12.11e-g**) has also been recorded and, for the first-time, cores with 90° platforms are found in small frequencies. Evidence for the exploitation of two or more striking platforms is also attested by multidirectional cores and a single discoidal core (**fig. 12.11d**). There is an increase in the frequencies of cores-on-flake (**fig. 12.11k**), which contribute their highest proportion in the Upper Phase. No tested nodules are present. A notable presence of core fragments has also been recorded (**tab. 12.5**).
All cores are made of chert. Around four fifths of cores and core fragments retain outer rind, as in the Middle Phase. Just over half have flake removals, although those with blade/let removals are still found in significant numbers (**tab. 12.6**). Again, a strict distinction between cores with blade/let, flake and mixed removals, is misleading. Overall, the size (linear dimensions) of cores is not significantly different from the other Phases (**tab. 12.7**), although mean weights show a decrease in value from the Middle Phase (see the comment on this matter in the section on cores from the Middle Phase).

Debitage

In total, 273 blade/lets including fragments have been recovered, accounting for a relatively small proportion of the assemblage (**tab. 12.3**). All blade/lets are made of chert and relatively few are entirely 'corticated' (**tab. 12.8**). Most have unidirectional dorsal scars, although there is a relatively high proportion with bidirectional opposed dorsal scars (**tab. 12.9**). Most commonly the blade/lets have plain butts or punctiform/linear butts, as in the Middle Phase. A notable proportion have faceted butts, a situation which has rarely been recorded elsewhere (**tab. 12.10**) and might be connected to a special technique of knapping 90° cores which also have faceted platforms. None of the blanks is a blade *sensu stricto*. On average, the blade/lets are broadly similar in size to those from the Middle Phase, but significantly wider and thicker than those in the Lower Phase (**tab. 12.11**).

In total, 1366 small flakes and flakes were recovered. Most are made of chert (87.0 %), with smaller frequencies of limestone (12.7 %), quartzite (0.2 %) and basalt (0.1 %). All whole flakes have been selected for further attribute analysis (n = 298). These flakes closely resemble those from the earlier Phases, generally retaining outer rind (**tab. 12.12**), with unidirectional and multidirectional dorsal scars patterns most common (**tab. 12.13**), and significant frequencies with plain or 'cortical' butts (**tab. 12.14**). Overall, the flakes are of similar size to those from the earlier Phases (**tab. 12.15**).

In total, 47 core-trimming elements have been recovered from the Upper Phase. Each is made of chert. Most are crested pieces, including 22 primarily first removals with one prepared versant, four first removals with both versants prepared, one secondary removal and eight fragments. The median dimensions are 29.0 × 9.5 × 5.1 mm (**tab. 12.16**). There are also five platform rejuvenations, with median dimensions for length 21.6 mm (range 17.7-25.3 mm, n = 3), width 21.6 mm (range 15.5-24.5 mm, n = 3) and thickness 8.3 mm (range 4.8-11.6 mm, n = 3). There are also eight *flancs de nucléus* with median dimensions of length, width and thickness of, respectively, 26.1 mm (range 20.5-38.0 mm, n = 5), 18.0 (range 11.8-28.1 mm, n = 5) and 8.2 mm (range 6.5-10.1 mm, n = 5).

Microburins and Related Products

A total of 5 microburins and 6 Krukowski microburins were recovered from the Upper Phase. Of this very small group of true microburins, three are from the proximal end and two from the distal end. All but one of the microburins have the notch on the left edge (**tabs 12.17-12.18**). In general, the microburins are restricted in size, indicating that they were detached from relatively narrow, thin microlith blanks (**tab. 12.19**).

Retouched Tools

End-Scrapers

There are 13 artefacts in this class (**fig. 12.12**): five single end-scrapers on flakes, an end-scraper on a retouch flake, a core-like scraper, a denticulated end-scraper, a double end-scraper (**fig. 12.12b**) and four fragments with end-scraper retouch. All but one are made on chert flakes and the last is made of quartzite. Eight have the scraper formed at the distal end (including one with retouch extending down the right edge), one is formed at the proximal end, one is retouched at both ends, a couple have retouch extending around most of the margin, and one is made at an indeterminate end. Excluding the fragments, the median size is 21.5 × 18.3 × 10.0 mm. The end-scraper made on a quartzite flake has a well-defined convex scraping-end and is particularly large measuring 41.9 × 32.4 × 10.5 mm.

Fig. 12.12 Upper Phase retouched tools: **a** end-scraper on a flake; **b** double end-scraper; **c** combination tool; **d** pointed straight-backed blade; **e-f** pointed straight-backed bladelets; **g-h** pointed straight-backed bladelets with truncated base; **i** pointed straight-backed bladelet with rounded base; **j** pointed straight-backed bladelet with retouched base; **k** *Aïn Kéda* point; **l-o** convex-backed bladelets; **p** convex-backed bladelet with truncated base; **q** convex-backed bladelet with rounded base; **r** convex-backed bladelet with retouched base; **s-u** convex-backed bladelets tending towards segments; **v-x** segments; **y** equilateral triangle; **z** denticulated flake.

Backed Flakes and Blades

This class only includes three tools. One is a distinctive straight-backed blade (type 35) with backing along the right edge; it would have had a point at the distal end, but the tip has been broken, leaving measurements of >47.3 × 14.5 × 7.7 mm. In addition, there are two burnt backed blade fragments (type 42) made of chert, one retouched along the right edge and the other retouched on an indeterminate edge.

Composite Tools

This class includes a single end-scraper/burin (type 44). It is made on a partially 'corticated' flake. It has a convex distal scraping end, with retouch continuing onto and extending down the entirety of both margins (**fig. 12.12c**). The burin, with a single facet, is on a break. It is probable that the break and burin spall might have occurred spontaneously during use when hafted. The piece measures 31.4 × 20.5 × 10.7 mm.

Microlithic and Related Forms

A total of 199 classifiable tools were recovered from the Upper Phase (**tab. 12.21**). The dominant forms are convex-backed bladelets *sensu lato* (types 56-59), which account for around two fifths of the microlithic and related types (**fig. 12.12l-u**). These are divided between broadly similar proportions of typical convex-backed bladelets (subtype 56a) and those tending towards segments (subtype 56b). Each of the other types of convex-backed bladelets *sensu lato* is found in lesser frequencies with a notable presence of convex-backed bladelets with truncated bases (type 58).

As a group, pointed straight-backed bladelets *sensu lato* (types 45-52) account for a relatively strong proportion of the tools, which is also the case in the Lower Phase. Nonetheless, there are some striking differences in the expression of this form. In contrast to the Lower Phase, there is greater internal variability in the range of formal types represented. It is plausible that this is due to the larger assemblage size of the Upper Phase. However, the pointed straight-backed bladelets *sensu lato* also appear comparatively well-made, with relatively intense, semi-abrupt to abrupt, retouch, creating a regular backed edge (**fig. 12.12d-f**). There is also a relatively high proportion of types with additional retouch (**fig. 12.12g-j**). Most often this is expressed in the forms with acutely truncated bases (type 47). A few *Aïn Kéda* points (type 52) have also been found (**fig. 12.12k**), with a distinctive form of inverse retouch at the tip (see **fig. 12.2**); so far in S8, this type has only be found near the top of the Upper Phase.

Few other microlithic types occur in very large frequencies, although geometric segments (type 82) are overall notably more common in the Upper Phase (**fig. 12.12v-x**). These differ only in the straightness of the unmodified edge and symmetry of retouched margin from the convex-backed bladelets tending towards segments (subtype 56b) (**fig. 12.12s-u**). A few isosceles, equilateral (**fig. 12.12y**), and scalene triangles (types 89-90) have also been recorded, and, together with segments, these 'geometric' microlithic (types 82-100) occur in relatively high frequencies in the Upper Phase (7.5 %) compared to the Middle and Lower Phases (4.4 % and 1.8 %, respectively).

None of the other microlithic forms is well represented in the Upper Phase. Many of the forms that dominated in the underlying units are notably absent or only contribute a tiny proportion in the Upper Phase, such as *La Mouillah* points, partially backed bladelets, Ouchtata bladelets and obtuse backed bladelets (**tab. 12.21**).

Overall, tools in this category are almost exclusively retouched along the entirety of one lateral margin (**tab. 12.22**). Most often they have been modified along the left edge by direct semi-abrupt/abrupt retouch, although these include fairly frequent examples with abrupt direct/crossed and crossed 'anvil' retouch (**tabs 12.23-12.24**). Nearly all the microlithic forms are retouched into (a) point(s) (**tab. 12.25**). On average, they are similarly-sized to those from the Middle Phase, but significantly shorter and narrower, yet thicker, than in the Lower Phase (**tab. 12.26**). This could be linked to a greater use of cores on flakes.

Microlithic Fragments

This is the most frequent category, with a total of 201 microlithic fragments (**tab. 12.20**). As with the classifiable types, the left edge is most commonly modified (**tab. 12.27**) and usually with direct semi-abrupt/abrupt retouch, although abrupt direct/crossed and crossed 'anvil' retouch are also found in relatively high frequencies (**tab. 12.28**). Around one in eight microlithic fragments retain the butt (**tab. 12.29**).

Notches and Denticulates

There are 14 tools in this class. These primarily consist of notched blade/lets, followed by denticulated blade/lets and denticulated flakes. All but one are made of chert, with the last of limestone. Half are broken laterally, one is a partial fragment, and the remainder are whole. Due to their size, a few may be manufacturing failures or microburin mishits. Most commonly the retouch location cannot be determined (35.7 %), with lower frequencies of retouch along the right edge (21.4 %), left edge (14.3 %), both edges (14.3 %), left edge and distal end (7.1 %) and proximal end (7.1 %). These tools are quite varied in size. The median size values are length 29.4 mm (range 18.6-81.1 mm, n = 6), width 14.1 mm (range 5.0-64.3 mm, n = 13) and thickness 4.7 mm (range 1.9-16.4 mm, n = 13). One of the pieces is particularly distinctive and is a denticulated flake made of limestone (**fig. 12.12z**). It is on a flake with a natural surface with four contiguous notches along the left edge that increase in size towards the distal termination; it has ochre covering the dorsal surface and is especially large measuring 81.1 × 64.3 × 16.4 mm. In contrast, the longest object made on chert measures only 47.6 mm.

Truncations

There are only seven truncations in the Upper Phase. Each of the truncations is made of chert. Five are made on blade/lets, one is made on a flake, and one is made on an indeterminate fragment. One is whole, with the remainder laterally broken. One more has the truncation at the proximal end than at the distal end. The median size values are length 15.9 mm (n = 1), width 9.0 mm (range 5.8-16.8 mm, n = 7) and thickness 4.0 mm (range 2.0-4.9 mm, n = 7).

Varia

This group consists of 24 non-standardised retouched pieces. All but one of the pieces are made of chert, the last being of limestone. Most are made on indeterminate blanks (34.8 %), with smaller percentages on blades (13.0 %) and bladelets (26.1 %), and flakes (26.1 %). The majority are laterally broken (65.2 %), with smaller numbers of partial fragments (30.4 %). Only a couple are unbroken. The median size values are length 22.1 mm (range 16.1-28.1 mm, n = 2), width 15.9 mm (range 7.2-36.2 mm, n = 16) and thickness 4.0 mm (range 2.0-14.8 mm, n = 16).

Sector 10

A total of 2526 lithic artefacts have been recovered from Sector 10. It should be emphasised that these do not come from a contiguous set of stratigraphic units but from the area that has produced burials and where sediments from other parts of the cave may well have been introduced (see **Chapter 2**). Overall, 39.7 % of the assemblage consists of unclassifiable knapping debris, which is significantly less than in any

Fig. 12.13 Sector 10 cores: **a-e** single platform cores; **f-h** opposed platform cores; **i** core-on-flake; **j** discoidal core; **k-l** multiple platform cores.

of the other assemblage groups from nearer the front of the cave. This is hard to explain in simple terms. For instance, even though total recovery methods were not used in the early seasons (only dry sieving was employed) we doubt that this had a significant 'winnowing effect' on the sample. Thus, some 60 % of the chips (pieces up to 2 cm in max dimension) would need to be missing to bring the figures up to that of S8 GS Phases. Moreover, there are far too many small flakes (1-2 cm) present in S10 to make this seem possible (for alternative suggestions see discussion below). Of the classifiable artefacts, small flakes occur relatively infrequently (13.3 %) and instead flakes are the most common (42.2 %). A high proportion of blade/lets (19.4 %), strong proportions of cores (4.9 %) and core-trimming elements (3.3 %), low frequencies of microburin products (1.6 %) and a relatively low percentage of retouched tools (14.1 %) have also been recorded in Sector 10 (**tab. 12.3**). There are insufficient spatial and sedimentation rate data available to calculate the lithic artefact productivity in the very complex setting of Sector 10.

Cores

In total 74 cores and core fragments have been recovered, accounting for 4.9 % of the assemblage. Single platform cores (**fig. 12.13a-e**) are most common and slightly more frequent than opposed platform cores (**fig. 12.13i**). Two 90° platform cores have also been recorded. This is a rare type only found so far in the Upper Phase. Further evidence of the exploitation of two or more striking platforms is provided by multidirectional cores (**fig. 12.13k-l**) and a single discoidal core (**fig. 12j**). There is a relatively high frequency of cores-on-flakes (**fig. 12.13i**), which occur in Sector 8 from the Middle Phase upwards. Only one tested nodule has been recorded from Sector 10. A fifth of the cores are unclassifiable fragments (**tab. 12.5**).
All but two of the cores are made of chert, with the others made of limestone and a dark grey and olive banded mudstone. Around one in eight are entirely 'decorticated'. The majority have flake removals, although blade/let removals contribute around a third of the recognisable negative scars (**tab. 12.6**). Median size values are shown in **table 12.7**, as are the mean weight values for cores which show that they were on average even larger in size than the cores from the Middle and Lower Phases.

Debitage

In total, 295 blade/lets including fragments have been recovered, accounting for 19.4 % of the assemblage (**tab. 12.3**). All the blade/lets are made of chert. Around half are entirely 'decorticated', but blade/lets retaining outer rind are nevertheless still relatively common (**tab. 12.8**). Of those with identifiable dorsal scars, around two thirds have unidirectional scars, followed by moderate numbers with bidirectional opposed and multidirectional dorsal scars, and only a small number have bidirectional crossed dorsal scars (**tab. 12.9**). Blade/lets and fragments retaining plain or punctiform/linear butts are found in roughly equal proportions and dominate the assemblage (88.5 %) (**tab. 12.10**). On average, the blade/lets are significantly longer, wider and thicker than from anywhere else in the cave (**tab. 12.11**).
In total, 844 small flakes and flakes have been recovered. Most were made of chert (93.0 %), with a smaller frequency made of limestone (7.0 %). All the complete or mostly complete flakes have been selected for further attribute analysis (n = 398). These flakes closely resemble those from all of the other Phases, generally retaining outer rind (**tab. 12.12**), with unidirectional dorsal scars prevalent, followed by strong numbers with multidirectional dorsal scar patterns (**tab. 12.13**), and most often having plain butts, but 'cortical' butts also being common (**tab. 12.14**). Nonetheless, the flakes are significantly longer, wider and thicker than those recovered from elsewhere at the site (**tab. 12.15**).
In total, 50 core-trimming elements have been recovered from Sector 10. Each is made of chert. Most are crested pieces, including 23 first removals with a single prepared versant, 10 first removals with both versants prepared, 2 second removals, and 2 fragments. The median dimensions are 41.6 × 13.4 × 7.2 mm (**tab. 12.16**). There are also six platform rejuvenations, with median dimension for length 19.6 mm (range

16.4-38.4 mm, n = 5), width 21.4 mm (range 11.2-31.2 mm, n = 5) and thickness 6.2 mm (range 3.3-8.5 mm, n = 5).

Microburins and Related Products

Twenty-five true microburins have been recovered from Sector 10. Most often these are distal examples with the notch on the left hand side (**tabs 12.17-12.18**), similar to the Middle Phase. These include larger examples as also seen in the Middle Phase (**tab. 12.19**).

Retouched Tools

Sector 10 has produced 217 tools. The tool sample is dominated by microlithic and related forms (48.8 %). There are relatively few microlithic fragments. For example referring to **table 12.20** it can be shown that there are about 1.6 times fewer fragments than in any S8 Phase (with the exception of the Mixed/Transitional Phase which is anomalous). This may indicate less trampling damage. End-scrapers account for a relatively high proportion of the tools from Sector 10 (15.4 %). Other classes occur only infrequently, accounting for 0.5-2.3 % of the tool assemblage (**tab. 12.20**).

End-Scrapers

This class (**fig. 12.14a-e**) comprised 33 tools: 13 end-scrapers on flakes, 7 denticulated end-scrapers, 2 nosed end-scrapers, 1 circular scraper, 1 end-scraper on a retouched flake, 1 end-scraper on a blade, 1 double end-scraper and 7 fragments. All are made of chert. All but four are made on flakes, with only a couple made on blades; two are also made on indeterminate fragments. Most are retouched distally (22, including one with additional retouch along the right edge and two with additional bilateral retouch), five are retouched proximally (including one with retouch extending down the left edge and one with retouch extending along the right edge), three are retouched at an indeterminate end, a couple are retouched at both ends (including one with retouch along the right edge), and one has retouch extending around the entirety of the perimeter. Excluding fragments, the median size is 30.8 × 23.7 × 8.7 mm.

Perforators

Only a single perforator has been recovered, which is made on the left edge of a small flake (13.1 × 23.6 × 4.1 mm).

Composite Tools

This is a rare tool class throughout the site. This sector contains a single end-scraper/backed blade made on a ‘non-cortical’ chert blade. It has backing along the entirely of the left edge and a well-formed convex end-scraper at the proximal end, removing the butt. It measures 47.3 × 15.7 × 4.9 mm.

Backed Blades and Flakes

There are eleven artefacts in this category (**fig. 12.14h-j**). All are made of chert. Most have direct semi-abrupt/abrupt retouch, with only a couple with mixed abrupt/crossed retouch. Just less than half are retouched along the left edge, whilst three are retouched along the right edge and three are retouched along an indeterminate lateral edge.

A couple of pieces are particularly distinctive and elongated artefacts. One is a bi-pointed straight backed bladelet with extremely regular backing along the right edge (**fig. 12.14f**). It measures 55.7 × 6.4 × 4.7 mm. The other is a convex backed blade with mixed direct/crossed forming a convex margin (**fig. 12.14g**). It measures 53.9 × 9.0 × 5.7 mm. Each of these delicate objects seemingly required an exceptional skill to attain a suitable blank and subsequently to form the back without breakage occurring. It is possible given their unusual nature that they were intentionally placed with one of the burials from this Sector.

Microlithic and Related Forms

Of the 105 classifiable microlithic forms, convex-backed bladelets *sensu lato* (types 56-59), account for around three fifths of the backed category (**fig. 12.14m-z**). There are relatively substantial numbers of typical convex-backed bladelets (subtype 56a) in contrast to those tending towards segments (subtype 56b). Each of the other types of convex-backed bladelets *sensu lato* is found only in small frequencies, although convex-backed bladelets with truncated bases (type 58) are relatively common. The range of types is similar to those found in the Middle and Upper Phases (**tab. 12.21**).

As a group, pointed straight-backed bladelets *sensu lato* (types 45-52) also make up a strong proportion of the microlithic types. The pointed straight-backed bladelets *sensu lato* broadly resemble in morphology those from the Upper Phase, rather than those from the Lower Phase. An *Aïn Kéda* point (type 52) was amongst this group (**fig. 12.14l**) and this type is found elsewhere only in the Upper Phase.

No other microlithic types have been found in very large frequencies in Sector 10. Many of the forms that dominate in the YS levels are absent or only contribute a tiny proportion in Sector 10, such as *La Mouillah* points, partially backed bladelets, Ouchtata bladelets and obtuse backed bladelets.

The microlithic and related forms are overwhelmingly retouched along the entirety of one lateral margin (**tab. 12.22**). Most have retouch along the left edge (**tab. 12.23**) and this tends to be direct semi-abrupt/abrupt, although there are significant proportions with relatively abrupt direct/crossed and crossed 'anvil' retouch (**tab. 12.24**). Most have been truncated into a point (**tab. 12.25**). Median figures for the microliths are 25.2 × 6.8 × 3.5 mm (**tab. 12.26**).

Microlithic Fragments

Even though the second most common tool category is that of unclassified microlithic fragments, there are relatively few examples in contrast to other excavated areas, with a total of 43 fragments from Sector 10. Most are modified along the left edge (**tab. 12.27**) most frequently with direct/semi-abrupt retouch, although abrupt crossed 'anvil' retouch is also relatively common (**tab. 12.28**).

Notches and Denticulates

There are 17 artefacts in this class (**fig. 12.14ab-ad**). These primarily consist of denticulated blade/lets, followed by denticulated flakes, and a variety of other forms. All are made of chert. Three are broken laterally, four are partial fragments, and the remainder are whole. Some may be manufacturing failures or microburin mishits. Most commonly the retouch location is along the left edge (35.3 %) or both lateral margins (35.3 %). A few have retouch along the left edge, others on the distal end (11.8 %), or along the right edge (17.6 %). Overall, median length, width and thickness values are, respectively, 32.2 mm (range 18.5-53.9 mm), 17.0 (range 12.6-17.9 mm) and 4.2 mm (3.8-7.2 mm).

Truncations

There is only one truncated piece. It is made of chert and has a slightly concave truncation at the distal end. It measures 28.4 × 15.0 × 5.6 mm.

Fig. 12.14 Sector 10 retouched tools: **a** end-scraper on a flake; **b** circular scraper; **c** denticulated end-scraper; **d** nosed end-scraper; **e** end-scraper on a blade; **f** straight-backed blade; **g** convex-backed bladelet; **h-j** straight-backed bladelets; **k** Mechta el-Arbi point; **l** *Aïn Kéda* point; **m-s** convex-backed bladelets; **t-v** convex-backed bladelets with truncated cases; **w** convex-backed bladelet with rounded base; **x** convex-backed bladelet with retouched base; **y-z** convex-backed bladelets tending towards segments; **aa** segment; **ab** notched blade; **ac-ad** notched flakes; **ae** fragment of a side-scraper.

Varia
This group consists of five non-standardised retouched pieces. All are made of chert and are extremely fragmentary, so that the original blank form could not be distinguished. In addition, there is one formal tool, a fragment of a side-scraper, made of chert (**fig. 12.14ae**). It has scraper retouch along the left edge and distal end. It is typical of forms observed in the MSA and may be intrusive.

In summary, the assemblage from Sector 10 looks slightly different from those from other areas of the cave and is thus difficult to subsume within any of the defined Phases. Stratigraphically, it should be closer to the Middle or very base of the Upper Phase. However, the cores on average weigh even more than the heaviest cores in Sectors 3, 8 and 9 (Lower Phase), the bladelets and flakes are also significantly longer, wider and thicker than from anywhere else in the cave. The artefacts in general are less heavily fragmented and this may indicate that the area was not excessively trampled. One further anomaly is that the Sector 10 assemblage includes large microburins (typical of the Middle Phase) but only sparse *La Mouillah* points, though the most common microlith types are convex-backed bladelets that are possible products of the same reduction process and may account for the near absence of the *La Mouillah* types. All in all, the arefacts in Sector 10 should perhaps be treated as a 'special' deposit made up of a combination of lithics and objects transferred in sediments to this sector as well as items deliberately selected for inclusion with the burials.

12.5 DISCUSSION

Lithic Raw Material Variance

In **Section 12.1**, the question was asked as to whether there is any interpretable information in the distribution of lithic raw materials through the observed stratigraphic range.
With the caveat that natural and inadvertent mechanical flakes are difficult to differentiate from simple (deliberate) artefacts in limestone, the complete datasets in **table 12.1** suggest that this raw material was used more commonly in the GS than in the YS, and increasingly so upwards in the GS (see also Section on 'Expedient Tool Manufacture' below). It is felt that this raw material should be treated as a 'local' resource and, given this special association, it has been removed from the further numerical analysis below, so as not to obscure any procurement patterns in other raw materials. The very large number of unclassified cherts have also been removed, a step which effectively gives much more importance to the non-chert raw materials, although the latter, always being rare, make no significant difference to the conclusions reached below. The data in **table 12.1** can therefore be reduced to the smaller set shown in **table 12.30**.
The columns of data for the total (GS + YS) Middle Phase and for the (Transitional/) Mixed Phase have been placed in small italic print in **table 12.30**, since these data may also obscure any trends in the best stratified assemblages. In fact, these data are 'intermediate' in exactly the way one would expect, given their respective components (either grouped, transitional or mixed).
A variance index has been calculated using the formula given at the foot of the table. The basic principle in the analysis is the comparison of observed percentages against a theoretical uniform distribution (one with 8.3 % of material in each of the 12 raw material categories). A perfectly uniform distribution would give a variance of zero; a rising figure indicates an increasing departure from uniformity, with the maximum possible figure representing a case with all material in only one of the raw material categories. Translating this into more archaeologically relevant terminology, a low figure suggests procurement of a broad range

	Sector 8 Upper Phase	Sector 8 Middle Phase			*Sector 8 Mixed Phase*	Sector 8 Lower Phase	Sector 10
	GS	GS	YS	*Total*	YS	YS	GS
	407	**134**	**284**	***418***	***96***	**384**	**343**
Chert							
Black	10 (2.4 %) [2.9]	4 (3.0 %) [2.3]	11 (3.9 %) [1.6]	*15* *(3.6 %)* *[1.8]*	*1* *(1.0 %)* *[4.4]*	24 (6.3 %) [0.3]	12 (3.5 %) [1.9]
Dark grey	14 (3.4 %) [2.0]	6 (4.4 %) [1.3]	4 (1.4 %) [4.0]	*10* *(2.4 %)* *[2.9]*	*2* *(2.1 %)* *[3.2]*	7 (1.8 %) [3.5]	9 (2.6 %) [2.7]
Grey/light grey	28 (6.9 %) [0.2]	2 (1.4 %) [4.0]	17 (6.0 %) [0.4]	*19* *(4.5 %)* *[1.2]*	*7* *(7.3 %)* *[0.1]*	13 (3.4 %) [2.0]	27 (7.9 %) [0.0]
Greyish brown	27 (6.6 %) [0.2]	16 (11.9 %) [1.1]	35 (12.3 %) [1.3]	*51* *(12.2 %)* *[1.3]*	*7* *(7.3 %)* *[0.1]*	21 (5.4 %) [0.7]	40 (11.7 %) [1.0]
Pale brown/ yellowish brown	165 (40.5 %) [86.4]	58 (43.3 %) [102.1]	101 (35.6 %) [62.1]	*159* *(38.0 %)* *[73.5]*	*44* *(45.8 %)* *[117.2]*	177 (46.1 %) [119.1]	76 (22.2 %) [16.1]
Brown/strong brown	108 (26.5 %) [27.6]	25 (18.7 %) [9.0]	68 (23.9 %) [20.3]	*93* *(22.2 %)* *[16.1]*	*26* *(27.1 %)* *[29.5]*	114 (29.7 %) [38.2]	122 (35.6 %) [62.1]
Reddish brown	15 (3.7 %) [1.8]	9 (6.7 %) [0.2]	20 (7.0 %) [0.1]	*29* *(6.9 %)* *[0.2]*	*5* *(5.2 %)* *[0.8]*	5 (1.3 %) [4.1]	12 (3.5 %) [1.9]
Dusky red/weak red	18 (4.4 %) [1.3]	9 (6.7 %) [0.2]	12 (4.2 %) [1.4]	*21* *(5.0 %)* *[0.9]*	*1* *(1.0 %)* *[4.4]*	3 (0.8 %) [4.7]	2 (0.6 %) [4.9]
White	16 (3.9 %) [1.6]	5 (3.7 %) [1.8]	15 (5.3 %) [0.8]	*20* *(4.8 %)* *[1.0]*	*3* *(3.1 %)* *[2.3]*	9 (2.3 %) [3.0]	39 (11.4 %) [0.8]
Basalt	0 (0.0 %) [5.7]	0 (0.0 %) [5.7]	0 (0.0 %) [5.7]	*0* *(0.0 %)* *[5.7]*	*0* *(0.0 %)* *[5.7]*	4 (1.0 %) [4.4]	0 (0.0 %) [5.7]
Quartzite	5 (1.2 %) [4.2]	0 (0.0 %) [5.7]	1 (0.4 %) [5.2]	*1* *(0.2 %)* *[5.5]*	*0* *(0.0 %)* *[5.7]*	7 (1.8 %) [3.5]	3 (0.9 %) [4.6]
Other	1 (0.2 %) [5.5]	0 (0.0 %) [5.7]	0 (0.0 %) [5.7]	*0* *(0.0 %)* *[5.7]*	*0* *(0.0 %)* *[5.7]*	0 (0.0 %) [5.7]	1 (0.3 %) [5.3]
Variance*	**139.4**	**139.1**	**108.6**	***115.8***	***179.1***	**189.2**	**107.0**

Tab. 12.30 Selected lithic raw material variance. *Σ (observed% – uniform%)^2/n, where n = 12, uniform% = 8.3 %; individual cell variance contributions shown in square brackets.

of materials, whilst a high figure suggests greater specialisation in fewer raw material types. It should be remembered that this variance index is effectively dimensionless and that it has meaning here only in a comparative sense. Nevertheless, it is important to note that none of the observed values is 'absolutely low', such that a combination of choice (for technological and/or aesthetic reasons) and of regional availability have clearly caused a general tendency towards selection of particular cherts throughout the LSA at Taforalt.

Looking first at the lowest YS (Lower Phase), the result (index of 189.2) suggests a relatively narrow range of raw materials (in comparison with other columns, by far the narrowest in the available samples), favouring the two most common (overall) material types (accounting for over 75 % of this Lower Phase sample). In the upper part of the YS (the lower part of the Middle Phase), the index has dropped radically (to 108.6), suggesting a considerable broadening of the raw material range (one of the two widest in the available samples). The two columns from the GS show very similar indices, suggesting an intermediate but relatively broad raw material range. Note that the 'variance' index involves a power relationship (to take account of moduli); it is therefore here confirmed that these figures (139.1 and 139.4) are closer to the 'wide' end of the spectrum observed in the Taforalt data than to the 'narrow' end.

Whilst these results are not, of course, determinative in their own right, and whilst the sample sizes are rather small (and the indeterminate/unclassified counts very high), it may be permissible to suggest factors plausibly contributing to the procurement patterns observed. The earliest visits to the cave may have involved a 'narrow' raw material range, perhaps reflecting short visits in a 'procurement round'. The 'wide' pattern in the latest YS perhaps reflects more deliberate source assay, possibly even including the need, or conscious objective, to acquire more local knowledge. In the GS, the pattern narrows a little to what one assumes was the 'best' source balance available (remembering also the incremental addition of limestone artefacts).

Sector 10 gives a 'wide' index value (107.0), the widest in the available samples. However, whilst the variance index is similar to that for the latest YS, the actual distribution of raw materials used is very different – indeed, the Sector 10 sample is also markedly different from both of the other GS samples (remembering also that S10 has a relatively low limestone artefact presence). Material selection in S10 appears to have favoured the stronger-coloured cherts, at the expense of paler or greyer material. It therefore seems plausible to suggest that different material selection criteria (presumably associated with the burial function of this Sector) were persistent enough to overcome any tendency towards 'homogenisation' that may have arisen due to the bulk import from other parts of the cave of GS sediment into Sector 10 (proposed in **Chapter 2**).

Lithic Artefact Productivity

The concept of productivity here is based on bulk density of artefacts (counts per standard unit of volume) weighted with estimated sedimentation rates (nominal thickness per standard unit of time). The resulting productivity figures (**tab. 12.4**) provide gross contrasts between Phases; this is a comparative metric, effectively dimensionless, but broadly linear in nature (a larger figure indicates a larger productivity). Thus major differences in productivity can be seen between the Upper Phase (9359 overall and perhaps as high as 14,000 for the upper (finer-grained and slower-accumulating) half of this Phase), the Middle Phase (2201) and the Lower Phase (260). It is possible that the estimate for the uppermost part of the Upper Phase is exaggerated due to higher rates of breakage and burning but the observed changes in productivity by artefact number appear broadly consistent with the idea that, increasingly through time, inhabitants were walking over and digging into earlier surfaces, creating more hearths, and/or clearing knapping waste into hearths, processes consistent with a more concentrated use of the cave.

Perhaps the most noteworthy change in average productivity is that seen abruptly across the Yellow Series/Grey Series boundary, from 642 to 10892, a 17-fold increase. A breakdown of the assemblage into unidentified knapping debris, debitage (including cores, core-trimming elements, microburins) and tools, shows interesting trends (**tab. 12.4**; see table caption for a full explanation of this productivity metric). The productivities in debitage in the Upper and Middle Phases (1576 and 754, respectively) are about an order of magnitude greater than those observed in the Lower Phase (104). A similar pattern is also reflected in the productivity of retouched tools from the Upper and Middle Phases (427 and 135, respectively) in comparison with the Lower Phase (22). In fact, as with the average productivity for all lithics, the principal abrupt change in all artefact categories shown in **table 12.4** is within the Middle Phase, at the Yellow Series/Grey Series boundary.

Overall, it seems reasonable to suggest that the higher productivities in numbers of lithic artefacts may be an index of a gross rise in activity within the cave. There is a steady, but modest, increase within the Yellow Series, the Transitional/Mixed Phase showing intermediate values for this parameter too, perhaps an indication that mixing is indeed at least a strong contributor to the overall nature of the lithic assemblage in this Phase. Significantly, after the beginning of the Middle Phase, there then appears to be a massive jump in productivity, plausibly reflecting the shift from dominantly natural to dominantly anthropogenic sediment accumulation and presumably also indicative of greater on-site knapping activity. In addition, allowing for the differential stoniness within the Upper Phase, it seems likely that this upward trend in productivity in lithic artefact numbers continues through time, with perhaps a 40 % increase even within the time-span of the Grey Series itself. The one caveat that must be borne in mind here is that the observed changes in productivity may be highly localised and the product of sampling strategy during the current excavation campaign, although it is considered unlikely that this could be the sole or dominant factor in the pattern observed, given the very magnitude of the changes noted (principally in Sector 8) and the other changes in the material culture thought to be indicative of greater activity levels and the possibility of increased sedentism (see **Chapter 18**).

Artefact Condition

Analysis of the lithic assemblages indicated some interesting changes in the frequencies of diagnostic artefact classes and undiagnostic knapping debris (i.e. chips and chunks). Overall, 33.6 % of the assemblage can be attributed to diagnostic artefact classes. The relative frequencies of total diagnostic artefacts vary dramatically between the Phases, with 21.6 % in the Upper Phase, 40.4 % in the Middle Phase, and 48.9 % in the Lower Phase.

In Sector 8, around 49.3 % of the assemblage shows evidence of burning, which includes discoloration and fracturing (**tab. 12.31**). Overall there is a steady increase in percentage burning upwards through the 'standard' YS to GS sequence with significantly more burnt artefacts in the Upper Phase (71.9 %), than in the Middle (36.8 %) or Lower Phases (23.1 %). Despite the otherwise strongly rising 'productivity' in burnt artefacts, there appears to be a slight fall off in values in the Upper Phase (**tab. 12.4**) which might be attributable to multiple fracturing of larger artefacts into smaller pieces not counted in this analysis. In the GS, there are also high levels of burning of the faunal, molluscan, and botanical remains, and of the sediments, all presumably anthropogenic in origin (see **Chapter 2**). There is no evidence for the use of heat treatment as a preparation for knapping. If anything, the burning is less often associated with the cores than the other classes. In fact, rates of burning are slightly higher amongst the retouched tools in all but the Lower Phase, which might imply that the tools were being discarded close to active hearths, whilst primary knapping took place further away from such features. To test this hypothesis, further horizontal excavations will be necessary. Even though the high levels of burning have somewhat obscured evidence of the reduction process, several prominent changes in lithic technology were recorded in the course of the sediment sequence. The comparatively high percentage of burnt artefacts in Sector 10 (64.5 %) may at first glance offer parallels with the Upper Phase but we would qualify this by noting that Sector 10 probably includes matrix trans-

		Burnt		Unburnt		Total
		n	%	n	%	n
Upper Phase		829	71.9	324	28.1	1153
Middle Phase	GS	125	49.0	130	51.0	255
	YS	148	30.5	338	69.5	486
	Total	273	36.8	468	63.2	741
Intermediate/ Mixed Phase		50	33.3	100	66.7	150
Lower Phase		127	23.1	423	76.9	550
Sector 10		703	64.5	387	35.5	1090
Overall		1982	53.8	1702	46.2	3684

Tab. 12.31 Lithic artefact burning traces. Burning frequencies of larger artefacts excluding debris, small flakes and flake fragments.

ferred in from the outer cave. If the material subsequently transferred was originally produced at more or less the same time, this does of course beg the question as to what kinds of activity (funerary feasting?) may have taken place nearer the entrance to have produced such a burning phenomenon.

One further point worth making here concerns the varying quantities of breakage amonst the microlithic tools. For example, it is only in the Lower Phase that microlith fragments markedly outnumber more or less whole microliths (91:57). In the Middle Phase, the ratio is the other way around (59:91), whilst the two classes have almost the same numbers (201:199) in the Upper Phase. It is clear from our analyses that in the Upper Phase the breakage must have been to some extent influenced by the high degree of burning but the same cannot be the case in the Middle and Lower Phases. Although we have no definitive explanation for the variation in breakage patterns, is it possible that retooling in the Lower Phase involved more replacement with ready made (imported) microliths. If this were the case, it might also suggest that relatively more tools were made in this part of the site in the Middle Phase. Such speculation must of course be weighed up against the relatively restricted areas sampled by our excavations. This is something that could eventually be tested against Roche's data although he only includes broken counts of some tool classes.

Reduction Sequences

Microlithic Toolkit Production

All of the lithic assemblages identified can be described as 'microlithic' and there are a number of similarities in reduction strategies throughout. In all Phases, small chert cobbles were selected primarily for the manufacture of blade/let blanks for microlithic tools and were likely sourced from the gravel banks of the Moulouya River catchment. Based on the 'cortical' elements, it appears that pebbles were brought to the cave whole, without first being 'decorticated'. In all Phases, the most common types of core are single platform examples (32.1-41.2 %), followed by slightly lower frequencies of opposed platform cores (21.4-29.4 %). It would be misleading to draw a sharp distinction between these types, as many of the opposed platform cores have only one heavily exploited platform, with the other probably serving to correct knapping mistakes. Most often, the additional platform only has a couple of removals and the core was usually abandoned soon afterwards. Thus, in many cases the discarded opposed platform cores appear to be indicative of a failed effort to regulate the core or a last-ditch attempt to maximise the number of removals towards the end of the reduction sequence. There is only a little evidence to indicate regular rotation of the core and/or concurrent exploitation of two or more striking surfaces. Forty-one (18 %) of bladelets show bidirectional opposed scars.

Even though there are broad similarities between Phases, subtle temporal changes are suggested in the methods of core reduction. In particular, there appears to have been an increasing reliance on certain techniques for maximising the available raw material towards the top of the sequence. For instance, there is a very slight increase in the numbers of cores-on-flakes, from a total absence at the base of the Lower Phase, to moderate frequencies in the Middle Phase (6.1 %) and relatively high frequencies in the Upper Phase (10.7 %). This may be connected with a way of extending material in the manufacture of microlith tool blanks. At Grotte des Contrebandiers on the Atlantic coast of Morocco, Olszewski/Schurmans/Schmid (2011) have suggested that cores-on-flakes, along with *pièces esquillées* (i.e. splintered pieces), show a deliberate process to maximise the use of raw materials. It is certainly the case that cores-on-flakes might indicate a more economic use of raw material at Taforalt but, unlike Contrebandiers, the use of the bipolar technique for reducing flakes does not seem to have been habitually practiced (this may be linked to differences in quality of raw material between the two sites); splintered pieces account for only a very small proportion of the diagnostic artefacts from the three major Taforalt Phases (0.2-0.4 %). The low, yet sustained, numbers of tested and early abandoned cores in the Lower and Middle Phases (5.9 % and 6.1 %, respectively), contrasts with a complete absence in the Upper Phase, perhaps suggesting a more extended use of the raw materials near the top of the sequence. Alternatively, Bouzouggar has noted that some of the cores in the lower part of the Grey Series (equivalent of the Middle Phase) were deliberately left with large stepped removals, a practice that changed further up the sequence; he believes they may have functioned as planing tools ('*rabots*'). Such ideas could be tested by use-wear studies.

Evidence from the core-trimming elements also suggests some changes in core-shaping strategies through time. An increasing proportion of such elements has been recorded upward through the sequence. In relative terms, core-trimming elements in the Upper and Middle Phases (2.1 % and 2.4 %, respectively) are broadly twice as common as in the Lower Phase (1.1 %). In each Phase, crested blades are the most common core-trimming elements. Most often these have only been prepared along one versant, occasionally with outer surface preserved on the other margin. In addition, from time to time, minor adjustments were made to the angle of platforms by the removal of small rejuvenation flakes, which are rarely large enough to be described as true core tablets. In the Upper and Middle Phases, *flancs de nucléus* are also recorded in small numbers, indicating another method of core rejuvenation, focused on refreshing the whole of the flaking face. No *flancs de nucléus* have been recorded in the Lower Phase, although the overall sample size is relatively small and the use of this technique cannot be excluded.

In every part of the sequence, the primary objective of core reduction seems to have been the manufacture of small blade/lets and elongated flakes. There were higher frequencies of blade/lets in the Lower Phase (20.2 %) than in the Middle Phase (16.3 %) and even fewer in the Upper Phase (12.3 %). This might be taken at first glance to indicate a drop in the prevalence of blade/let production in favour of flake manufacture. However, several features of the assemblage tentatively indicate that the reduced frequencies reflect a more rigorous use of available blade/let blanks in the upper parts of the stratigraphic sequence.

First, the relative frequencies of 'cortical' and 'non-cortical' elements amongst the flakes remained stable, but there were more 'cortical' blade/lets towards the top of the sequence, suggesting that, rather than an increase in the manufacture of flake blanks, more 'non-cortical' blade/lets are being utilised (and removed) from the assemblage towards the top.

Second, a more exhaustive use of available blade/lets is supported by the ratios of these items to retouched tools. In the Upper Phase the ratio of blade/lets to tools was 1:1.69, which means that retouched tools were more common than blade/lets. However, in the Middle and Lower Phases, the ratios were respectively 1:0.93 and 1:0.85, which means that retouched tools were here less common than unmodified blade/lets. An almost two-fold increase in the number of blade/lets retouched into tools would account for the relatively low numbers of 'non-cortical' blades and high proportions of tools in the Upper Phase. The ratio of flakes to tools remains relatively low and consistent across the Upper, Middle and Lower Phases (1:0.34, 1:0.31 and 1:0.30, respectively), which suggests little change in the selection and retouching of flakes into tools. It seems likely that a reduction in the relative frequencies of blanks can be interpreted as an index of the degree of blank use. Thus, the recorded drops in the frequencies of blade/lets would suggest that raw materials were being utilised more exhaustively towards the top of the sequence, especially in the Upper Phase.

One potential caveat is that the signal of blade/let manufacture and use is potentially masked by the increased levels of burning, which may have led to greater fragmentation of blade/lets and bias against the blade/let recognition in the more heavily burnt components of the assemblage. However, the frequencies of artefacts classified as blade/lets and their fragments remain relatively stable throughout and suggest limited changes in the fragmentation of blade/lets regardless of levels of burning. Of the blade/lets, around three quarters are broken fragments in the Upper, Middle and Lower Phases (75.4 %, 76.3 %, and 73.4 %, respectively).

There were a few subtle changes in the morphology of blade/lets over time, which indicate that, in addition to the increased utilisation of available blade/lets, there were also changes in their manufacture. Even though bladelets dominate throughout and there is limited evidence for the manufacture of blades *sensu stricto*, there are significant differences in size of surviving bladelets through time, with progressively wider and thicker values towards the top of the sequence giving a statistically significant result. It is plausible that this is simply a result of the increase in 'corticated' elements, although the dimensions of the microlithic tools suggest otherwise (see below). A subtle change has also been observed in the length of bladelets, with progressively longer blanks towards the top of the sequence.

There is some subtle variation in the morphology of striking platforms on blade/lets that might be indicative of changes in manufacturing technique (see **tab. 12.10**). For example, there are significantly fewer blade/lets with punctiform/linear butts in the Upper Phase (33.3 %) than in the Middle (47.5 %) and Lower Phases (78.9 %). At first glance this might imply greater attention to the preparation of butts lower down in the sequence but the appearance of blanks with faceted and dihedral butts in the Upper and Middle Phases would appear to contradict this. The use of hard hammer technique does not appear to have been prevalent in any of the Phases.

Microburin Technique

It appears that some of the most marked differences in reduction occurred at the stage of transforming blade/lets into retouched tools, including differences in the utilisation of the microburin technique for sectioning blanks. Evidence of the use of the microburin technique has been recorded from each of the major Phases. However, there are significant differences observed in the frequencies of microburin discards, along with changes in tool forms, which suggest that the nature and use of the technique fluctuated considerably through time.

In the Upper Phase, very few microburin discards have been recovered, yet most of the microlithic forms from this interval are thought to have been made using the microburin technique, such as convex-backed bladelets *sensu lato* (types 56-59). A general lack of microburin discards may indicate that sectioning of blanks and retouching of microliths was conducted elsewhere in the cave. Alternatively, the limited number of microburin discards might reflect the retouching of microburins themselves into microliths (**fig. 12.4**), as has been suggested in relation to roughly contemporary industries in the Near East (Neeley/Barton 1994).

Throughout the Middle Phase (YS and GS), a notable feature of the assemblage is the abundance of microburin discards, which were found alongside relatively high numbers of *La Mouillah* points (type 62). A *La Mouillah* point retains a microburin facet at one end and has a backed margin. This type is quasi-absent elsewhere in the site. There is some question as to whether *La Mouillah* points represent an intermediate stage in the manufacture of other microlithic forms (e.g. convex-backed bladelets *sensu lato*, segments) or final tool forms in and of themselves. Judging by the lack of macroscopic wear, it seems plausible that *La Mouillah* points were an intermediate stage in microlith manufacture. If this is the case, then the high discard rates of these 'unfinished tools' might indicate a liberal use of raw material during the Middle Phase. In this Phase, the microburins were often relatively large (another possible indication of the abundance of raw material).

In the Lower Phase, few microburin discards have been recovered and, additionally, microlithic forms retaining their bulbs are common, such as obtuse-ended backed bladelets and Ouchtata bladelets. Thus, the relatively limited number of microburins may genuinely reflect a rarity in the utilisation of the microburin technique in the Lower Phase. There is also some slight evidence here for differences in the use of the microburin technique. In contrast to the Transitional/Mixed Phase, the microburins mainly removed the butt of the blade/let, the notch was most often formed on the right margin, and only a relatively short section of the blank was removed.

Although no detailed comparative analysis of microburins from earlier excavations has yet been made, it can be noted that some of the general stratigraphic distributional trends seen here are remarkably similar to those observed by Roche (1963, 147). In particular, he recognised a decreasing upward pattern in the GS microburin proportions; his data also show that the pattern was geographically consistent across the interior, middle and exterior zones of the cave. An additional feature is that, at each level, the lowest numbers of microburins occurred towards the exterior, with the highest numbers towards the interior.

Microlithic Typology and Lateralisation

Major differences have been recorded across the sequence in the most common microlithic forms.

The Upper Phase assemblage is dominated by convex-backed bladelets *sensu lato*, followed by moderate numbers of pointed straight-backed bladelets *sensu lato*. A relatively high proportion of the convex-backed bladelets *sensu stricto* tend towards typical segments. A small number of true 'geometric' segments have also been recorded and, together with the other 'geometric' forms, make up a relatively strong proportion of the tool assemblage.

The Middle Phase is similarly dominated by convex-backed bladelets *sensu lato*, although there is only a low proportion of pointed straight-backed bladelets *sensu lato.* In contrast, there are relatively strong numbers of *La Mouillah* points in the Middle Phase, which, as noted above, might represent an intermediate stage in microlithic tool manufacture (**fig. 12.6**). None of the other microlithic forms is particularly well-represented, but several forms more commonly found at the base of the sequence have been recovered here too in small numbers (e.g. obtuse-ended backed bladelets, Ouchtata bladelets).

The Lower Phase differs substantially from the other two Phases. Convex-backed bladelets *sensu lato* make up only a small proportion of the assemblage and *La Mouillah* points are entirely absent. In contrast, the most common forms are Ouchtata bladelets, whilst obtuse-ended backed bladelets (differing mainly from the former in the thickness of the retouched edge) are also relatively common. Even though pointed straight-backed bladelets *sensu lato* are recorded in broadly comparable relative frequencies as in the Upper Phase, differences are noticeable in their morphology. In the Lower Phase, the pointed straight-backed bladelets *sensu lato* tend to have more marginal retouch, which is relatively irregular. In addition, some of these forms resemble the partially backed bladelets with pointed ends, differing only in the extent of the retouch along the edge, and this last form also only occurs in notable frequencies in the Lower Phase. The highest frequency of scalene bladelets is also recorded here. None of the other types is well-represented in the Lower Phase.

The length of microlithic forms also differs significantly across the sequence, with shorter examples, on average, recorded in the Upper and Middle Phases. Neeley / Barton (1994) have suggested that a reduction in microlith size relative to blank size might be symptomatic of a shift towards the manufacture of more than one microlith from a single blank. Given that blank length remains relatively stable throughout the sequence this could explain the shift towards shorter forms at Taforalt. Further evidence for producing more than one microlith from a single blank is also suggested by the changing application of the microburin technique in the Upper Phase, which we tentatively suggest allowed manufacture of microliths from both the microburin and the corresponding blade / let section with a trihedral point. However, in the Middle Phase, there is strong counter-evidence, indicating that typically only a single tool was manufactured from each blank, as evidenced by the numerous surviving long microburin discards.

It is generally assumed due to their size that microliths normally served as replaceable inserts or tips in hunting projectiles. However, it is equally possible that they were hafted in handles for other uses such as "[…] 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, 476). There is little direct evidence for hafting methods in the North African record, although a sickle haft retaining three microlithic backed inserts was recovered from a later Epipalaeolithic level at Columnata (Cadenat 1960). No such evidence is available from the preceding LSA / Iberomaurusian but some indication that at least a proportion of these tools were used as projectile tips comes from a preliminary study of diagnostic macro-fractures patterns on microlithic forms from Tamar Hat, eastern Algeria (Merzoug / Sari 2008; Sari 2014). At Taforalt, observations tentatively indicate that some of the microliths were components of composite tools. There is also a slight shift temporally from damage initiating laterally along one edge to damage initiating from the end of the tools, which might be indicative of changes in hafting configuration and / or use (pers. obs. J. Hogue). More experimental data are required better to understand and reconstruct the hafting methods and uses of such tools during the LSA. Nonetheless, it is tempting to speculate that changes in techno-typological attributes may reflect a progressive shift in the function of microlithic forms through the sequence.

As well as the changes mentioned above, there is significant variation in retouch lateralisation. In the Upper and Middle Phases there is an overwhelming tendency towards retouching the left margin (61.9 % and 80.0 %, respectively), in contrast to the percentage of such examples in the Lower Phase (36.8 %). A similar observation was also made in the retouch lateralisation on the microburin discards. Some authors have argued that retouch lateralisation reflects the handedness of the knapper (e. g. Conneller 2006; Peresani / Miolo 2012). However, other studies have consistently shown that, whilst there may be some subtle variation in handedness, based on geographical and ethnic differences, about 90 % of all people are right-handed (McManus 2009 but see Stock et al. 2013 for a discussion of variability in this characteristic).

An alternative suggestion by Close (1977; 1978; 1989) is that retouch lateralisation is functionally neutral and, as such, reflects 'stylistic' traditions for manufacturing tools by different socio-cultural groups (cf. Sackett 1977). Another possibility is that style might lie with the haft, i. e. determining how the microliths are inserted (A. Roberts, pers. comm.). Close has recorded the dominance of right lateral backing on microlithic forms from the Iberomaurusian sites of Rassel and Tamar Hat (eastern Algeria). Based on this and other similarities in the lithic assemblages, she concluded that they were created by a single, diachronic, social group. Existing and recently obtained AMS radiocarbon dates indicate that Rassel and Tamar Hat seem to overlap in age and, as noted above, right lateral backing was also dominant in the Lower Phase at Taforalt, which suggests some level of commonality with the assemblages from eastern Algeria. However, our study has included younger assemblages falling outside the timeframe examined by Close. Thus, left lateral backing was most common in both Upper and Middle Phases at Taforalt, which at leasts suggests there was a shift in retouch lateralisation through time at this site.

Based on the proposition that retouch lateralisation is 'stylistically' determined, and bearing in mind the other changes in lithic technology, it is tempting to speculate that the shift in retouch lateralisation might be linked to a change in socio-cultural group. It is interesting to note a dominance of tools retouched along the left margin has also been observed at Afalou Bou Rhummel (Hachi 2003) and Columnata (Sari 2012; 2014) in Algeria, sites that are broadly contemporary with the Upper and Middle Phases at Taforalt. This shift seems to challenge the existing notion that all microlithic assemblages from this region dating from the latest Pleistocene (i.e. Iberomaurusian) were the product of only one extended socio-cultural grouping (*contra* Close 1989; 1978; 1977; Sari 2012; 2014).

Expedient Tool Manufacture

In addition to the prevailing use of fine-grained chert probably from gravels of the Moulouya River catchment, there are also low background levels of a 'lithographic' limestone throughout the sequence, which is much coarser than the chert but is not as coarse as the actual bedrock of the cave. It appears that this material was locally available outside and below the cave (see **Chapter 2**) and was utilised for tool manufacture in a relatively *ad hoc* fashion. Most of the flakes in this material are relatively large, often retaining their original exterior surfaces, and have probably been struck using hard-hammer percussion, with little if any preparation of the edge of the striking platform. Only a few of the flakes of the limestone have been made into retouched tools, most often notches and denticulates. There was probably little time investment needed to produce tools of this sort, as the technology is basic, and the inhabitants of the site had a ready supply of limestone to hand. Even though there are low background levels of this material throughout the sequence, there is a significant increase in the quantity of limestone in the Upper Phase. There may be another reason why limestone was freely available actually on site: we have noted that enormous quantities were brought into the cave in the Grey Series period for pyrolithic reasons (**Chapter 2**).

It is also worth reiterating here that the majority of chert (and quartzite) artefacts originated from pebbles 2-10 cm long and were simply too small to produce the larger and heavier tools. This may also explain rocks sourced close to the cave such as limestone where the size was not so restricted. Furthermore, the latter is relatively isotropic and experiments have shown that it exhibits surprisingly reliable flaking properties, with good conchoidal fracture and unlike dolomitic limestone, for example, is able to hold an edge with not too much crushing.

While no detailed work has yet been undertaken on the Roche lithic artefact collections, it can be noted that similar trends in the distribution of the large (limestone) tools can be seen in his excavations (1963, 150). For example, the vertical increase in limestone is clearly apparent from his descriptions and seems to hold true for all three inner, middle and outer zones of the cave.

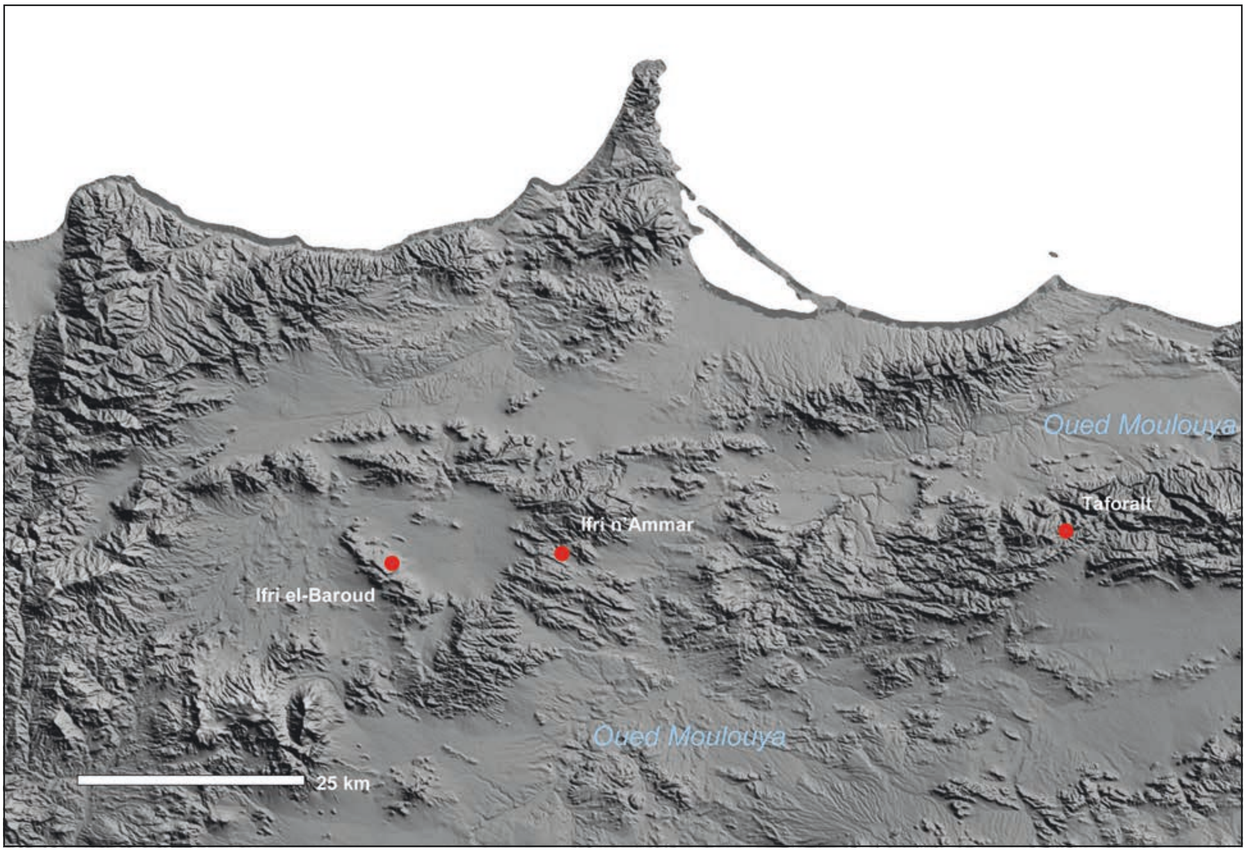

Fig. 12.15 Map showing Iberomaurusian sites of Ifri el-Baroud and Ifri n'Ammar in relation to Taforalt. – (Background image courtesy of NASA, SRTM).

Wider Regional Comparisons with Iberomaurusian Assemblages

Previous authors have applied different models for categorising variation in the Iberomaurusian, which have tended to be based on fluctuations in major tool groups (such as end-scrapers, burins, backed bladelets, etc.) (e.g. Balout 1955; Camps 1974; Lubell/Sheppard/Jackes 1984). In contrast, this study has found little evidence for variation in the major tool group frequencies at Taforalt and we therefore see little utility in using this method here (Hogue 2014). Instead, changes in the *chaîne opératoire* and nature of the microlith toolkit are far more useful for dividing the assemblages. Evaluation of the published literature suggests that several of the changes identified at Taforalt might have wider regional parallels. However, it has been difficult to apply the method uniformly because of the general lack of comparative information from other sites, so most of the comparisons are based primarily on tool counts with some general observations on the manufacturing techniques.

Lower Phase

There are few assemblages of comparable age to those from the Lower Phase at Taforalt. However, a coherent set of radiocarbon ages dating from ~20 to 11-10 ka cal BP has been published from the nearby site of Ifri el-Baroud (**fig. 12.15**), located in the *Rif Oriental* (Morocco) (Görsdorf/Eiwanger 1999). Those lithic assemblages have currently only been described according to broad lithostratigraphic divisions (e.g. *escar-*

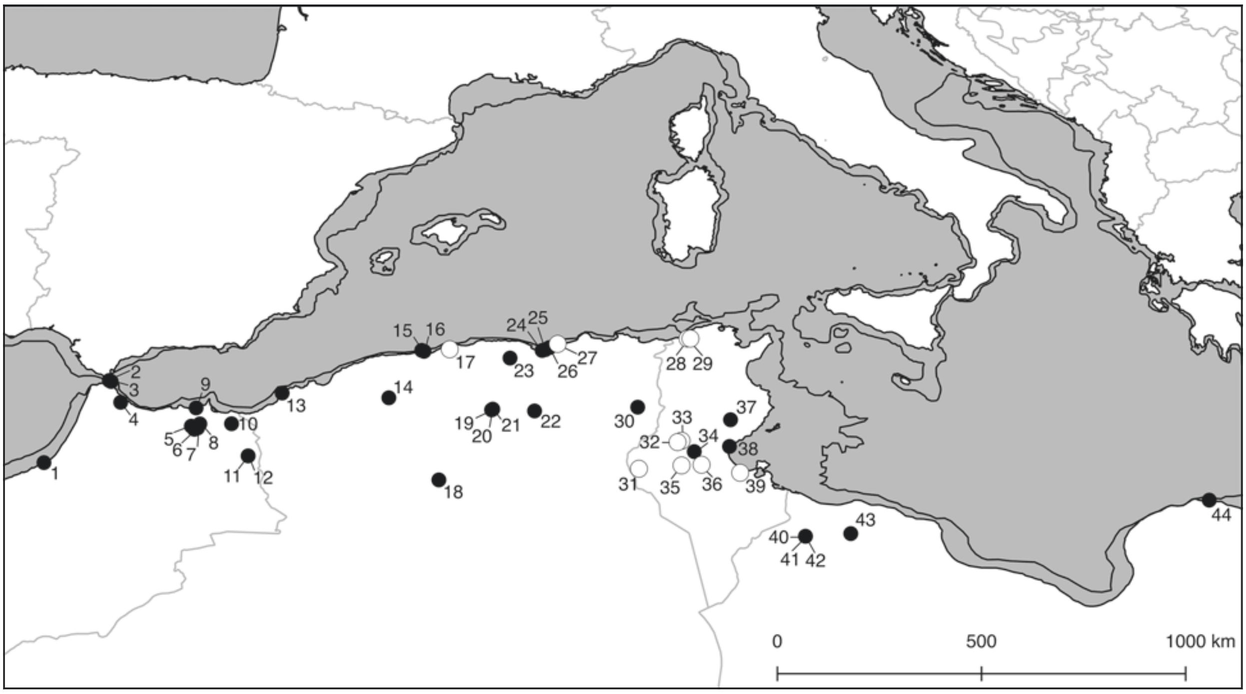

Fig. 12.16 Distribution of Iberomaurusian and related microlithic assemblages: **1** Contrebandiers; **2** Kehf That el Ghar; **3** Ghar Cahal; **4** Kehf el Hammar; **5** Taghit Haddouch; **6** Hassi Ouenzga open air site; **7** Ifri el-Baroud; **8** Ifri n'Ammar; **9** Ifri Armas; **10** Grotte des Pigeons Taforalt; **11** Chaâba Bayda site 1; **12** Chaâba Bayda site 2; **13** Oued Guettara II; **14** Columnata; **15** Rolland; **16** Rassel; **17** Oued Kerma; **18** El Haouita; **19** El Hamel; **20** El Onçor; **21** Es Sayar; **22** M'Doukal; **23** Gueldaman 1; **24** Tamar Hat; **25** Afalou Bou Rhummel; **26** Taza I; **27** Djidjelli; **28** Ouchtata *rive gauche*; **29** Ouchtata *rive droite* localities; **30** Wadi Mezeraa; **31** Grotte Velozzo; **32** Sidi Mansour; **33** Lalla; **34** Bir Oum Ali; **35** Menchi; **36** Ain el Atrouss; **37** Rammadiya El Oghrab; **38** Fadh el Nadhour 1; **39** Mareth; **40** SJ-00-55 West; **41** SJ-00-55; **42** SJ-00-55 East; **43** SG-99-41; **44** Haua Fteah.

gotière and *couche rouge*) (Nami 2007), which makes it difficult to tease out finer-grained chronological differences. Nonetheless, there are some observable similarities between lithic assemblages from the *couche rouge* and the Lower Phase at Taforalt, with a small assemblage, containing pointed straight-backed bladelets (type 45), partially backed bladelets (type 63), obtuse-ended backed bladelets (type 67) and Ouchtata bladelets (type 70), having been described from *sondage II*. The available radiocarbon ages for the *couche rouge* suggest a broadly equivalent age to the Lower Phase at Taforalt, with the el-Baroud dates ranging from between 20,488-20,003 cal BP (Bln-4774, 16,777 ± 83 BP) to 16,287-15,826 cal BP (Bln-4745, 13,359 ± 72 BP) (Görsdorf/Eiwanger 1999; Nami 2007, 228).

There is also some evidence for techno-typological similarities between Taforalt and assemblages elsewhere in the Maghreb. New AMS radiocarbon ages indicate occupation between ~25 to 20-19 ka cal BP at the site of Tamar Hat, situated on the *Golfe de Béjaïa* (eastern Algeria), and the lithic assemblages from there are also characterised by the careful production of blade/lets from single platform cores using a soft-hammer technique, with resulting blanks often being transformed into pointed straight-backed bladelets (type 45) and partially backed bladelets (type 63), as well as into more marginally retouched Ouchtata bladelets (type 70). A notable feature which also offers comparison is in the lateralisation of retouch, with a preference for modification on the right edge of blanks at both localities (Hogue 2014; Hogue/Barton 2016).

Evident similarities are also observable amongst assemblages in Tunisia (**fig. 12.16**). Gragueb (1983) has re-analysed assemblages from across the country and records a series of early assemblages with high proportions of bladelets with Ouchtata retouch, obtuse-ended backed bladelets, and scalene backed bladelets, as well as predominance of right lateral retouch (>70 %) and low proportions of abrupt crossed retouch

(<25 %) on backed bladelets *sensu lato*. This appears broadly in keeping with material from the Lower Phase at Taforalt. None of the Tunisian assemblages is well dated, but an age estimate, based on correlation with a local aeolianite stratigraphic member, of at least ~21 ka cal BP has been suggested for some of the assemblages located in the vicinity of Ouchtata itself in northern Tunisia (ibid., 16). Currently there are no available radiocarbon determinations on bone or charcoal for sites in southern Tunisia, although an age of (C-3569) 17,470 ± 315 BP (21,945-20,325 cal BP) is available on ostrich eggshell from Bir Oum Ali (Vernet/Aumassip 1992). This may indicate the broadly contemporary appearance of LSA technology in southern Tunisia, but associated assemblages have not yet been fully described.

Transitional/Mixed Phase

Some scope for comparison may occur with the site of Ifri n'Ammar (**figs 12.15-12.16**), in the Moroccan *Rif Oriental* (Mikdad/Eiwanger 2000; Moser 2003). A gradual shift from marginally retouched Ouchtata bladelets at the base of the sequence in *enlèvement* [spit] 28 (as yet undated) to high concentrations of *La Mouillah* points (type 62) and numerous microburins in *enlèvements* 25-23 has been noted. An age of (UtC-6180) 13,590 ± 70 (16,651-16,148 cal BP) from *enlèvement* 26 gives a *terminus ante quem* for the inception of the Ouchtata bladelet-rich assemblages, which falls towards the end of the timeframe for the Lower Phase at Taforalt. It is easy to see parallels between the successive industries at Ifri n'Ammar and Taforalt and yet the replacement of assemblages rich in Ouchtata bladelets by those rich in *La Mouillah* points seems more gradual at Ifri n'Ammar. A mixture of Ouchtata bladelets and numerous microburin discards has also been recorded in the Transitional/Mixed Phase, although there were few *La Mouillah* points. Unlike Taforalt however, the assemblage from Ifri n'Ammar might suggest the possibility of a genuine gradual transition between industries comparable to those of the Lower and Middle Phases at Taforalt. It is difficult to evaluate fully this hypothesis, as there is strong evidence of bioturbation at Ifri n'Ammar in most levels of the *couche rouge* (i.e. the 70 cm thick Unit B, below the 'grey snail' Unit A) (cf. Klasen et al. 2018). Moreover, excavations at Ifri n'Ammar involved the use of horizontal spits and it is certainly plausible that the *enlèvements* cut across distinct sediment boundaries, as is suggested by the available stratigraphic profiles. If so, each *enlèvement* might include a mixture of lithic materials from a relatively broad time-range and time-averaging between stratigraphic units could explain what appears to be a relatively gradual change in the retouched components when compared with the sequence at Taforalt.

Middle Phase

Evidence for similar assemblages to those in the Middle Phase at Taforalt is less persuasive. Setting aside the stratigraphic caveats mentioned above, there is some evidence for comparable assemblages at the nearby site of Ifri n'Ammar, with high concentrations of *La Mouillah* points (type 62) and numerous microburins in *enlèvements* 25-23, which date from ~16.4-16.2 ka cal BP (Moser 2003).

A lithic assemblage including relatively high frequencies of *La Mouillah* points and numerous microburins has also been described from the open-air site of Es Sayar, located at the eastern edge of the *Hauts Plateaux* in northern Algeria (Amara 1977). A single radiocarbon age on ostrich eggshell of (Gif-4349) 13,100 ± 250 BP (16,491-14,955 cal BP) also suggests that the assemblage is broadly contemporary with the Middle Phase at Taforalt.

No other sites with radiocarbon ages show clear affinities with the Middle Phase at Taforalt. However, a couple of particularly important caves were excavated in the early-19th century by Barbin (1910; 1912; Pallary 1909) along the margins of the Oued Mouillah, c. 5 km north of Maghnia in western Algeria, which showed a proliferation of "*lames à dos et* «*piquant trièdre*»" (now known as *La Mouillah* points). Interestingly, the sites of *La Mouillah* provided the type-assemblage for the Iberomaurusian (Pallary 1909) as well as the namesake of the *La Mouillah* point (Tixier 1963). Unfortunately, the collections from these sites were largely divided up between different institutions and there do not appear to have been any subsequent excavations at the caves. Nonetheless, the high numbers of *La Mouillah* points is of interest, given that it is one of the defining characteristics of the Middle Phase at Taforalt.

If the timeframe for the Middle Phase (c. 15,615-14,453 cal BP; cf. **Chapter 4**) at Taforalt is anything to judge by, then this technological repertoire was relatively short-lived, which may help explain the scarcity of comparable assemblages from other sites. A limited occurrence of such technology, but over a slightly longer period, is also suggested at the site of Ifri n'Ammar, with 37 *La Mouillah* points recorded in spits 28-18 (Moser 2003, 75) and covering a maximum potential age range of 16,651 cal BP (spit 26) to 14,378 cal BP (spit 18) (Moser 2003, 101). Beyond any genuine chronological patterning in the use of this technology, major difficulty in detecting similar occurrences is perhaps linked to the tendency of researchers in the region to describe assemblages by broad groups associated with *escargotières* (as an undifferentiated whole) and an underlying *couche rouge* (again often poorly differentiated into component stratigraphic units), as at Ifri el-Baroud (Nami 2007). Given that our work indicates the continuation of technological strategies across sedimentary boundaries, as well as significant changes in lithic assemblages without marked shifts in sediment type, *a priori* division of assemblages simply by gross sediment type is only likely to mask further variation within the Iberomaurusian. Although spit excavation may sometimes be the only logistical option, excavations of well-stratified sites using fine-grained approaches are needed to test whether similar assemblages exist at other sites.

In terms of yet wider connections, high proportions of convex-backed bladelets *sensu lato*, the prevalence of *La Mouillah* points and extensive use of the microburin technique have been used in the past to link the Iberomaurusian with the Mushabian of the Negev and the Sinai Peninsular (Bar-Yosef 1987). The Mushabian is now known to date between ~16.7-12.9 ka cal BP (Maher/Richter 2011; Maher/Richter/Stock 2012), which means that, at least in chronological terms, the possibility raised by Bar-Yosef (1987) of the Mushabian being ancestral to the Iberomaurusian remains an open question. Given the shared cultural markers (e. g. *La Mouillah* points), albeit in smaller proportions, in preceding assemblages of both regions, it is difficult to exclude the alternative hypothesis of independent development of homologous industries in each region. A separate development of these industries is also supported by the lack of similar assemblages in the intermediate zone between the Maghreb and the Levant.

Upper Phase

Based on the techno-typological characteristics of the assemblages, there is some evidence for continuity in the microlithic tool forms between the Middle and Upper Phases at Taforalt, with convex-backed bladelets *sensu lato* dominating in both Phases. Furthermore, there is also some suggestion of 'stylistic' continuity (e. g. functionally neutral, learned patterns of behaviours) in the form of retouch lateralisation that might indicate that both assemblages were manufactured by the same socio-cultural grouping, as opposed to that of the Lower Phase. Nonetheless, there are also shifts in technology in the Upper Phase, including the more thorough use of available raw materials and subtle changes in microlithic shapes.

Based on the number of sites broadly contemporary with the Upper Phase, it appears possible that there was a regional increase in populations at this time (Linstädter/Eiwanger/Mikdad/Weniger 2012). Regrettably, however, only a few of these lithic assemblages have been described in any detail. Amongst the sites that offer comparison are the *escargotière* layers at Ifri el-Baroud, which have yielded nine radiocarbon determinations in stratigraphic order ranging from 12,932 ± 78 BP (15,738-15,204 cal BP) to 11,508 ± 60 BP (13,469-13,230 cal BP) (Nami 2007). Of the microlithic elements from the *escargotère* in *sondage II*, the clear majority are convex-backed bladelets *sensu lato* and pointed straight-backed bladelets *sensu lato*, and there are also a comparable number of geometric segments, as observed in the Upper Phase at Taforalt. A similarity in microlithic forms is also observed at Ifri n'Ammar (Moser 2003), with a proliferation of convex-backed bladelets *sensu lato*, but largely to the exclusion of all other microlithic forms from *enlèvement* 18 onwards. The latter can be dated at the earliest from about (UtC-6177) 12,480 ± 80 BP (15,072-14,235 cal BP), near the beginning of the Taforalt Upper Phase, and is marked by the development of a large ashy midden. A notable increase is also recorded in the occurrence of geometric types (mainly segments) from *enlèvement* 11 onwards, which has been dated to (Erl-4399) 11,009 ± 144 BP (13,134-12,690 cal BP). Another site, Ghar Cahal, located in the Tingitane peninsula of northwest Morocco, has also yielded a stratified sequence of radiocarbon determinations for the later Iberomaurusian: (OxA-11323) 11,125 ± 65 (13,102-12,810 cal BP), (OxA-11322) 11,180 ± 65 BP (13,165-12,840 cal BP) and (OxA-11321) 9,470 ± 44 BP (10,799-10,578 cal BP) (Bouzouggar et al. 2008). Preliminary investigation of the lithic material shows similarities in knapping strategies, including the use of coarser-grained rocks for the manufacture of relatively expedient tools, as well as similar tool types to those found at Taforalt in the Upper Phase (Hogue pers. obs).

Grotte des Contrebandiers, situated on the Atlantic Coast of Morocco, has yielded three radiocarbon determinations of (Gif-2579) 14,460 ± 200 BP (18,095-17,071 cal BP), (Gif-2577) 12,500 ± 170 BP (15,261-14,089 cal BP) and (Gif-2580) 12,320 ± 600 BP (16,331-13,086 cal BP), although these 1980s dates are generally considered to be ambiguous (Roche 1976; Olszewski/Schurmans/Schmidt 2011). Nonetheless, there are some similarities with the lithic technology of the Upper Phase at Taforalt, with evidence for cores-on-flakes, as well as *pièces esquillées*, both probably intended at Taforalt to maximise the use of small-sized fine-grained raw materials. Differences in typology somewhat limit comparisons, although non-geometric forms are described as including pointed (*Aïn Kéda* points and points/spikes), curved-backed, and blunt-ended forms. The prevalence of *Aïn Kéda* points is potentially interesting, as this form is only found in any frequency at the (surviving) top of the Upper Phase at Taforalt. This microlithic form is known from the eponymous site of Aïn Kéda (western Algeria), which has tentatively been assigned to the Iberomaurusian *sensu lato* (Tixier 1963, 102). However, it should be noted that *Aïn Kéda* points have also been identified in Holocene assemblages, such as those observed at Mechta el-Arbi (Pond/Collie/Romer/Cole 1928), the Aïoun Berriche localities (Pond/Chapuis/Romer/Baker 1938) and Dakhlat es-Saâdane (Tixier 1955). Thus, the presence of this form might give some indication the assemblages belong to the end of the Pleistocene with similarities to the early Holocene industries.

The rockshelter site of Afalou Bou Rhummel, located at the edge of the *Golfe de Béjaïa* (eastern Algeria), shows broad similarities in the stratigraphic sequence to that of Taforalt, with a lower series of reddish clays (*couches XII-XI*) overlaid by an upper series of less compact sediments with a strong anthropogenic input that has been subdivided between relatively thin archaeological horizons (*couches X-V*) and overlying lighter-coloured more friable lenticular sediments with numerous cobbles, molluscs remains and bone fragments (*couches IV-I*) (Hachi 2003; 1996; Hachi et al. 2002). Unfortunately, only the finds from the *couches V-I* have been described in any detail. A wide range of ages have been given for *couche III* (11,450 ± 230 BP, Ly-3327, 13,753-12,824 cal BP; 11,560 ± 90 BP, unknown lab no. (Hachi 2003), 13,570-13,216 cal BP; 11,900 ± 140 BP, unknown lab no. (Hachi 2003), 14,080-13,456 cal BP) and *couche IV* (13,120 ± 370

BP, Alger-0008, 16,849-14,409 cal BP; 12,400 ± 230 BP, Ly-3288, 15,268-13788 cal BP; 12,020 ± 170 BP, Gif-6532, 14,477-13,461 cal BP). Each of the radiocarbon determinations has large error margins and must be treated with caution, but they give a general indication of an overlap in age with the Upper Phase at Taforalt. Based on the typological data at Afalou Bou Rhummel, the microlithic toolkit in each of the described *couches* is dominated by convex-backed bladelets *sensu lato* and by pointed straight-backed bladelets *sensu lato*. A notable feature of the assemblage is the increase in numbers of geometric segments towards the top of the sequence. However, there are also sizeable amounts of geometric triangles (types 89-93) in *couche IV*, which are practically absent in broadly contemporary deposits of the Upper Phase at Taforalt. Hachi (2003, 230) has also noted the increasing prevalence of coarse-grained local materials towards the top of the sequence at Afalou Bou Rhummel, which suggests at least superficial similarities with use of raw materials observed at Taforalt.

Earlier and more recent analyses of the lithic assemblages from Columnata (Brahimi 1972; Sari 2012; 2014), also suggest broad similarities in the lithic assemblages to those from the Upper Phase at Taforalt. The Columnata assemblage has been recorded as being dominated by convex-backed bladelets *sensu lato* and straight-backed bladelets *sensu lato*, but there are also particularly high numbers of geometric segments. A relatively high proportion of microburin discards has also been recorded and it is thought that the microburin technique was predominantly used to manufacture convex-backed bladelets *sensu lato* and segments. Sari (2012; 2014) has observed that there is a good availability of raw material in the vicinity, suitable for producing bladelet blanks, and it is plausible that the hypothesised recycling of microburin products was not necessary at this site. Irrespective of this detail, most microliths are retouched along the left edge at Columnata, which is consistent with the pattern observed in the Upper Phase at Taforalt. A single radiocarbon determination on freshwater mollusc shells (*Unio*) of (Alg-97) 10,800 ± 425 BP (13,495-11,394 cal BP at 95.0 % probability) has provided a broad age for the assemblage, suggesting a dating towards the end of the Pleistocene (Brahimi 1970; Rahmouni / Roussillot / Armanet 1972).

A small assemblage has also been described from El Onçor (Bou Saâda, Algeria) (Heddouche 1977), which has been dated by a single radiocarbon determination on ostrich eggshell to (Gif-4433) 10,040 ± 190 BP (12,390-11,161 cal BP). The microlithic toolkit consists almost entirely of convex-backed bladelets *sensu lato* and straight-backed bladelets *sensu lato*, showing an affinity in the frequency of these types with the Upper Phase at Taforalt. The use of the microburin technique is also attested.

Many sites lacking radiocarbon dates have been subject to more detailed lithic studies and might also be related on techno-typological grounds to the Upper Phase at Taforalt, including the sites of Bou Aïchem (Goetz 1967), El Hamel (Tixier 1954), Oued Yquem (Collina-Girard 1988), Rhirane (Wengler / Wengler 1980) and Velozzo (Treinen 1975). Gragueb (1983) has also described a sub-group of the "Southern Tunisian bladelet industries", including Menchia, Aïn el Atrous, Mareth, Aïn Zigzou and Buttes d'Guettar, as being characterised by high frequencies of backed bladelets (70-90 %), that tend to be pointed straight-backed bladelets *sensu lato* and convex-backed bladelets *sensu lato*, with backing most often on the left margin (55-70 %) and formed by crossed retouch (c. 55 % of cases). This sounds strikingly like the description of the Upper Phase at Taforalt, although these industries have been considered distinct from the Iberomaurusian (Gobert 1962; Castany / Gobert 1954). Lubell et al. (1984) have previously highlighted that several regionally discrete entities follow the Iberomaurusian (e. g. Keremian, Columnatian, varieties of the Capsian) and have reasonably made the argument for increased regionalisation towards the end of the late Pleistocene. Certainly, subtle differences in the occurrence of particular microlith types (e. g. *Aïn Kéda* points, segments, triangles) might indicate some diachronic and / or regional variation amongst later contemporary assemblages.