Chapter 17

Lithic artefacts: Phase 6, the elephant area

by Francis Wenban-Smith

INTRODUCTION

The great majority of the lithic collection from the site came from the Phase 6 clay, which produced 2,238 finds in total, although these included 157 natural pieces. The Phase 6 collection was sub-divided into three subsidiary assemblages for analysis (Table 17.1):

- Assemblage 6.1, the dense concentration south of Trench D;
- Assemblage 6.2, the generally more dispersed material north of Trench D, excepting the cluster around the elephant skeleton; and
- Assemblage 6.3, the specific cluster of artefacts around the elephant skeleton (Fig. 17.1).

Assemblages 6.1 and 6.2 are discussed subsequently (Chapter 18); the remainder of this chapter focuses on assemblage 6.3 from around the elephant skeleton. After a brief review of the quantity and provenance of this assemblage (below), the following section considers its taphonomy and site formation processes, taking account of results from sampling for microdebitage, the clustering of the lithic material and the degree of refitting. After this is an analysis of the technological *chaîne opératoire*, focusing on the source and transport of raw material, the evidence from refitting sequences of reduction and the typology of artefacts recognised as tools. The final section considers the interpretation of the elephant area as a whole, covering what might have been the circumstances of the elephant's death and the hominin interaction with its carcass, and whether the lithic evidence can provide any wider insights into hominin behaviour of the era.

Table 17.1 Phase 6 lithic collection, subsidiary assemblages

Assemblage	*Context/s*	*Natural pieces*	*Total flints*	*Notes*
6.3	40039 40078 40078? 40099 40100 40103	12	93	Flints from near elephant skeleton
6.2	40039 40068 40069 40070 40078 40099 40100 40103 40144 40158	6	135	More dispersed flints that were not near the elephant skeleton or part of the main scatter south of Trench D, including some from within the Phase 6b tufaceous channel fill
6.1	40036 40039 40039? 40078 40100	139	2010	Flints from main concentration south of Trench D
Total		157	2238	

Table 17.2 Assemblage 6.3, artefact collection from around the elephant: provenance and stratigraphic phasing (excluding natural pieces)

Phase	*Context*	*Artefacts (n)*	*Notes*
6	40100	1	-
	40078?	2	From bulk spoil samples taken after first discovery of elephant; uncertain context
	40078	62	Darker brown organic-rich bed in clay with elephant bones
	40099	14	Grey clay under the elephant bone horizon
6a	40103	1	Grey clay divided from overlying context 40099 by thin Fe-rich horizon, which was however faint immediately below the elephant skeleton
	40039	1	The bottom bed of the clay, sealed beneath the base of context 40103 in the vicinity of the elephant
Total		81	

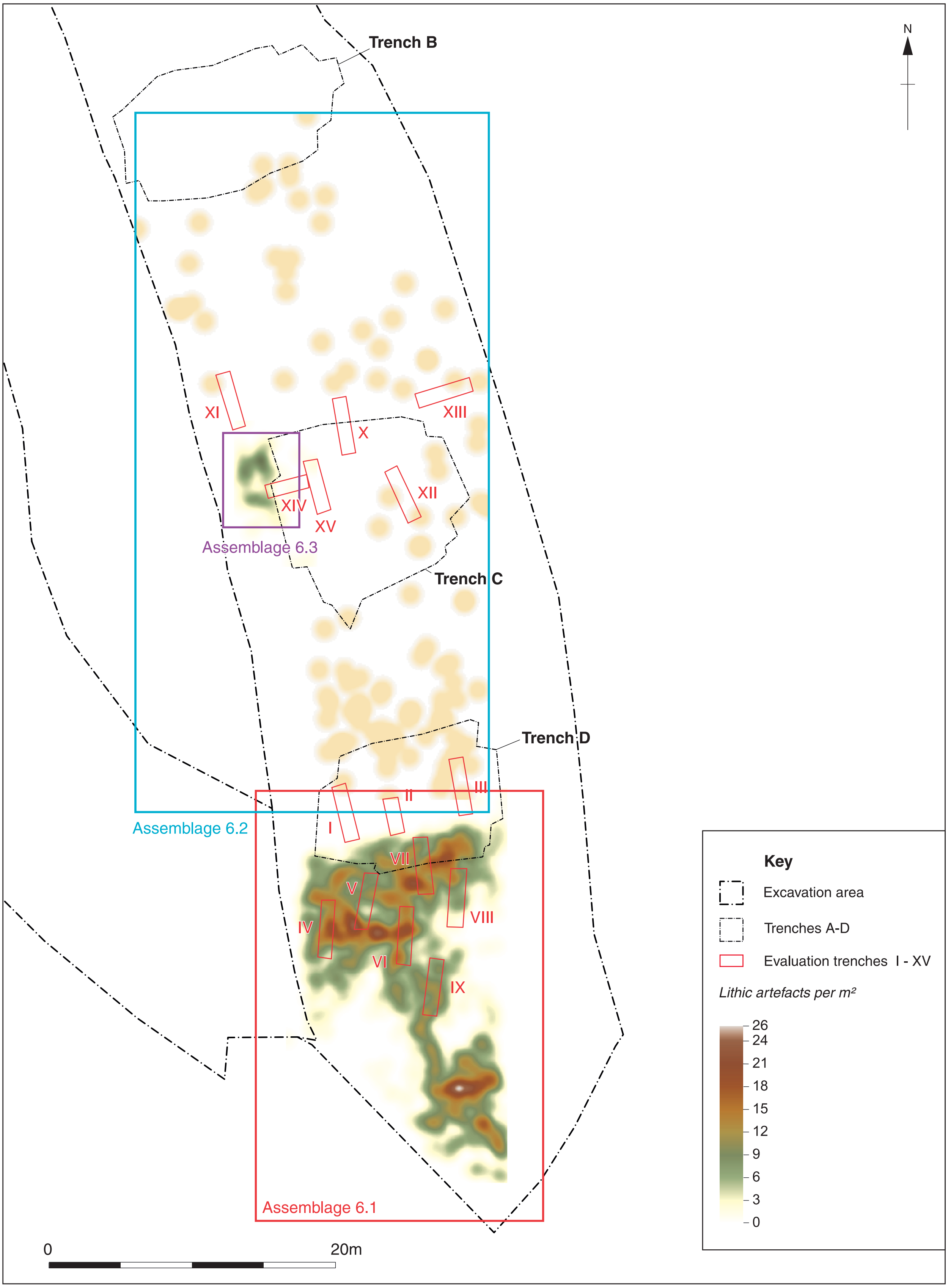


Figure 17.1 Phase 6 lithic distribution overview

PROVENANCE AND QUANTIFICATION

In total, there were 81 lithic artefacts recovered from the immediate vicinity of the elephant skeleton (Table 17.2; Fig. 17.2). Most of these were excavated, but two came from the bulk samples of machine spoil taken immediately after initial discovery of the skeleton. These were allocated context '40078?' as, although most of the sediment was from the same general horizon as the elephant bones, contamination from other horizons was also likely. The great majority of artefacts came from the same specific dark brown organic-rich context 40078 as the elephant

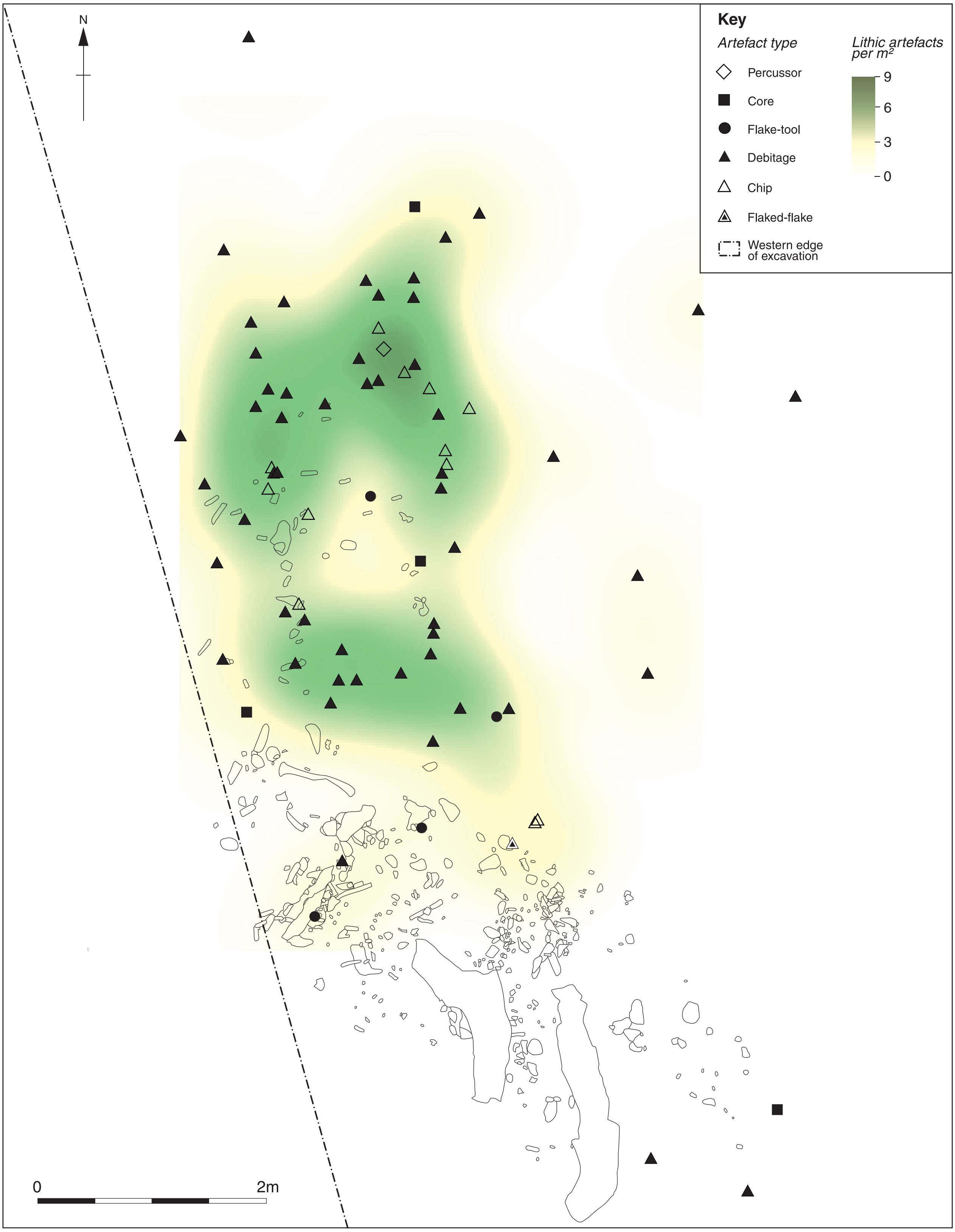
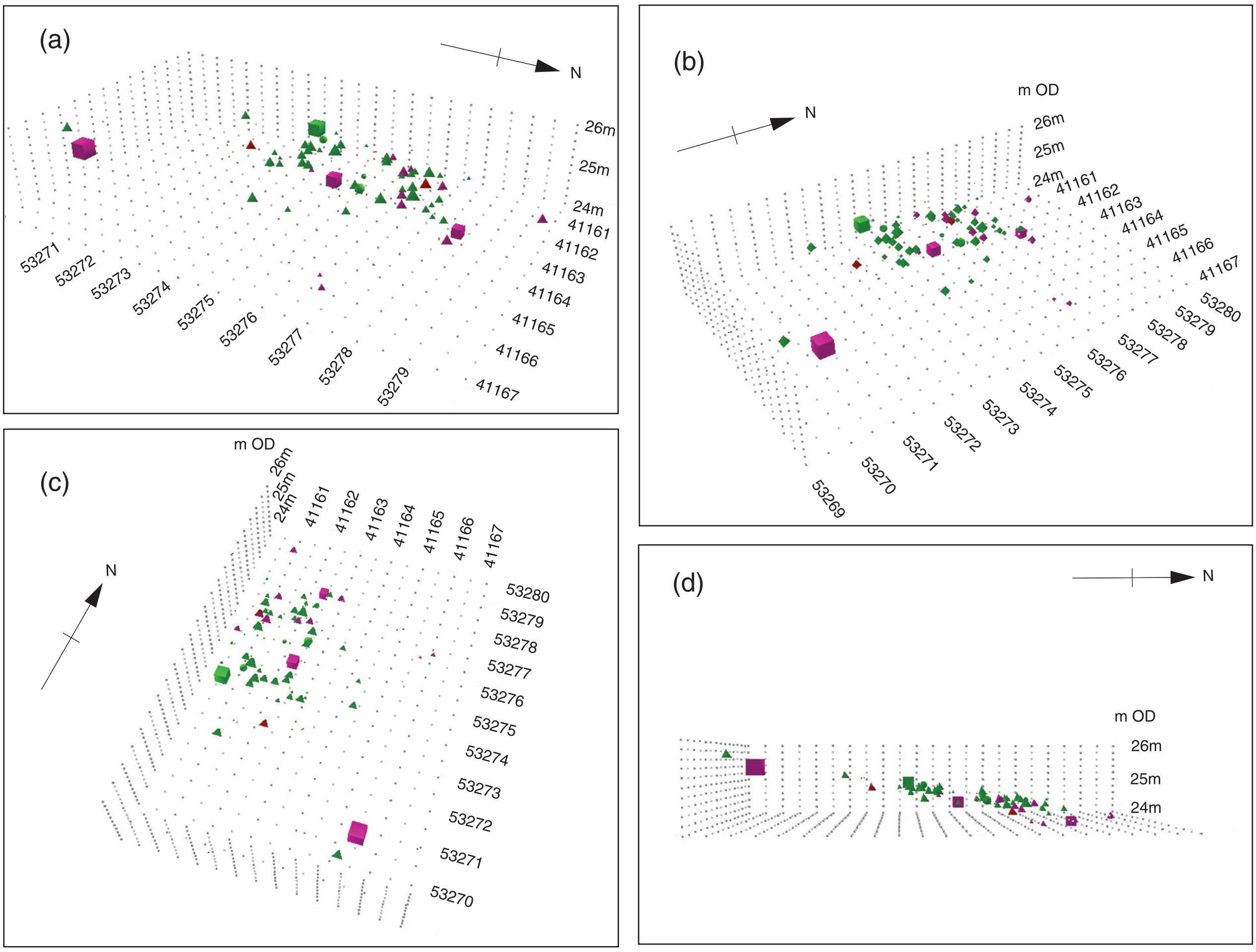


Figure 17.2 Lithic artefacts in relation to the elephant skeleton

bones, and thus are securely associated with them. The association of a few of the artefacts with the elephant skeleton is, however, questionable, particularly the two from the bulk samples, and the single artefact from context 40039 which was recovered from a clearly distinct bed well below the elephant horizon. All these artefacts were, however, initially included for consideration as part of the assemblage potentially associated with the elephant skeleton, prior to refitting studies to investigate the integrity of their stratigraphic provenance. Likewise, although almost all of the artefacts in the assemblage were in absolutely mint condition, as if freshly knapped, a few artefacts that were merely in 'fresh' condition and a single artefact (from context 40078) that was in slightly abraded condition were also all included in this initial consideration. This was prior to the refitting study and consideration of site formation processes.

TAPHONOMY AND SITE FORMATION

Almost all the artefacts from the assemblage around the elephant skeleton came from two contexts, 40078 and 40099; a few others came from overlying or underlying contexts, or were of uncertain provenance (Table 17.2). The mint or fresh condition of most artefacts and their clustering around the elephant skeleton provided an initial indication that they probably represent undisturbed evidence from hominin activity associated with the carcass. However, it remained to be established whether the different context provenance distinguished different episodes/phases of artefact deposition, or whether they perhaps reflected post-depositional artefact movement within the sediment, post-depositional development of sedimentary boundaries or imprecise field recording. To investigate the taphonomy



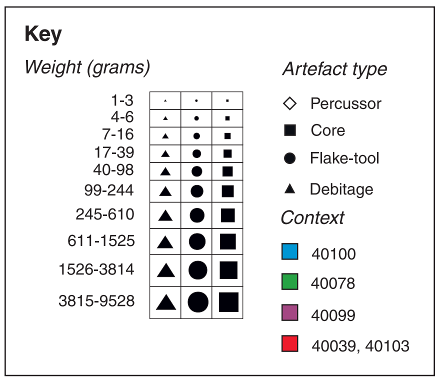


Figure 17.3 Snapshots from 3-D GIS model of the lithic scatter around the elephant skeleton: (a) oblique view (looking south-west); (b) oblique view (looking north-west); (c) top view; (d) side view (looking west)

and site formation process of the assemblage further, three approaches were adopted. Firstly, a 3-D GIS model was created with artefacts represented by different symbols for different technological categories, with the symbols sized according to their weight and colour-coded by context. This allowed initial investigation of the 3-D distribution of the artefacts, and of whether there was any immediate visual evidence of size-sorting, either laterally or vertically. Some snapshots from the model are illustrated here (Fig. 17.3), showing various views of the scatter around the elephant skeleton. This is however a poor second to viewing the 3-D model for real, which is available in the ADS online resources accompanying this monograph (ADS 2013).

The 3-D modelling showed that almost all of the artefacts were contained in a narrow band *c* 10-15cm thick that dipped northwards at an angle of *c* 20° from horizontal (Fig. 17.3d). There was just one exception (apart from those lacking precise coordinates, such as those recovered from the two bulk samples). This was the find from context 40039, which was a piece of irregular waste found at least 10cm lower than the rest of the lithic material; it was therefore excluded from subsequent analyses of the material around the elephant. There was no evidence of size-sorting, either horizontally or vertically.

Secondly, a refitting study was carried out. This included all the material from close to the elephant skeleton, designated as assemblage 6.3, which was examined in conjunction with the more sparsely distributed flints from the wider area of *c* 10m around the elephant skeleton. The results demonstrated a high proportion of refitting material near the skeleton, with seven distinct refitting groups A-G ranging from 2 to 24 artefacts in size (Table 17.3; Fig. 17.4). The single abraded flake in the assemblage from around the elephant (Δ.40659) did not refit, and so was excluded from subsequent analysis of the elephant assemblage, along with the two flakes of uncertain provenance from the bulk samples and the artefact from context 40039, none of which refitted. Of the 77 artefacts now comprising the elephant assemblage, including 12 tiny chips, 52 of them were indisputably refittable (ie 68% of the assemblage), and an additional two were thought likely to be part of the Group B sequence. The maximum spatial separation for any material within the same refitting group was also measured (Table 17.3). The greatest ranges (of between 4

Table 17.3 Assemblage 6.3: refitting groups and non-refitting artefacts summary [total excludes: natural pieces; two insecurely provenanced pieces Δ.44020 and Δ.44021 from bulk samples; debitage Δ.43843 from context 40039; and abraded debitage Δ.40659 from context 40078]

Refitting group	*Description*	*Artefacts (n)*	*Context*	*Maximum separation (m)*	*Notes*
A	'Piebald nodule'	7	40078	2.7	Sequence of flakes without core, from distinctive banded grey/white flint with green cortex
B	'Large cylindrical core' Δ.40494	7	40078	4.0	Sequence of flakes with core from early in its reduction
B?	Additional debitage, possibly related to large cylindrical core Δ.40494?	1 1	40099 40078	4.0 5.1	Cortical irregular waste from end of a cylindrical nodule, that is probably start of Group B sequence Small flake-flake that could be from secondary working of missing flake early in Group B reduction sequence
C	'Main core' flaking sequence, Δ.40871	18 6	40078 40099	5.0	Reasonably complete reduction sequence from initial decortication of nodule through to core
D	Broken percussor	5 2	40078 40099	4.7	Broken flint percussor
E	Broken core, 'Shattered nest'	3	40099	2.6	Core that has broken into three pieces from one blow, one of these pieces then knapped further
F	Broken flake	2	40078	0.4	Medium size flake, partly cortical that has broken on knapping
G	Broken cortical flake	2	40078	0.3	Small cortical flake that has split during percussion
-	Core	1	40099	-	Large core on southern fringe of elephant lithic concentration
-	Flake-tools	2 1	40078 40103	-	Two utilised flakes and one notched tool
-	Flakes	3 2 1	40078 40099 40100	-	Mostly from edge of elephant lithic concentration
-	Irregular waste	2	40078	-	-
-	Chips	11	40078	-	-
Total		77			

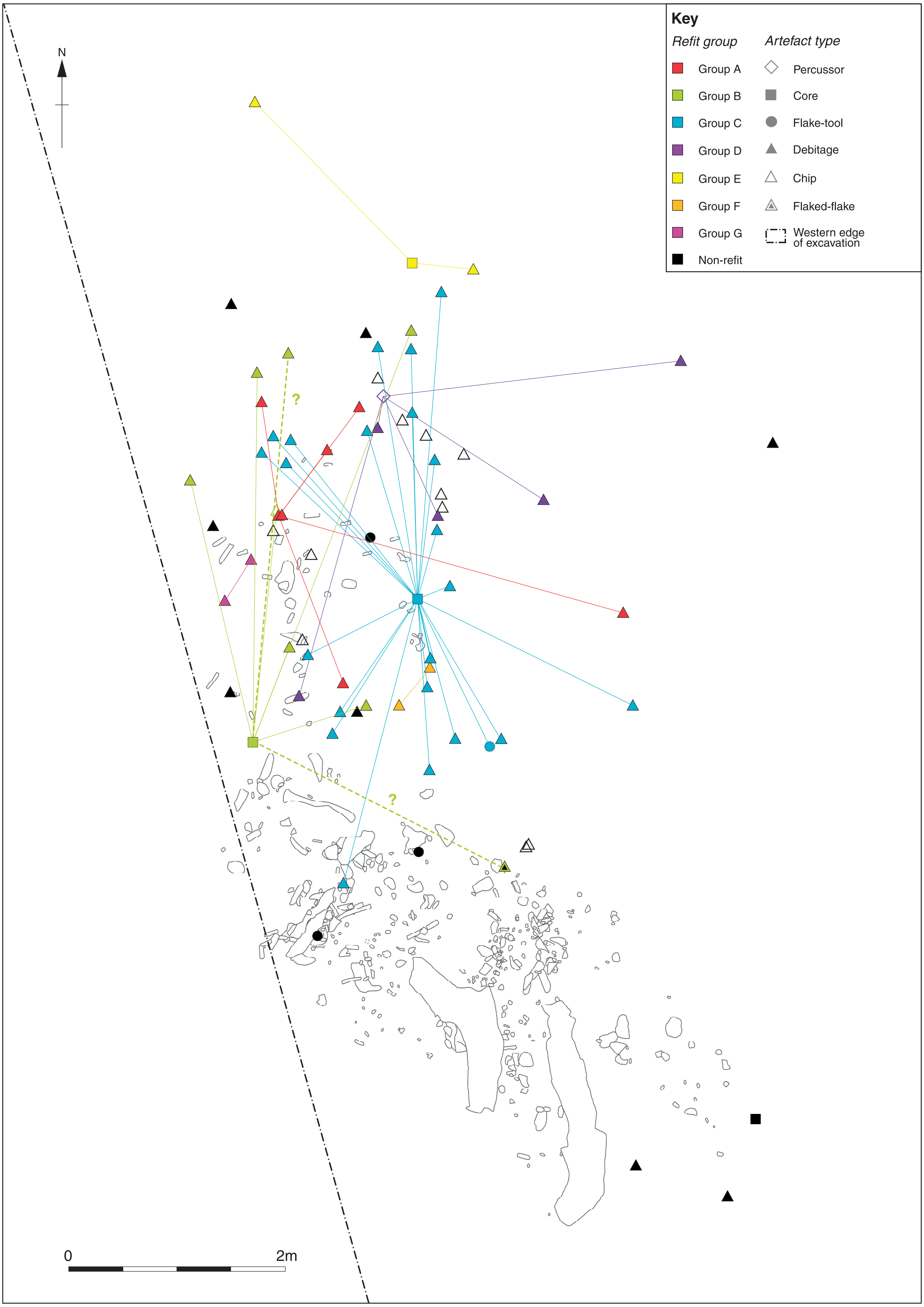


Figure 17.4 Orthogonal view (from above) of refitting groups A–G around elephant skeleton [lines linked to core or heaviest piece for groups where n>2]

and 5m) were recorded for the larger refitting groups B, C and D. The other, smaller groups had much more reduced refitting ranges, particularly the broken flakes represented by refitting groups F and G, which were less than 0.5m apart in both cases. The high proportion of refitting material (rising to 79% if one excludes the 11 small chips that were not refitted, but of which many appear likely to belong to the same raw material as the refitting groups), the internal clustering of the refitting groups and the generally small distances of separation all suggest a minimum of post-depositional disturbance.

The refitting summary table (Table 17.3) also shows the contexts of the refitting material within each of the refitting groups. This demonstrates that, although most of the groups contain material from just one context, two of the larger groups (C and D) contain material from both contexts 40078 and 40099. This establishes that there is no basis for regarding the material from these two contexts as meaningfully divisible. Although the two artefacts from contexts 40103 and 40100 did not refit to any other material, they are included in subsequent analyses as part of the elephant assemblage as they were shown in the 3-D GIS model to come from the same narrow band of artefacts as the rest of the elephant assemblage. Also, the distinction of these contexts from contexts 40078 and 40099 in the vicinity of the elephant was often unclear.

The third and final element of the taphonomic investigation was the microdebitage study. Experimental studies of technologically similar simple flake-core reduction sequences (see Wenban-Smith 1985 and 1996; Toth 1982) have established that even uncomplicated knapping strategies without platform preparation produce abundant microdebitage in the size ranges characterised here as chips and spalls, that is less than 20mm long; and also that all sizes of debitage are tightly spatially co-clustered for undisturbed knapping scatters. Based on the experimental work of Wenban-Smith (1985), which provides the most relevant comparison with similar reduction sequences applied to similar nodular flint raw material, small flakes in the size range 10-50mm typically remain within a circle of radius *c* 0.75m around the centre of the tight cluster of larger flakes (Fig. 17.5). Smaller chips in the size range 2.5-10mm typically remain within a slightly larger arc of up to 1m. The quantities of material produced in these size ranges were also collated in this study. Data from four experiments carried out in 1985 are shown, along with a fifth experiment carried out in 2011 as a control (Table

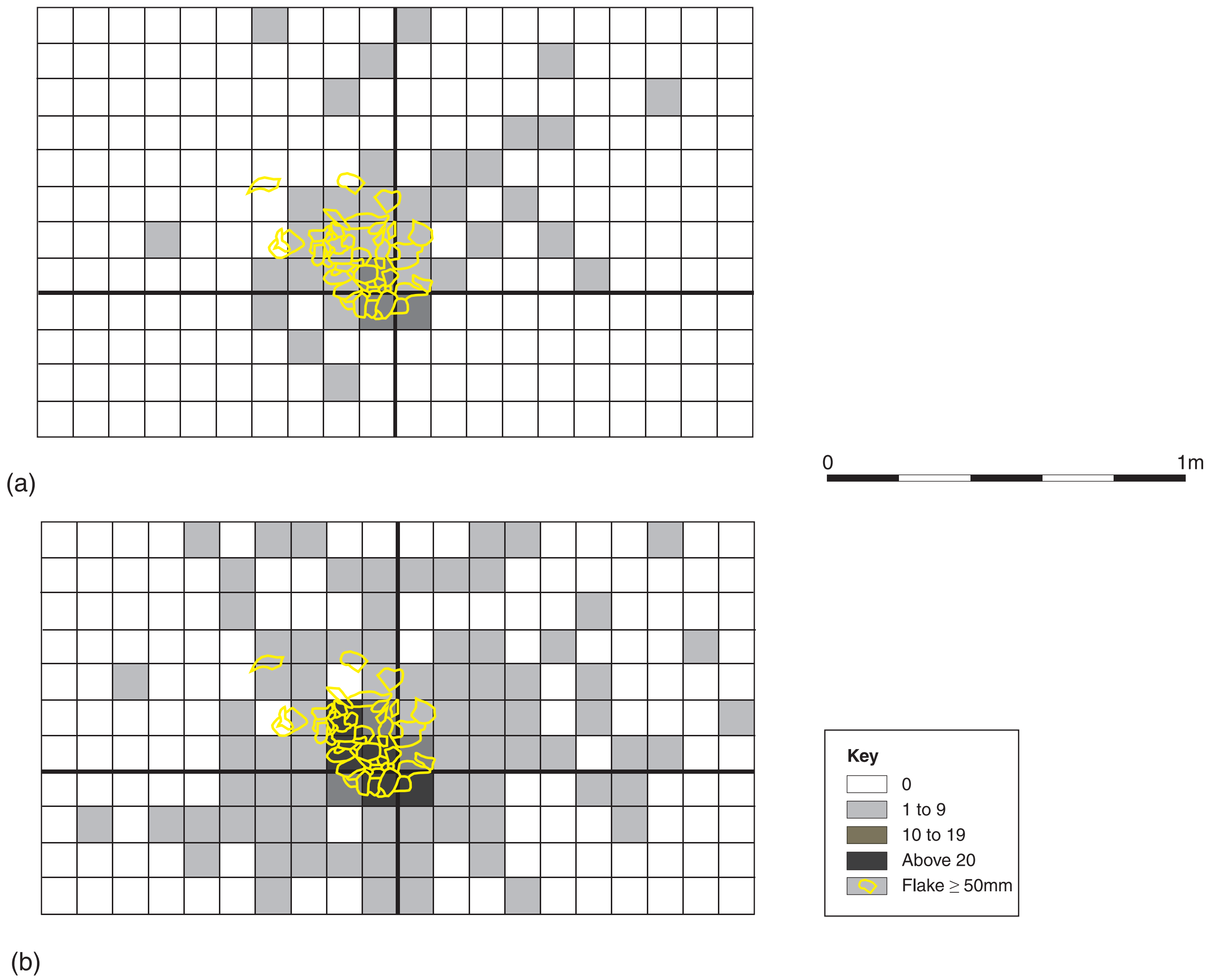


Figure 17.5 Spatial distribution of experimental flake/core (Clactonian) debitage: (a) flakes 10–50mm; (b) chips 2.5–10mm (from Wenban-Smith 1985)

17.4). All five experiments gave very consistent results, which indicated that for a knapping sequence long enough to produce at least 10 flakes ≥50mm, significant quantities of debitage (approximately four times as many) would be produced in the size range 10-50mm. There would also be even greater quantities of microdebitage in the size range 2.5-10mm (approximately ten times as many).

In order to investigate microdebitage from the lithic concentration around the elephant, an L-shaped pattern of sample squares was dug, with the long axis approximately NNW-SSE through the centre of the scatter, and the shorter axis orthogonal to this at the southern end of the scatter (Fig. 17.6). Each sample square was 0.5 x 0.5m wide and about 5cm deep. Unfortunately, rather

Table 17.4 Debitage size-profiles: comparative experimental data, assemblage 6.3 and microdebitage sampling strip

Size-range	*Ex 1*		*Ex 2*		*Ex 3*		*Ex 4*		*Ex 5 (2011)*		*All exps*		*Ass. 6.3*		*Microdebitage strip*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
≥ 50mm	14	8	32	6	27	7	39	6	10	6	136	7	27	41	10	53
≥10-50mm	53	30	115	21	100	25	128	20	46	26	440	23	38	58	6	32
2.5 - 10mm	108	62	403	73	270	68	469	74	121	68	1359	70	1	1	3	15

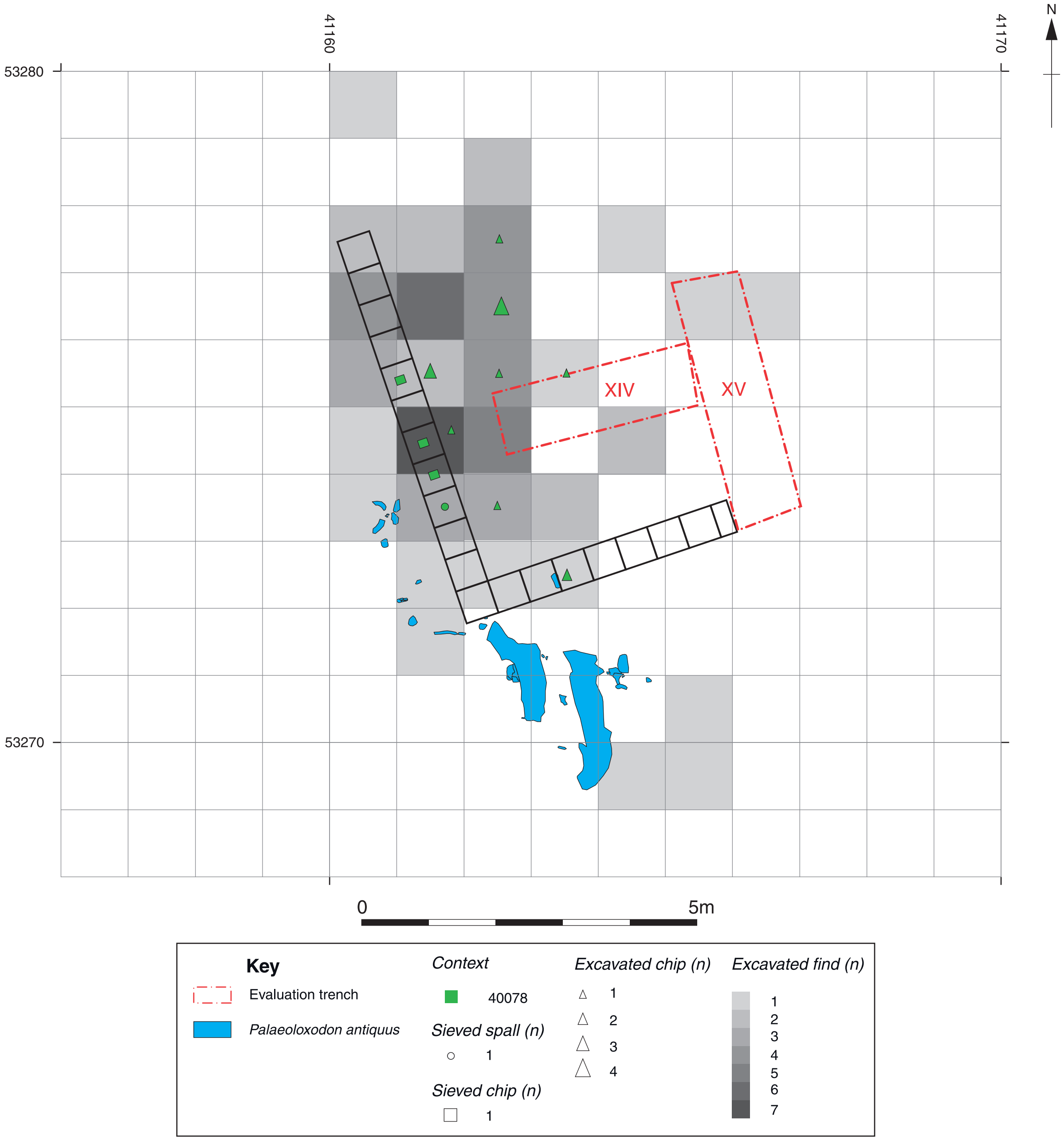


Figure 17.6 Microdebitage sampling and lithic recovery around the elephant skeleton

than the total sediment recovery that was intended within these squares, a sediment subsample of approximately only 2kg was taken from within each square, compromising meaningful comparison of the quantity of microdebitage recovered from the sampling with that from the comparative experimental work. Nonetheless, the results are presented here. Comparative quantitative data for the elephant scatter generally, and the longer axis of the L-shaped sample strip, are presented in the tabular data summary (Table 17.4). The quantities of microdebitage recovered in the sample strip are shown in relation to the distribution of larger artefacts in the elephant concentration (Fig. 17.6). Even allowing for the incomplete sampling, there seems to be an anomalous lack of the smaller chips and spalls that one would expect to be present in an entirely undisturbed and freshly knapped lithic scatter.

This impression was reinforced during hand excavation in the scatter area. Even though one cannot expect to reliably recover very small debitage when trowelling, one is generally aware when small pieces are encountered, particularly when flint artefacts are contained in a very clayey matrix as was the case here, as they scrape against the metallic trowel. From both personal experience of trowelling by the skeleton and the anecdotal reports of other excavators, this was not a common occurrence in the elephant area, and it was thought that a very high proportion of the lithic remains that were present were found and recovered. All flint pieces detected during trowelling were recorded as small finds, leading to the assemblage from around the elephant including 12 chips less than 20mm long. If there had been a greater abundance of small debitage, many more would have been noted and recorded during trowelling.

Taken together, the evidence seems to indicate a slight spatial disturbance of the larger lithic material, as well as of the elephant skeleton parts, alongside a sedimentary burial process that has led to the dispersal of the very small and more transportable lithic microdebitage. The distribution arc of each of the larger refitting groups B, C and D is, at *c* 5m, slightly larger than in the comparative experimental models of single reduction sequences (Fig. 17.5). It should of course be remembered that the Palaeolithic knappers may not have completed their reduction sequences on the same spot, and, as discussed below, Group D is a broken percussor rather than a reduction sequence. In addition, the elephant bones themselves are distributed more widely than, and have lost the patterning of, an entirely undisturbed skeleton (Chapter 8). Nevertheless, the fact that the elephant bones are still relatively concentrated in a scatter, with the tusks for instance still identifiably parallel, indicates minimal disturbance of faunal material in the area of the elephant skeleton. The larger lithics too are evidently minimally disturbed, given the high degree of refitting with the constituents of all the lithic refitting groups contained within such restricted areas. It seems inconceivable that the co-occurrence of the elephant skeleton and the undisturbed refitting scatters in the same location, and the same narrow stratigraphic horizon, should be a coincidence within the wider context of the sparsely distributed lithic and faunal remains in the surrounding Phase 6 clay. Consequently it seems inescapable that the knapping activity reflects hominin engagement with the carcass.

As discussed previously (Chapter 4), the Phase 6 clay is thought to have been mostly introduced into a standing/fluctuating water body by slopewash from high ground to the west. The elephant carcass, which was originally lying on a firm dry surface rather than mired in soft sediment, as indicated by the lack of deformation of the sedimentary sequence under the horizon where the bones were recovered, would have had substantial thickness when fresh. It seems that as it collapsed (or perhaps exploded) with decay, and perhaps also slightly spread out laterally due to water movement and slopewash input, some parts of the skeleton became incorporated in organic-rich peaty/clayey sediment during a phase of raised water level. This would have partially submerged parts of the decaying skeleton, leading to their preservation. The larger lithic artefacts that were associated with hominin activity in the area of the skeleton seem to have remained almost undisturbed during this process, perhaps also subject to very slight lateral displacement. However the smaller microdebitage that would almost certainly also have been present have been dispersed during this process of burial.

The final and most unfortunate aspect of the taphonomy and site formation process of the elephant area, is that its western part was bulk-excavated by machine in summer 2003 and taken away in the back of a lorry without anyone knowing of its presence. It is therefore now entirely uncertain whether there were many, or few, faunal and/or lithic remains lost during this process. There is thus forever a fog of uncertainty over whether the lithic collection is a relatively complete representation of activity in the vicinity of the elephant skeleton, or whether certain potentially behaviourally significant gaps and absences in the lithic collection (discussed below) would have been filled by recovery and analysis of the lost part of the site.

TECHNOLOGY, TYPOLOGY AND THE *CHAÎNE OPÉRATOIRE*

Introduction and raw material

The assemblage regarded as reliably associated with the elephant skeleton contained 77 artefacts, of which 12 were chips <20 mm long, and there were also four other artefacts from the area that were excluded from the elephant assemblage on grounds of their provenance, as discussed above. Each artefact was analysed separately, prior to refitting, and the initial technological breakdown of the assemblage is given without consideration of the refitting results (Table 17.5; Fig. 17.7). Besides two broken pieces of percussor (which were subsequently shown by refitting to belong to the same single

Table 17.5 Assemblage 6.3: technological categories, excluding natural pieces

	5 - Percussor (broken)	*10 - Tested nodule*	*20 - Core*	*30 - Core-on-flake*	*40 - Core-tools*	*50 - Handaxe-on-flake*	*60s - Fl-tools*	*80 - Fl-flakes*	*90 - Flakes*	*100 - Irreg. waste*	*110 - Chips*	*Sub-total (n)*
Elephant scatter	2	-	4	-	-	-	4	1	37	17	12	77
% - inc chips	2.6	-	5.2	-	-	-	5.2	1.3	48.1	22.1	15.6	
% - excl chips	3.1	-	6.2	-	-	-	6.2	1.5	56.9	26.2	-	65
Non-elephant material	-	-	-	-	-	-	-	-	2	2	-	4
% - inc chips	-	-	-	-	-	-	-	-	100.0	100.0	-	
% - excl chips	-	-	-	-	-	-	-	-	100.0	100.0	-	4

percussor), there were four cores and four flake-tools, each representing approximately 6% of the assemblage. The remainder was waste debitage, comprising about 57% flakes and 26% irregular waste, if the chips are discounted. In general, it was regarded as preferable to omit chips from the quantitative assemblage summaries, as their recovery was very patchy, depending upon the care of individual excavators and the methods of excavation. Omitting the chip-counts therefore makes quantitative intra-site assemblage comparisons more meaningful, particularly when expressed as percentages, both between the different assemblages from Phase 6, and between assemblages from different phases of the site's sequence.

The raw material represented in the assemblage is very varied. The cortical remnants on the debitage and cores are in a range of conditions, from fresh and unabraded suggesting a raw material source reasonably fresh from Chalk, to highly smoothed suggesting a history of substantive transport and reworking prior to collection for knapping. There is a reasonably high incidence of frost-fracturing, most of which demonstrably precedes knapping, where possible to tell. Most of the frost-fracturing is relatively minor, without major implications for flake production or technological potential. However quite a few pieces are very severely frost-fractured, which would have severely limited their potential for producing sharp-edged flakes or for carrying out any more ambitious reduction scheme such as handaxe manufacture or Levalloisian production. The flint itself is typical grey nodular flint of the Swanscombe area. Some pieces show evidence of knots

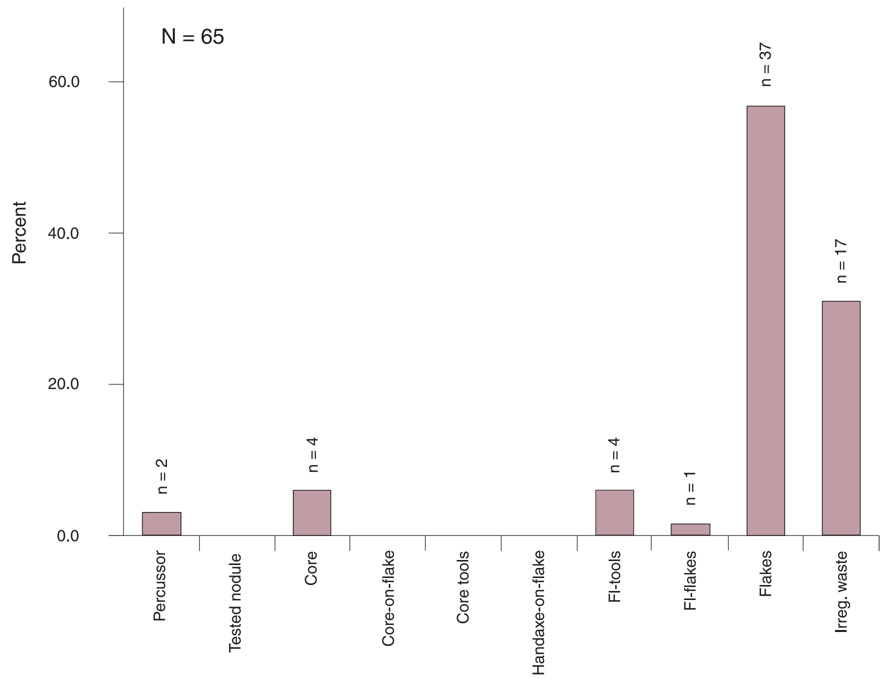


Figure 17.7 Technological summary of assemblage 6.3, from around the elephant skeleton

Table 17.6 Assemblage 6.3: cores

Find ID	*Refitting group*	*Whl*	*%Cx*	*DSC*	*ML*	*WtG*	*Notes*
Δ.40494	B	1	9	6	158	1386	Cylindrical core, with alternating flaking at one end [Fig. 17.10]
Δ.40871	C	1	2	12	92	324	Globular core, with small remnant cortical patch, and migrating flaking [Fig. 17.8a]
Δ.41100	-	1	5	6	217	1856	Broken tabular slab of flint, with one very large flake removal, and several smaller ones
Δ.41376	E	0	3	8	84	186	Broken piece of larger core, subsequently flaked further [Fig. 17.8b]

of clearer, more glossy flint surround by more opaque flint – the so-called Devil's Eye of local folklore – and much of it is quite pale, cherty and coarse-grained in the interior, with only a narrow band near the nodule's exterior being relatively translucent and glossy. The refitting work demonstrates at least seven different flaking sequences carried out on different pieces of raw material (Groups A-G); in addition to the refitting material, there is one large core (Δ.41100), three flake-tools and two pieces of larger debitage which all appear to come from additional distinct pieces of raw material, making a total of at least thirteen distinct episodes of reduction not including various smaller pieces of debitage and irregular waste.

Four cores and a percussor

A certain amount of technological information is interpretable from the separate artefacts, particularly the cores, prior to the more detailed discussions based on the refitted reduction sequences. The cores all represent apparently unstructured, or very simply structured, flaking strategies (Table 17.6).

Core Δ.41100 (not illustrated, and for which no refitting flakes were found) was found slightly apart from the main group, at the extreme south-west end of the scatter, near the tips of the tusks (Fig. 17.2). It was a thick, broken (possibly deliberately) tabular slab of flint, with several smaller removals at one end, and then, on the opposite face, one huge flake removal (*c* 140 x 120 x 40mm). It was attempted to find this removal in the material from around the elephant skeleton and in the wider surrounding area, but this was unsuccessful. Such a large flake would have been easily recognisable, so it clearly is not present in the Phase 6 collection. There are a few minor frost-fracture flaws visible, but there is obviously a substantial quantity of good quality flint remaining in the core, which was easily accessible if desired.

Core Δ.40494 was also quite large (Fig.17.13a); its cortex was blueish-grey, and moderately abraded, suggesting a history of derivation, and the interior flint was a quite rare combination of glossy, fine-grained and at the same time a pale opaque mottled grey. It had undergone a short sequence of flaking at one end, including removal of flakes from alternating platforms. There were also some other impact marks on the core which caused cortical chips to be detached, but not successful flakes. The core was abandoned with a substantial amount of good quality flint easily accessible and unexploited. Most of the debitage from this core was found nearby and refitted to it (as Group B), and more details of the reduction sequence are discussed further below.

Core Δ.40871 was relatively small (Fig. 17.8a), weighing less than a quarter of the two above-mentioned cores. It had, however, been subject to a much longer sequence of reduction, with scars from 12 flakes on the core, and 23 pieces of refitting debitage present in the assemblage from around the elephant. The core itself retains a small area of cortex opposing a very obtuse edge, from which a series of alternating flakes had been struck. Most of the removals from this core were present in the scatter around the elephant skeleton, including large pieces of irregular waste from the start of its reduction, and the more detailed reduction sequence revealed by the refitting of this material is discussed below under Group C (below). As with core Δ.40494, the raw material is dense, fine-grained and an opaque mottled pale grey. The cortex is, however, relatively unabraded suggesting a lesser history of derivation prior to collection for knapping.

The last core, or core remnant, associated with the elephant skeleton is Δ.41376, which joined to two other pieces as Group E (Fig. 17.8b). In contrast to the other cores, it is made of a more typical type of local flint raw material, dark grey and slightly glossy with some large pale grey coarser inclusions, with the interior stained slightly orange/ochre by iron oxidisation; the cortex is white and relatively unabraded. When considered in isolation, the main core remnant piece is relatively uninformative. It shows a few small flake removals from one platform, before a further attempted removal deeper back into the same platform struck on a pre-existing fracture-plane that has led to the core breaking up. When considered as a refitted group (see below) there is, however, more technological information.

None of the debitage or flake-tools shows any distinctive morphology or scar patterning that represents anything other than these simple reduction strategies. Many of the flakes show clear ring-cracks at the point of percussive impact, indicating striking with a hard-hammer percussor. And there are also many ring-cracks on the surviving cores and flakes representing hard-hammer

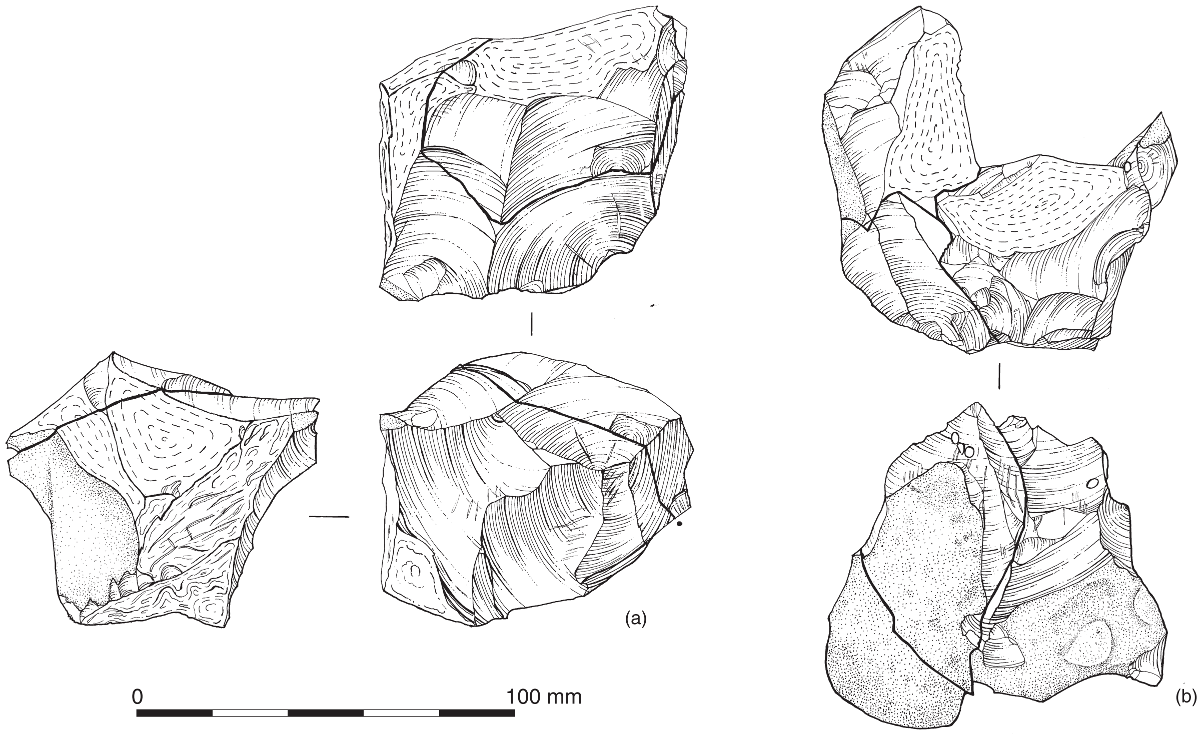


Figure 17.8 Cores from around elephant skeleton: (a) Δ.40871, with last refitting flake Δ.41040 [Group C]; (b) refitted broken core pieces Δ.40834, Δ.41351 and Δ.41376 [Group E] [ill. B. McNee]

percussive blows that failed to detach flakes. When refitting was undertaken, it quickly became clear that one of the refitting groups [Group D] did not represent a flaking reduction sequence, but the broken parts of a nodular flint percussor. Seven broken pieces of the percussor, including a tiny interior chip, were found in the northern half of the lithic scatter associated with the elephant skeleton, within an area *c* 4.5 x 2m (Fig. 17.9a).

This percussor is a small flint nodule, about 120 x 80 x 60mm in size, and weighing *c* 750g, including all the refitting pieces. It is flat on one side, and slightly domed on the other, with a broad ridge extending most of its longer axis (Fig. 17.9b). It has grey cortex worn smooth by natural working and abrasion, and its perimeter and protrusions are also heavily battered and abraded by natural processes. Superimposed on this background of natural abrasion, there are distinct areas of fresh percussion impact marks on several protrusions, particularly on two distinct protrusions on its upper ridge, from one of which also emanate several small flake scars. This evidence of fresh and localised battering underpins interpretation of the nodule as a knapping percussor. Its interior is heavily frost-fractured, and it seems that the act of percussion has caused it to break up. Some of the fresh battering scars cross from one broken piece to another, proving that this battering took place prior to its disintegration. Other small scars do not however cross between broken pieces, suggesting an attempt to continue using the percussor after it had begun to break up. The messy splintering of the highest protrusion on its domed surface seems to reflect an attempt to hold the broken pieces of the percussor together, and to continue knapping with it in its broken state.

The following section looks in more detail at the sequences of reduction and *chaînes opératoires*, as revealed by the refitting sequences. The subsequent section considers certain debitage products as potential tools, and, in the one instance of secondary working, considers how this was applied to turn the flake into a presumably more useful cutting tool.

Refitted reduction sequences

This section focuses on the knapping strategies applied at the elephant area as revealed by the longer refitting sequences of Groups A, B, C and E (Fig. 17.10). Even more than the preceding analysis of the cores, these allow characterisation of the lithic material culture not just as types of differently shaped outcomes, but as patterns of knapping procedure. Furthermore, within the context of an essentially undisturbed activity area, the stages of reduction present reflect the spatial organisation of the production process. Absences in the flaking sequence may represent the selection and export of certain flaking products as desired or chosen, contributing both to a tentative understanding of the intentions of the knapper and to a behavioural interpretation of the site.

As well as illustrating each reduction sequence with photos and drawings, it was found useful to represent each sequence as a tabulated order of flaking events (Table 17.7–17.10). Even when certain flakes were absent, the sequences were all sufficiently complete that continuous sequences of reduction could be recon-

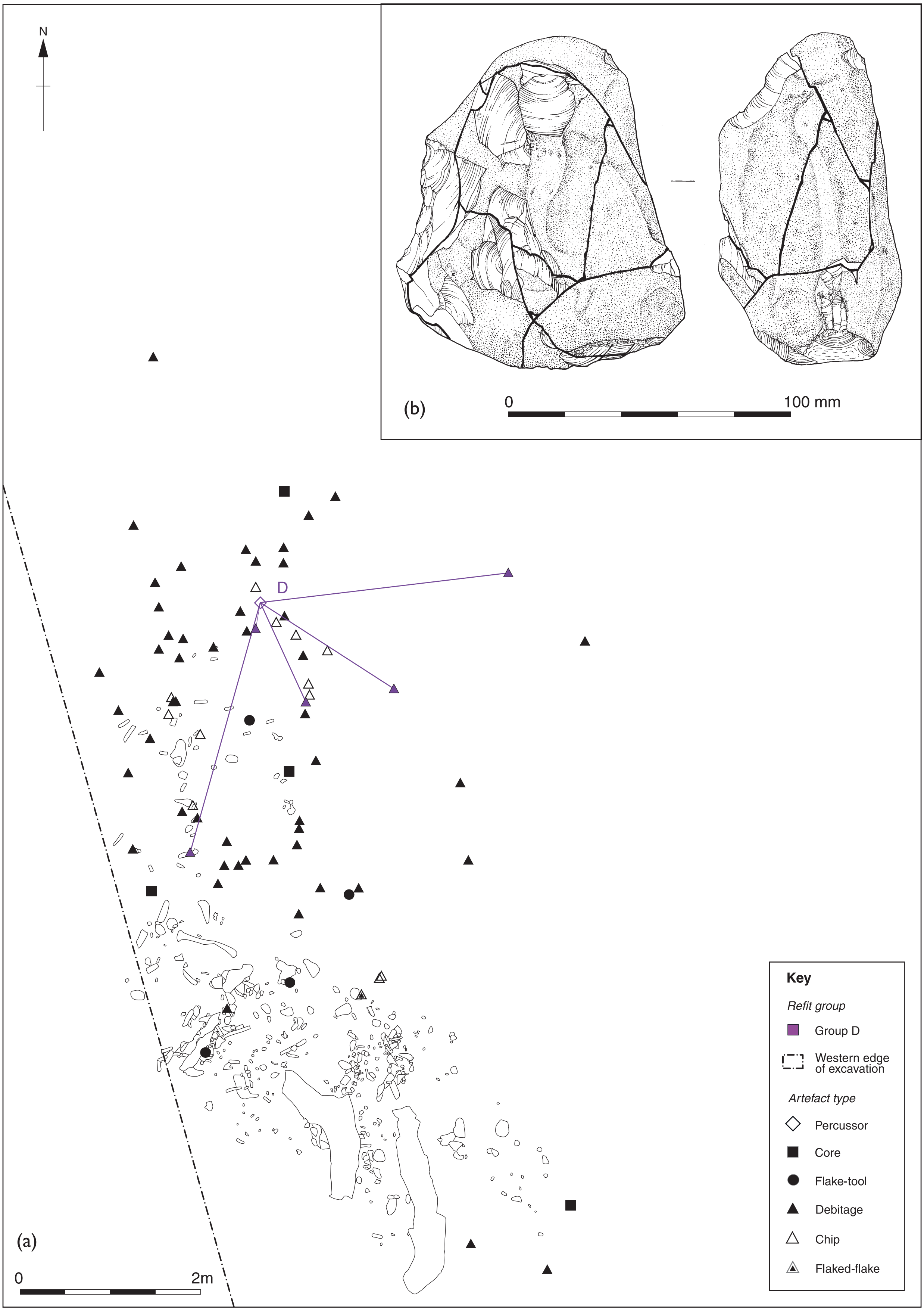


Figure 17.9 Refitted percussor from near elephant skeleton [Group D]: (a) distribution of Group D refitting pieces; (b) the refitted percussor [ill. B. McNee]

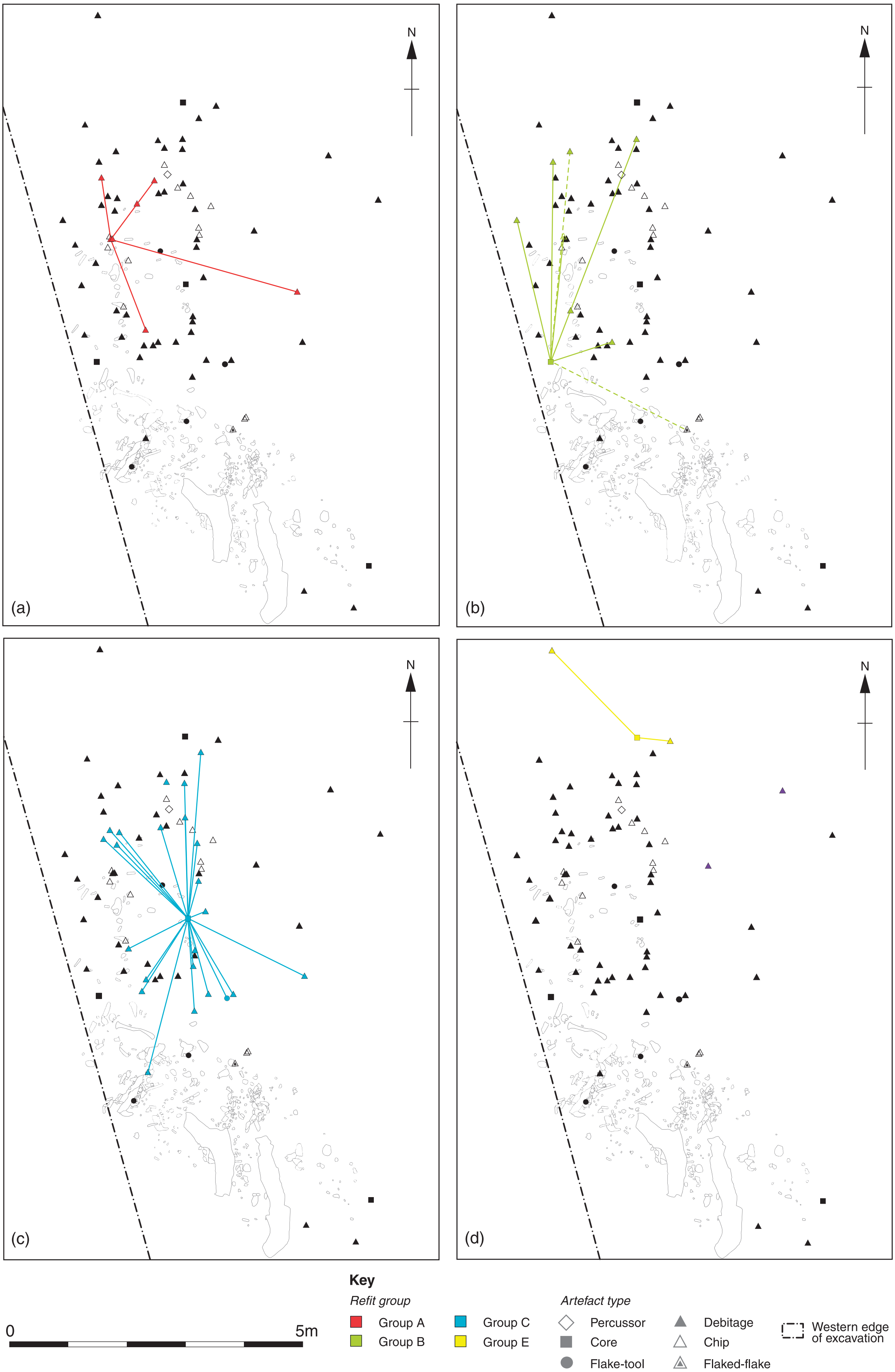


Figure 17.10 Distribution of main refitting flake groups around the elephant skeleton: (a) Group A; (b) Group B; (c) Group C; (d) Group E

structed from the combination of the surviving material and the scars of missing removals. In these tables, certain descriptive conventions were followed. As specified in the captions, different symbols were used for different technological categories. Solid filled symbols were used to represent material present in the sequence, with its find number. Hollow symbols were used for missing material, with a notional letter suffixed in a series starting at 'a' for each reduction sequence. Each row in the summary tables represents a separate flaking event. Each time the same striking platform was used for a subsequent removal (or attempted removal), the following row is separated by a dashed line. Each time the striking platform changes, the row following is separated by a solid line. When the striking platform changes, there are also specific comments on this re-positioning. When the new platform is struck on the scar of the immediately preceding removal, this is regarded as an 'alternate' platform; when struck on the scar of an earlier removal, it is regarded as merely a 'new' platform, even if it superficially appears alternate.

Finally, one technical aspect that was investigated in course of this part of the study was handedness of the knapper, following the work of Toth (1985; Schick and Toth 1993: 140-142). Toth suggested that, when striking a series of flakes from a single platform, handedness is reflected in the debitage by a tendency for a preferential migration of the striking impact point away from the knapper, leading to a recognisable bias in the distribution of cortex on the right dorsal side of the resulting flakes (when oriented with the butt upwards). This was investigated here, not by the examination of the dorsal cortical distribution on flakes (or, as is equally possible, of the side/order of sequential dorsal scars), but by direct examination of the direction of rotation of the striking impact point when sequential refitting flakes were struck from the same platform. This rotation is described here as movement of the percussion point relative to the flat, stationary platform, when viewed from above. Thus, for typical right-handed knapping, the striking point would be described as migrating away from the knapper a*nticlockwise*, whereas for a left-handed knapper, it would be described as a *clockwise* rotation (Fig. 17.11).

Group A, 'Piebald nodule'

This group of refits included seven artefacts, all of them categorised as flakes when studied separately. Three of them were broken, but none of the broken flakes joined with each other. The raw material was an opaque fine-grained flint with distinctive piebald banding near the cortex. The cortex was a distinctive pale mottled greenish/greyish white, and there was an intermittent orange iron-stained band beneath the cortex in places, suggesting the raw material originated from the Bullhead flint bed. The raw material was very distinctive, and although a search was made through the rest of the Phase 6 collection, no other pieces of this refitting sequence were found.

The sequence appears to represent the initial stages of reduction of a core, with the core and any later removals absent. The constituent flints are mostly distributed within an area of about 3 x 2m, with a single outlier (Δ.40247) a little further away on the eastern side of the scatter (Fig. 17.10a). The five flints from the middle part of the sequence are shown here fitted together (Fig. 17.12a), together with the first Δ.41024 (Fig. 17.12b) and the last Δ.41025 (Fig. 17.12c); and the sequence is described in more detail in the accompanying tabular summary (Table 17.7).

The sequence starts with two 100% cortical flakes (events # 1-2), one of which is missing, and the other of which (Δ.41024) creates a wide clear striking platform which is then used for the following sequence of four consecutive removals (events # 3-6). There is no sideways migration of the striking point between events # 3 and # 4; between events # 4 and # 5 there is a 60mm anti-clockwise migration; and then between events # 5 and # 6 there is a matching clockwise migration back towards the earlier striking points. The initial anti-clockwise move

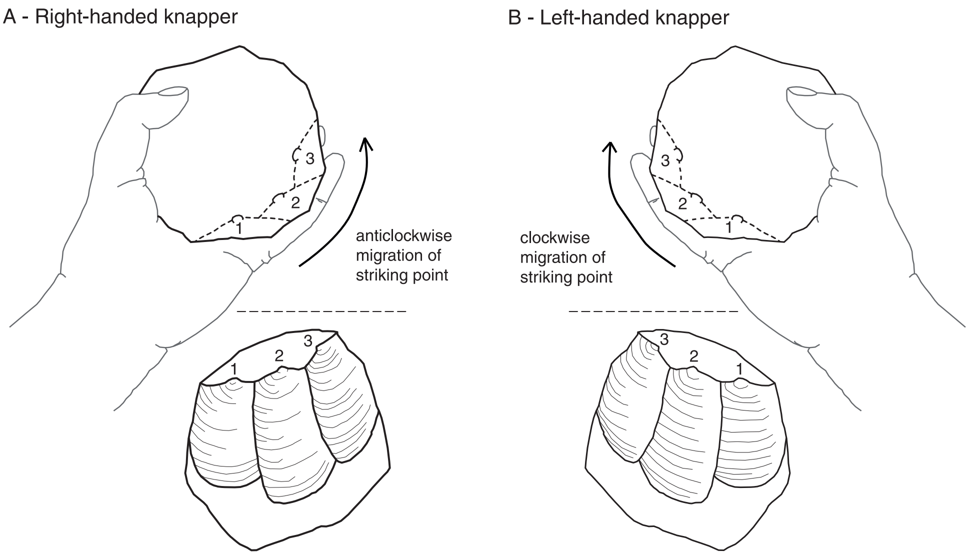


Figure 17.11 Suggested preferential striking point migrations for right- and left-handed knappers when removing consecutive flakes from the same platform

between events # 4 and # 5 could perhaps tentatively be construed as matching the preference of a right-handed knapper, but is inconclusive on its own.

The last flake of this sequence breaks in two, and the quite substantial distal piece 'Δe' is missing. After this, there is removal of a small chunky flake 'Δf' that appears to represent preparation of a new striking platform, followed by removal of a substantial flake Δ.40957 (event # 8) across the direction of the earlier sequence of consecutive removals, using the scar of flake 'Δf' as an alternate platform. A number of incipient cones from failed flake removals on the surface of Δ.40957 perhaps

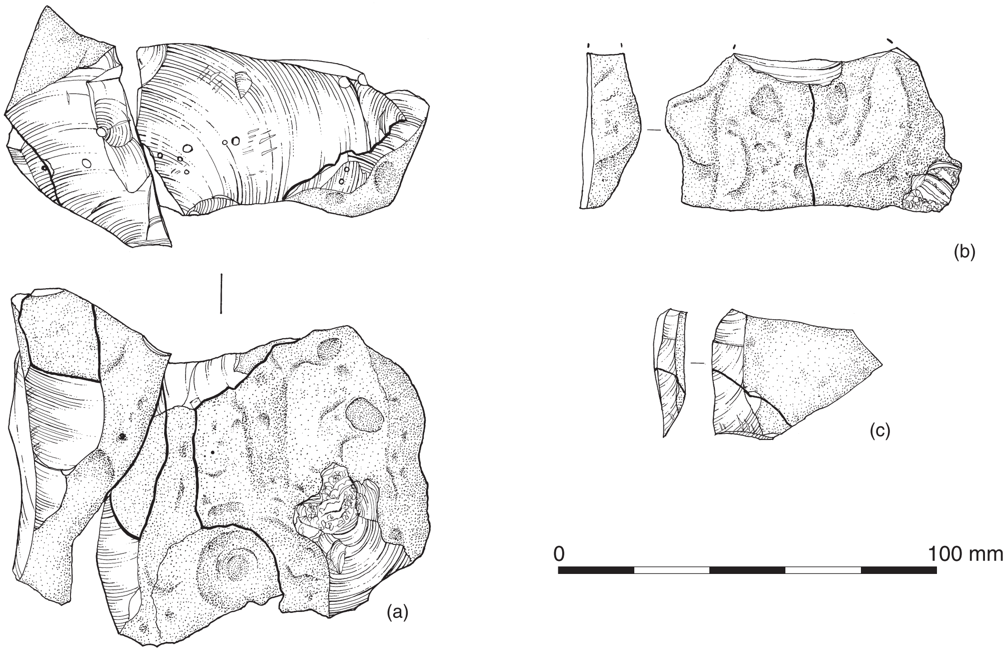


Figure 17.12 Refitting from around elephant skeleton: Group A: (a) five flints from middle of the sequence; (b) first flake in the sequence, Δ.41024; (c) last flake in the sequence, Δ.41025 [ill. B. McNee]

Table 17.7 Elephant area, Group A 'Piebald nodule': reduction *chaîne opératoire*

Event order #	*Core/platform positioning*	*Flake removal*	*Comments*
1-2?	On protruding cortical contour	△a⇩	Sequence starts with two 100% cortical flakes △a, and ▲41024=△b, their relative order unknown; distal part △b is missing
1-2?	On different protruding cortical contour	▲41024=△b⇩	
ò			
3	New platform, alternate (▲41024=△b scar)	▲40733=△c=△d⇩	Butt of flake present, but missing two small 100% cortical mesial and distal pieces △c and △d
4	Same platform (directly behind)	▲40248⇩	Quite solid flake; at least two blows taken to remove it, reflected in incipient cones on striking platform
5	Same platform (other end, *c* 60mm anti-clockwise)	▲41189⇩	Quite large 100% cortical flake
6	Same platform (back to original end, *c* 50mm clockwise)	▲40247=△e⇩	Quite substantial broken distal piece △e is missing
7 *	New platform (▲41189 scar)	△f⇩	Small chunky flake △f, possibly deliberate platform preparation
8	New platform, alternate (△f scar)	▲40957⇩	Some visible damage on one obtuse edge, interpreted as excavation damage, not use-wear
9	New platform, alternate (▲40957 scar)	▲41025⇩	Small flake, mostly cortical — last part of surviving Group A sequence
10+?	Uncertain how/whether knapping continued	△g+, ☐h+	Core and possible subsequent removals missing – do not believe present in rest of Phase 6 assemblage, as raw material is very distinctive

△ - missing debitage from refitted sequence; ☐ - missing core from refitted sequence; ▲ - debitage present in reduction sequence
* No evidence of intervening flakes in the surviving sequence, but possible invisible reduction episodes on absent material

attest to an intervening stage of attempted continuation of use of that platform after event # 6, before moving onto creation of a new platform by flake 'Δf'. The scar from flake Δ.40957 is then in turn used as an alternate platform for the final removal of the sequence, Δ.41025 which is a small, mostly cortical flake with a sharp edge down one side (Fig. 17.12c).

The only potentially significant gap within the sequence is the missing distal part of flake Δ.40247, which would have been of reasonable size, and would have had a sharp edge down one side opposed by a cortical side that would have been relatively comfortable to hold. The other potentially significant flake with potential for use as a cutting tool is Δ.40957 which has a robust sharp edge at its distal end, but which did not, however, show any sign of macro use-damage – although it did have some abrasion interpreted as excavation damage on one obtuse edge.

It is interesting that one of the two initial decortication flakes is absent, as is the core and any subsequent removals. Unfortunately, due to the loss of part of the site, it is entirely uncertain whether these would have been close at hand, or whether they represent larger-scale mobility, and a more extended spatial scale of the organisation of production.

Group B, 'Large cylindrical core'

This group of material (Fig. 17.13) comprises one large core Δ.40494, six pieces of refitting debitage, and an additional piece of irregular waste (Δ.41259) that does not refit, but has such similar raw material and cortical characteristics that it is confidently believed to represent part of the same reduction sequence. The core was found in amongst the spread of bones (Fig. 3.17), and the rest of the refitting group was found within an area of approximately 2 x 4m to the north of the core (Fig. 17.10b).

This refitting group appears to represent the progression from the very first cortical removal from a virgin core, to abandonment of the core after removal of relatively few flakes (<10) and with a substantial amount of good quality flint remaining and accessible. There are, however, some missing flakes from the recovered sequence, which is summarised in the accompanying table (Table 17.8), and discussed in more detail below.

The first removal is thought to be the non-refitting piece of irregular waste Δ.41259 (Fig. 17.13b). This clearly represents the initial removal of the cortical end of a cylindrical flint nodule; the raw material and cortical characteristics are so similar to core Δ.40494 that it is confidently believed that this piece represents the start of its reduction. There is then a gap in the sequence, with removal of at least two further flakes Δa and Δb of reasonable size by so called 'salami-slice' technique, whereby the convex cortical surface of a cylindrical nodule is used directly as a striking platform, with some rotation of the core between flake removals. After these, the next two flakes Δ.40725 (Fig. 17.13c) and Δ.41188 (Fig. 17.13e) are removed from successive alternating platforms, starting with the scar of removal 'Δb'. After this, event # 6 is the removal of flake Δ.40732 = Δ.41279 from the same platform as event # 5, with the striking point rotated slightly clockwise (contra the presumed preference of a right-hander). This flake broke in two as a *siret* fracture

Table 17.8 Elephant area, Group B 'Large cylindrical core': reduction *chaîne opératoire*

Event order #	*Core/platform positioning*	*Flake removal*	*Comments*
1	Striking onto cortex at one end of cylindrical nodule	▲41259 *⇩	Start of sequence with knocking off irregular piece rom one end of cylindrical nodule
2, 3	Rotating core, and other 'salami slice' flakes off same end, struck on cortex	△a, △b⇩	Probably at least two flakes missing from sequence (one of which might be the blank for the flake-flake ▲40658)
4	New platform, alternate (△b scar)	▲40725⇩	100% cortical flake, with hinge termination
5	New platform, alternate (▲40725 scar)	▲41188⇩	Small flake with narrow platform and hinge termination
6	Same platform (c 25mm clockwise)	▲40732=▲41279⇩	Medium-size flake, broken during removal; not apparently used, although useful sharp edge
7	New platform, alternate (▲40732=▲41279 scar)	△41005⇩	Small flake, hinge termination; can be interpreted as failure due to incorrect striking too close to platform edge
8	New platform, on cortex further down core, without altering its orientation	△c (failed)⇩	Impact marks on cortical protrusion show failed attempt to strike a flake, leading to a few tiny cortical chips (not recovered)
9	Same cortical platform (further up core surface, *c* 35mm behind)	▲41023, ■40494 **	Impact marks from at least two heavy blows fail to remove large flake, but only small cortical flake ▲41023

△ - missing debitage from refitted sequence; ▲ - debitage present in reduction sequence; ■ - core left at end of sequence

* This piece does not refit, but is confidently grouped with the other material from this sequence on the basis of its similar cortex and flint texture, and its clear match with the missing end of the surviving core ■40494

** One of the mysteries of this core is that it was abandoned while still containing a substantial mass of good-quality flint; here, this abandonment is tied in with the broken hammerstone (refitting Group D), which is suggested to have broken at Event #9 of this sequence, leading to abandonment of the core without further knapping

(Fig. 17.13d); the large piece still retained what seems to be a useful sharp edge opposed by a blunt cortical edge, but there is no sign of macro-damage suggesting use.

The following removal (Δ.41005, shown fitted to the core – Fig. 17.13a), struck on the alternate platform resulting from the removal of flake Δ.40732 = Δ.41279, was a small flake that seems to represent a failure due to striking too close to the edge of the platform, leading to a short, thin flake with a hinge termination. This seems to have been the beginning of the end of this core's life. Although the precise order of subsequent events is slightly speculative, there are two distinct areas of impact directly onto the cortex of the main body of the core, identified here as events # 8-9. Event # 8 is presumed to take priority, because it does not require any re-orientation of the core after event # 7, and leaves several impact marks on a cortical protrusion, without detachment of a flake. Event # 9 is then represented by further batter-marks *c* 35 mm higher up the core, behind another protrusion that might serve as an (ambitious) striking platform to remove a substantial flake from the main body of the core. However, no major removal was forthcoming, although a small chip was detached (D.41023, shown here fitted to the core – Fig. 17.13a).

The impacts associated with events # 8-9 would have been pretty heavy, particularly in conjunction with failure to remove a flake, and would have sent substantial shock-waves through the percussor. Although speculative, it seems reasonable to suggest that the abandonment of core Δ.40494 whilst still containing a substantial quantity of accessible and high quality fine-grained flint (it weighs almost 1400g) might be associated with breakage of the percussor resulting from events # 8-9, and that the broken percussor is present at the site, fitted together as Group D (Fig. 17.9).

It is also very tentatively suggested that flake-flake Δ.40658 (Fig 17.13f) might be from the same raw

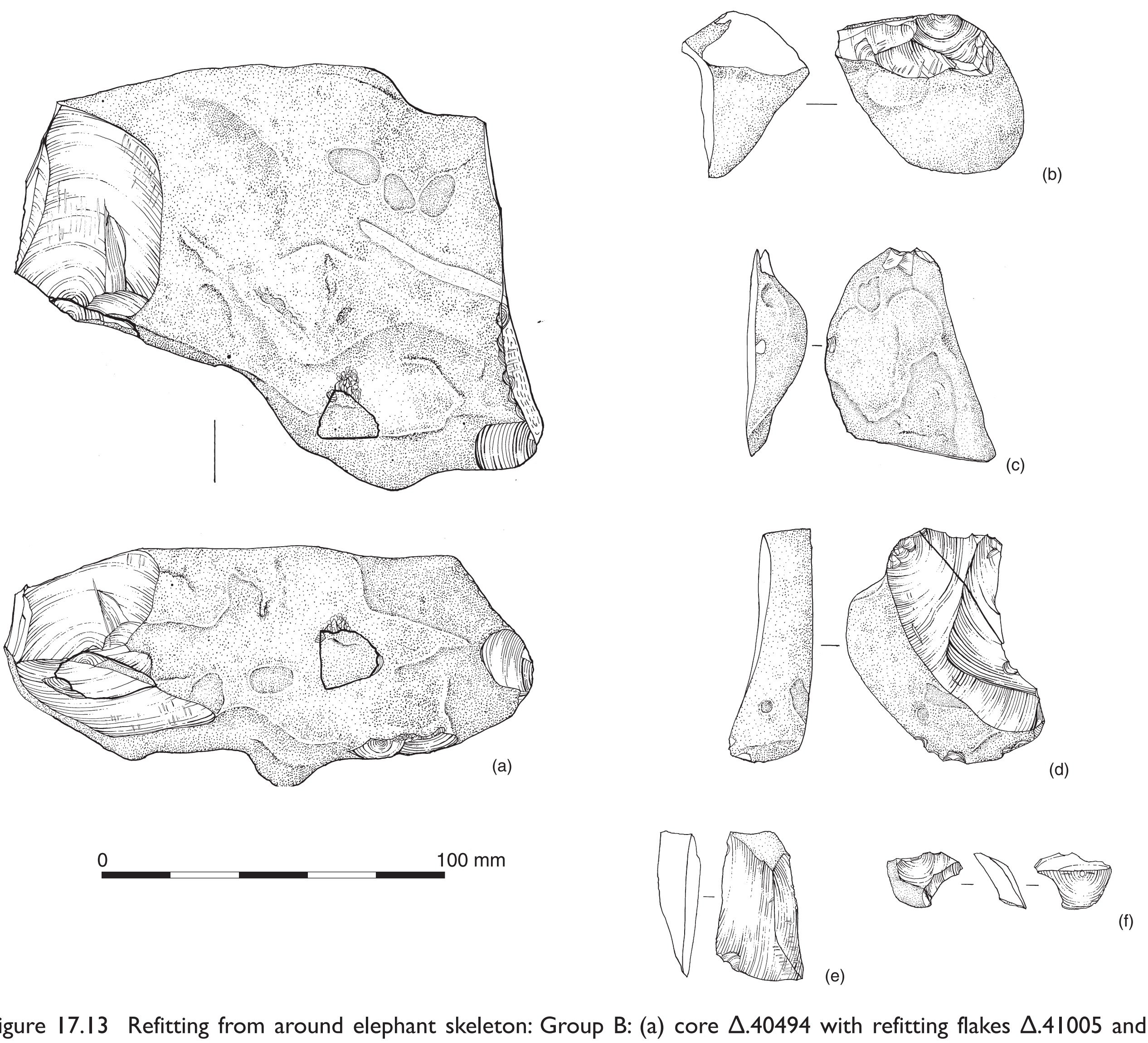


Figure 17.13 Refitting from around elephant skeleton: Group B: (a) core Δ.40494 with refitting flakes Δ.41005 and Δ.41023; (b) irregular waste Δ.41259, thought to be from the start of the sequence; (c) flake Δ.40725; (d) joined flake Δ.40732=Δ.41279; (e) flake Δ.41188 ; (f) flake-flake Δ.40658 from making notched flake-tool, thought to perhaps be of same raw material as Group B [ill. B. McNee]

material as the rest of Group B, and that it therefore represents secondary working of one the missing flakes Δa or Δb to form a notched cutting tool.

In summary, Group B represents a flaking sequence that was started and finished by the elephant carcass, with the reduction strategy being a combination of salami-slice and alternating platform technique applied to one end of a cylindrical flint nodule. Some of the resulting debitage is absent, and it is therefore thought that these may have been either collected for use unmodified as cutting tools, or for secondary working to make a more designed notched flake-tool.

Group C, 'Main core'

The most spectacular of the refitting sequences from around the elephant was Group C, which comprised 23 pieces of debitage fitted back to core Δ.40871 (Fig. 17.8a). All these pieces were contained within an area approximately 5 x 3m, with the core roughly in the middle (Fig. 17.10c). The raw material for Group C was a quite substantial flint nodule, probably initially weighing *c*1800g, allowing for some of the missing pieces of debitage from amongst the recovered refitting material. Its cortex was generally white, with some pale greyish/blueish patches, and rough and unabraded suggesting a minimal history of derivation and transport. The interior flint was dense, fine-grained and mostly a pale, mottled opaque grey; in places there was, however, a thin band of glossy more translucent dark grey flint near the cortex.

As discussed above, when merely considering the core on its own, the reduction approach can be described as one of broadly alternating reduction on a thick edge opposed by a cortical face. When the full refitted sequence was considered, it became clear that there is more structure and pattern in its reduction, with clear evidence of a preferential orientation of the core, interspersed with episodes of transverse striking across the preferred orientation as certain platforms became exhausted or less viable. A literally blow-by-blow account of the core's reduction is presented in the tabular summary (Table 17.9) and the photographic montage of key stages of its reduction (Fig. 17.14) so this is not repeated here in text form. Rather, the overall strategy of reduction is summarised, with certain key points highlighted.

Although 23 pieces of refitting debitage were recovered, there are several gaps in the sequence. The full sequence is thought to have almost 30 removal events, before abandonment of the core, with several small pieces of cortical waste debitage missing along with three reasonably sized flakes Δi, Δj and Δm, which are candidates for having been selected and extracted as desirable end-products.

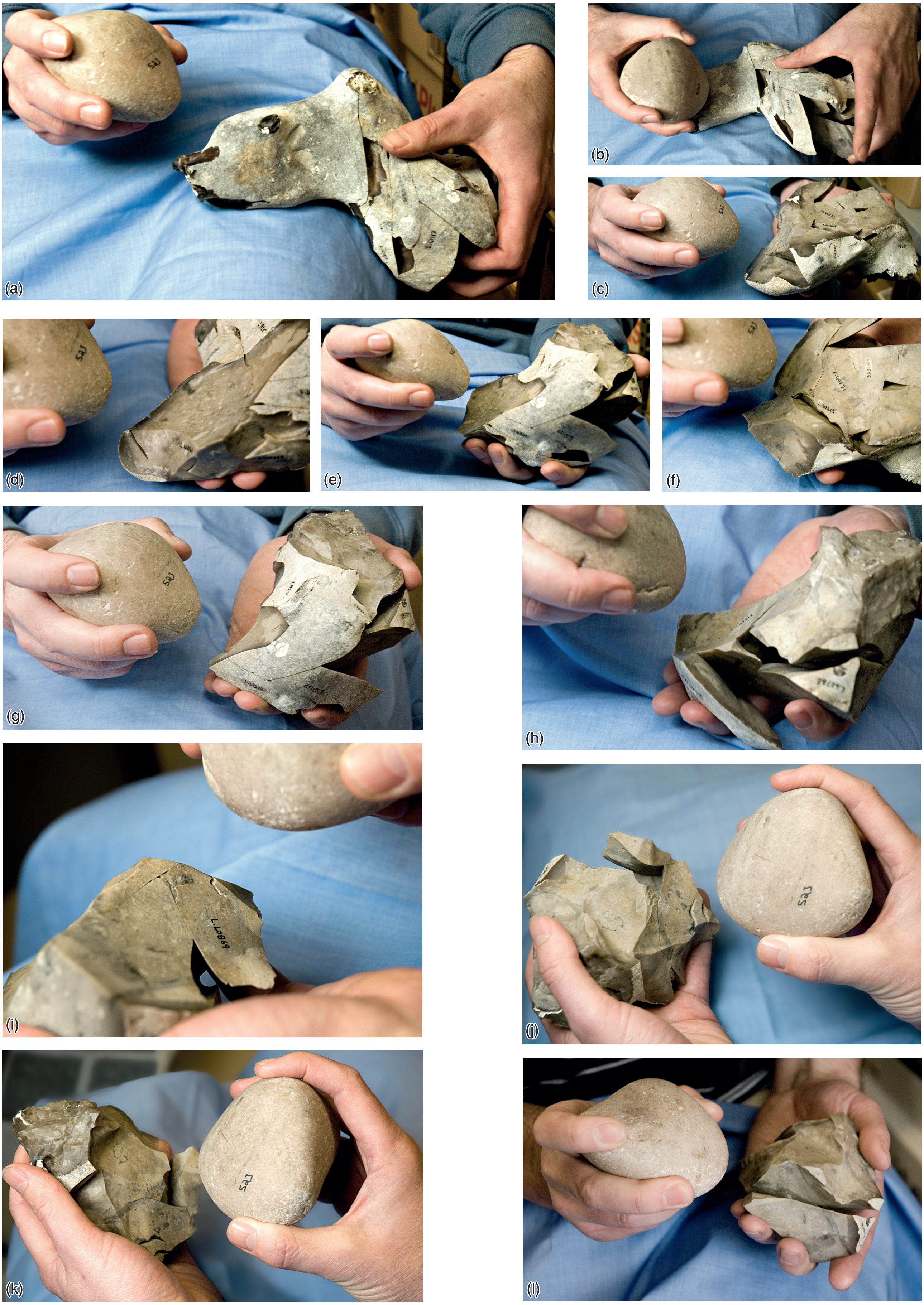
As with Groups A and B, very early stages of reduction seem to have taken place at the spot, after some initial testing (event # 1, the evidence of which was not recovered). This included preliminary removal of protruding cortical lumps to reduce the less usable bulk of the raw material and create striking platforms to start its reduction (events # 2-5).

After this, the preferred orientation of the core becomes established, with one aspect generally being maintained as the upper striking platform surface (Fig. 17.14). The general pattern of reduction is one of occasional platform alternation interspersed with episodes of repeated flake removals from the same platform. There is regular evidence on the striking platforms that a hard-hammer percussor was used, and the repeated incidence of similarly wide ring-cracks seems to indicate consistent use throughout reduction of the same percussor with a relatively wide hemispherical spread at the point of knapping impact. For series of flakes struck from the same platform, there is a marked preference for the striking point to migrate anti-clockwise through the series, suggestive of a right-handed knapper. Of the four instances where there are such series, three of them (events # 6-9, # 16-17 and # 19-21 – see Fig. 17.15a) include an anti-clockwise striking point migration, and the fourth (events # 10-12) has no sideways migration. In addition, event # 24 represents an anti-clockwise migration on essentially the same striking plane, but on a different flake scar, so technically a new platform following the nomenclatural convention applied. There are hints of what could be interpreted as personal knapping idiosyncrasies in the sequence. There are several instances of deliberately striking on dihedral platforms, usually avoided by modern and prehistoric knappers (although note the comments of Bradley and Sampson 1986), within the context of Levalloisian core-surface trimming. There is also a regular habit of striking on the furthest edge of plain platforms (assuming a right-handed knapper; or conversely, if left-handed, on the nearest edge).

Apart from one or two small preliminary decortication flakes, the bulk of the early decortication of the nodule took place at the spot, and the last removal (event # 27, flake Δ.41040) was also recovered less than 1.5m from the core. This latter flake (illustrated attached to the core, Fig. 17.8a) showed some faint macro use-wear on one of its sharp protrusions, as well as a larger chip on one edge, possibly a deliberate secondary notch removal, and so is regarded as probably having been used as a tool. It was found at the southern edge of the lithic concentration, nearer the elephant bone spread, in close proximity to two other flakes interpreted as having been utilise, supporting its interpretation as a tool.

Group E, 'Shattered nest'

This group of material comprises just three pieces of flint, two of them initially classified as irregular waste, and one of them as a broken core (Fig. 17.8b). All three were found at the northern edge of the scatter by the elephant skeleton, within an area of roughly 2 x 2m (Fig. 17.10d). Rather than representing a sequence of reduction, the refitting pieces represent the shattering of a core into three pieces simultaneously, caused by a percussion blow struck directly onto a frost-fracture. However, the various flake scars on the refitted group still allow reconstruction of a narrative of reduction (Table 17.10).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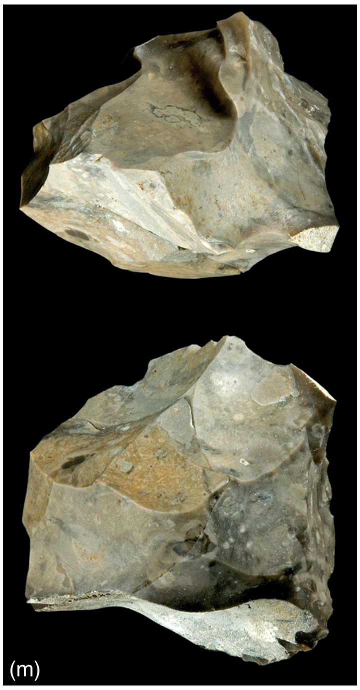


Figure 17.14 *(facing page and this page)* Refitting Group C from around elephant skeleton, progression of reduction and final core: (a) event #2, Δ.41068; (b) event #4, Δ.40885=Δ.40791; (c) event #5, Δ.41096; (d) event #6 Δ.40250; (e) event #7 Δ.41103; (f) event #10, Δ.41094=Δ.41067; (g) event #14, Δ.41208; (h) event #15 , Δ.40787; (i) event #18, Δ.41212; (j) event #19, Δ.40771, (k) event #22, Δ.41162; (l) event #23, Δ.40786; (m) final core Δ.40871, with last flake Δ.41040 attached; (n) refitted nodule, with all pieces attached.

0 100 mm

Table 17.9 Elephant area, Group C 'Main core': reduction *chaîne opératoire*

Event order #	*Core/platform positioning*	*Flake removal*	*Comments*
1	Start of sequence, cortical platform at tip of cylindrical protrusion	△a, △b⇩	At least one, and probably two, pieces of irregular cortical waste △a, △b knocked off tip of cylindrical protrusion (possibly likewise at other end of core)
2	Same platform (directly behind)	▲41068⇩	Cortical platform
3	New platform, alternate (▲41068 scar)	△c⇩	Small cortical flake △c knocked off tip of cylindrical protrusion
4	Same platform (directly behind △c scar, but on cortex)	▲40885=▲40791=△d⇩	Cylindrical protrusion snaps off as irregular waste, together with ▲40791 and a quite substantial third piece △d
5	New platform, alternate (▲40885 scar)	▲41096=△e⇩	Large flake, hinged profile and 100% cortical; prob. simultaneous detachment of missing small chunk of irregular waste re from platform overhang
6	New platform, alternate (▲41096 scar)	▲40250⇩	
7	Same platform (directly behind)	▲41103⇩	
8	Same platform (*c* 45 mm anti-clockwise)	▲40628=▲41108=△⇩	Removal ▲40628=▲41108 is missing proximal end △f; uncertain relative order of this flake in relation to previous two from same platform
9	Same platform (directly behind)	▲41013⇩	Quite a wide flake, successfully removes remnant ridge left from #3
10	New platform, alternate (▲41013 scar)	▲41067=▲41094⇩	Deep platform, leads to thick, hinged flake which nonetheless tidies core to inverted pyramidal form
11	Same platform (directly behind)	△f⇩	Small triangular waste from resulting platform overhang
12	Same platform (directly behind)	△41229 (failed)⇩	Failed detachment of ▲41229 leaves internal fracture-plane defining proximal end of flake's ventral surface
13	New platform, natural flint surface on left dorsal ridge of ▲41229	▲41229⇩	Flake eventually removed by striking sideways onto left side of its dorsal ridge
14	New platform, near-alternate (ridge between ▲41067=▲41094 and ▲41096=△e scars)	▲41208=△g⇩	Flake struck directly on dihedral ridge between two flake scars; distal end △g of flake snapped during removal and missing
15	New platform, alternate (▲41208=△g scar)	▲40787=△h⇩	Chunky, 50% cortical flake, hinged at distal end
16	New platform, alternate (▲40787=△h scar)	▲41117⇩	
17	Same platform (c 25mm anti-clockwise)	△i⇩	Solid flake, with straight, naturally sharp distal end – a good candidate for use/modification as a flake-tool
18	New platform, alternate (△i scar)	▲41212⇩	
19	New platform, alternate (▲41212 scar)	▲40771⇩	Short triangular flake
20	Same platform (directly behind)	▲41095⇩	Slightly longer, elongated triangular flake
21	Same platform (*c* 35 mm anti-clockwise)	▲40869⇩	Squat transverse rectangular flake, struck on shallow ridge between ▲41212 and ▲40787 scars; platform preparation, shifts angle to bypass hinge protrusions at bottom end of car
22	New platform, alternate (▲40869 scar)	▲41162⇩	
23	New platform, alternate (▲41162 scar)	▲40786⇩	
24	New platform (anticlockwise *c* 30 mm, past edge of ▲41162 scar)	△j⇩	
25	New platform, alternate (△j scar)	▲41041=△k=△l⇩	Small siret-fractured piece of proximal end present; rest of flake missing, probably represented by at least two pieces
26	New platform, alternate (▲41041=△k=△l scar)	△m⇩	Mod. small flake, but would have had sharp edge down one side and at distal end good for cutting use
27	New platform (clockwise 100°)	▲41040, ■40871	Final flake of Group C is ▲41040 (which may have been used as a flake-tool), and is found 1.55m from core ■40871

[△ - missing debitage from refitted sequence; ▲ - debitage present in reduction sequence; ■ - core left at end of sequence]

Table 17.10 Elephant area, Group E 'Shattered nest' core: reduction *chaîne opératoire*

Event order #	*Core/platform positioning*	*Flake removal*	*Comments*
1, 2, 3	Uncertain history of migrating and/or alternating platform use prior to start of surviving sequence	△a, △b, △c⇩	Probably about. three previous removals, one of which exposes crack from internal frost-fracture
4	New platform, directly on frost-fracture crack	▲40834=▲41351=▲41376⇩	Knapping blow on frost-fracture crack between ▲41351 and ▲41376 leads to shattering of nodule into these three pieces
5	New platform, pre-existing scar	△d⇩	Knapping continues on largest piece ▲41376, with removal of a medium-size flake △d (not present)
6	New platform, alternate (△d scar)	△e⇩	Tiny, failed flake (not present), crushing edge of platform
7	Same platform (directly behind)	▲41376=□f	Attempted removal fails and core breaks again along pre-existing frost-fracture, leaving visible point of impact and start of cone of percussion; remnant core □f absent

[△ - missing debitage from refitted sequence; □ - missing core from refitted sequence; ▲ - debitage present in reduction sequence]

Unlike the other refitting sequences associated with the elephant carcass, the earliest stages of its reduction are absent from the recovered assemblage. There seem to have been at least three removals – Δa, Δb and Δc – prior to start of the surviving sequence, one of which exposes a pre-existing frost-fracture. The next blow is applied directly onto the frost-fracture, and it is possible that this was with the deliberate intention of breaking the core into smaller pieces of non-flawed flint with which to continue knapping. The two smaller pieces (Δ.40834, weighing 62g; and Δ.41351, weighing 90g) are both then abandoned without further reduction. The larger piece (Δ.41376, weighing 186g) is however flaked further, with removal of a flake Δd which was not recovered. The scar from flake Δd was then used as an alternate platform for attempted removal of another flake Δe. This latter flake was however mis-struck, and the edge of the striking platform was crushed, with only the removal of a tiny hinged flake. The subsequent blow is slightly deeper into the same platform, but the fracture-plane intersects a pre-existing frost-fracture, and the core breaks again, leaving the surviving broken piece Δ.41376 and another broken piece □f that is missing.

This sequence contrasts with the other three refitting sequences in that firstly, the flint is poorer quality, strongly affected by frost-fracturing and secondly, the earliest stages of its reduction were not recovered. Even though the flint was of poor quality, knapping persisted after the nodule broke for the first time, suggesting in this instance some pressure to maximise its exploitation.

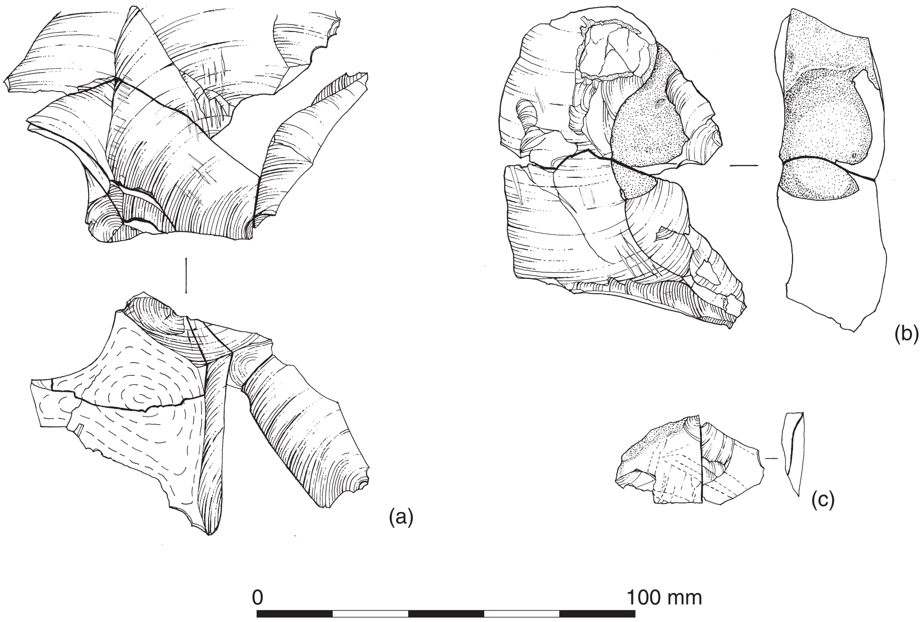
Refitted flakes

In addition to the four refitted flaking sequences of Groups A, B, C and E, and the broken percussor of Group D, there were two other refitting groups, F and G, both of them comprising two joining pieces of a broken flake. The former of these, Group F (Fig. 17.15b), was quite a large flake (weighing *c* 120g when whole). Both pieces were found only about 0.40m apart at the southern side of the scatter by the elephant. The cortex is fresh, white and unabraded, and the flint is fine-grained, glossy and mottled light/dark grey. Its dorsal scars show at least two previous knapping episodes with intervening core rotation prior to its own removal. When struck, it instantly broke into two due to internal fracture-planes caused not by frost-fracture, but by previous failed knapping blows. There is no evidence of the core from which this flake came or of any later removals from the same piece of raw material.

The last refitting group, Group G, is a relatively tiny exterior chip that has split in two as a *siret* fracture. Both pieces were found close together at the western side of the lithic scatter (Fig. 17.15c). It is not thought that this chip belongs with any of the other refitting groups, although this cannot definitively be ruled out because of its small size. There are no scars from previous removals, so it provides no technological information, other than that, being wholly from the exterior of a flint nodule (naturally polished, weathered flint, rather than cortex) it probably represents an early stage of nodular reduction. It is also possible that it has chipped off a percussor, although it does not seem to join with the broken percussor of Group D.

Flake-tools and miscellaneous debitage

There were just four artefacts identified as tools in the assemblage by the elephant. One of these was quite a small secondarily worked flake with a single notch on one side (Fig. 17.16a). The other three were unmodified flakes (or in one case, irregular waste) with sharp edges that showed visible signs of minor chipping/scaling interpreted as macro-use wear. One of these is flake Δ.41040 (Fig. 17.8a) which was the last flake detached from core Δ.40871, from the Group C refitting



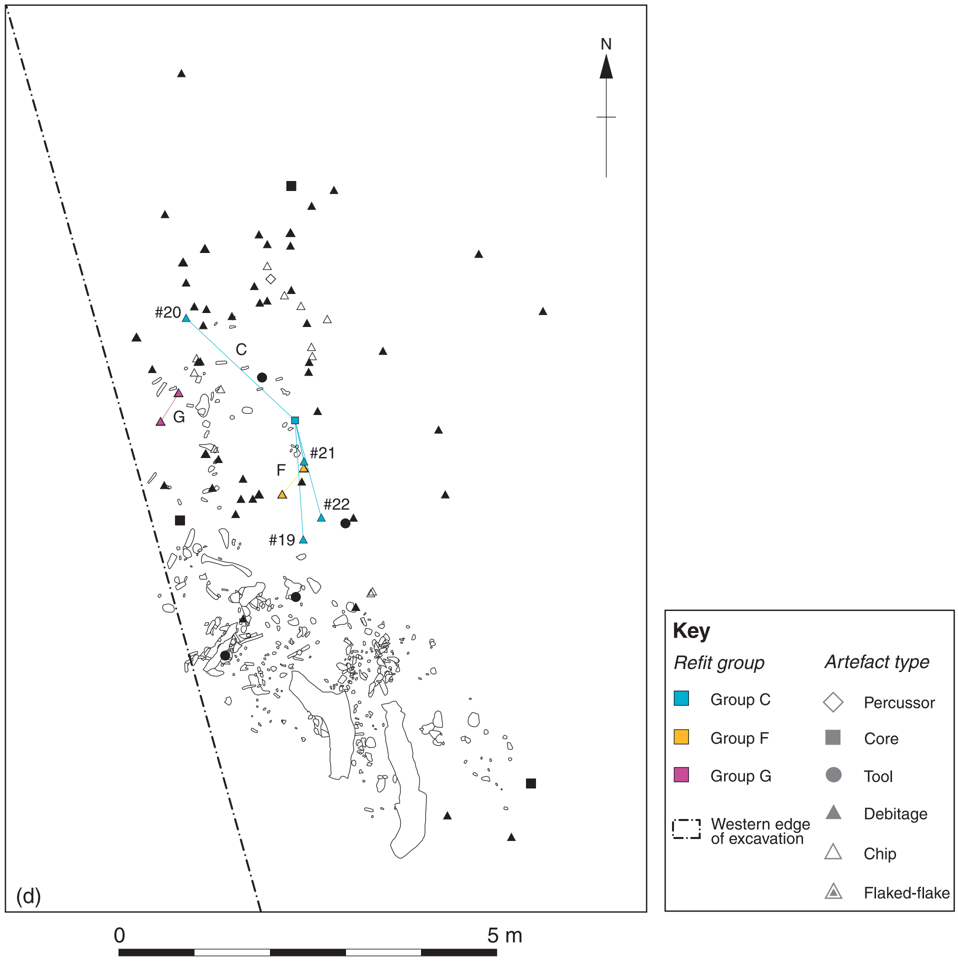


Figure 17.15 Refitting from around elephant skeleton: (a) Group C, events #19–22 - showing anticlockwise migration of striking point on platform; (b) Group F, broken flake Δ.40657=Δ.40792 ; (c) Group G, broken flake Δ.40799= Δ.40955; (d) thumbnail of illustrated flint locations and refitting connections [ill. B. McNee]

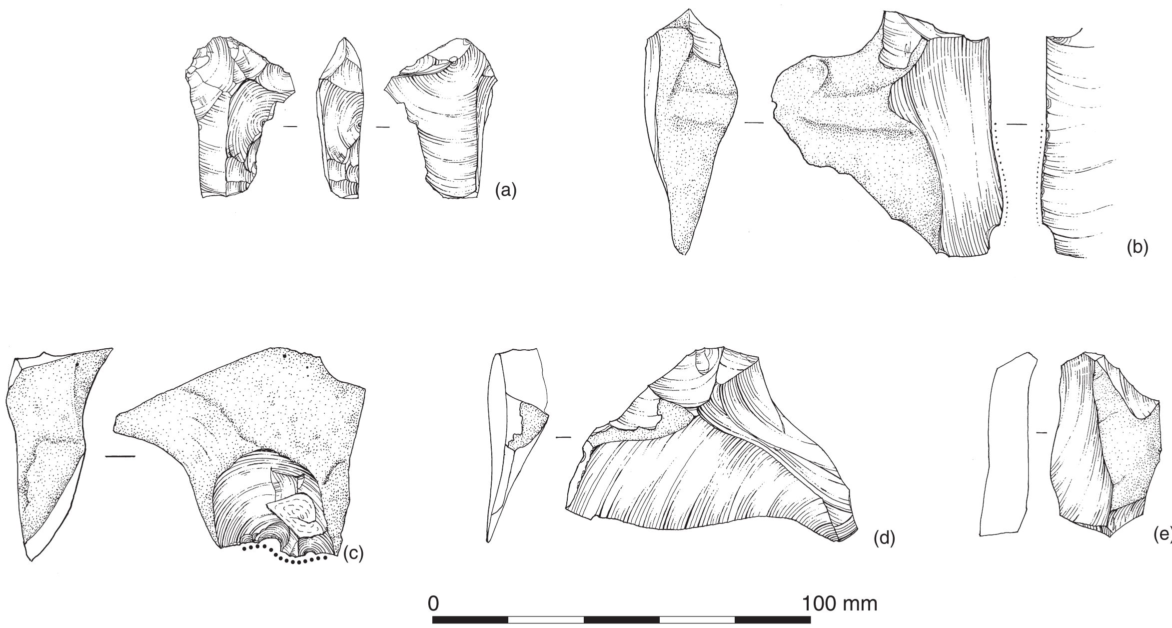


Figure 17.16 Non-refitting flints from around elephant skeleton: (a) single-notched flake, Δ.41066; (b) utilised flake, Δ.40883; (c) utilised flake, Δ.40357; (d) flake, Δ.41069; (e) flake, Δ.40723 [ill. B. McNee]

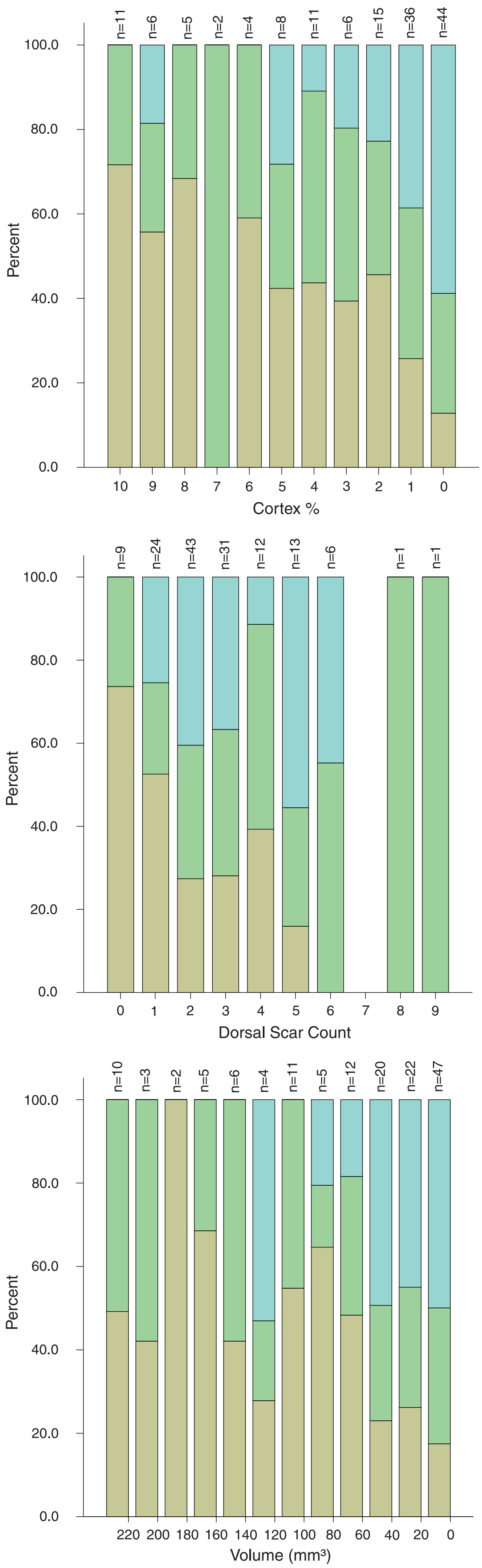
sequence. The other two are shown here (Δ.40883 – Fig. 17.16b; Δ.40357 – Fig. 17.16c). Although the notched flake-tool was found in the centre of the scatter, the other utilised pieces were all found at its southern edge, in amongst the surviving elephant bones (Fig. 17.2). In addition to these flake tools, one small flake Δ.40658 (Fig. 17.13f) was interpreted as a flake-flake from making a notched flake-tool.

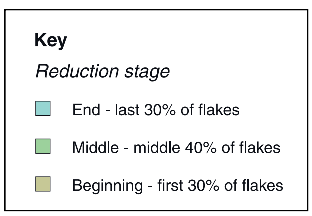
Apart from these tools, and the flake-flake, the remainder of the non-refitting elephant lithic assemblage comprised six flakes and two pieces of irregular waste. Two of the larger flakes are also illustrated (Fig. 17.16d; e). Both have long sharp edges, but there is no visible evidence of them having been used. All of the aforementioned larger artefacts seem to be of distinct raw material both from each other, and from the six refitting reduction sequences, indicating that the site retains evidence of working of a minimum of twelve separate pieces of raw material. Of the remaining six pieces of debitage, several were small and stained, unlike the refitting and other material discussed above, and it is possible that some or most of them are coincidental background noise, rather than being genuinely evidence of activity associated with the elephant carcass. One of them (Δ.42139) was a small piece of the distal end of a flake, made of distinctive orange semi-translucent flint that was definitely not present elsewhere in the assemblage. The others had the raw material obscured by staining, and, if not coincidental background noise, could perhaps be associated with the same raw material pieces as already represented by the rest of the assemblage. Therefore, in total, there are probably thirteen pieces of raw material represented in the assemblage, four of them by refitting reduction sequences, and the other nine by single artefacts.

The chaîne opératoire *and organisation of production*

Although opinion differs on this (cf. Bar-Yosef and van Peer 2009) the approach taken here is that discussion of the *chaîne opératoire* involves a deeper, more emic engagement with the cognitive and physical landscape of the knapper than the mere description of the reduction sequence. Thus, rather than merely describing the progression of knapping reduction and the apparent stages of production present wholly as perceived from a modern perspective, it attempts to imbue these with ancient purposive intent and integrate them into the organisation of the lithic technological system, from initial raw material procurement, through transformation by knapping and selective appropriation of certain lithic products for use, up to the point of their loss/abandonment/discard.

One of the first points to arise from analysis of the assemblage is that the three longer refitting sequences (Groups A, B and C) all include the early stages of reduction. This suggests that the raw material was locally obtained, unless heavy raw material was brought a substantial distance before most of it was abandoned as waste debitage after knapping. As indicated by the geological investigation to the west of the site (Chapter 4) and the quantity of natural flint nodules in the assemblage from the Phase 6 clay south of Trench D (Chapter 18), it seems clear that flint raw material was available near the site, on, and at the foot of, the slope that would have been rising up to the west. Therefore it seems likely that at least three pieces of raw material were collected locally and knapped on the spot as an immediate expedient response to the presence of the elephant carcass. Work done previously by Wenban-Smith (1996) investigated a range of flake attrib-





utes to establish which ones, and in which combination, provided the best indication of reduction order. For simple flake/core technologies applied to nodular flint raw material, as exhibited at the elephant site, it was found that there was a strong correlation of the dorsal scar count with reduction progression, and an inverse correlation of size and % cortex (Table 17.11; Fig. 17.17). These variables were then combined by canonical correlation into a single function, after standardising the different variables (subtracting the mean, and dividing by standard deviation) to remove the impact of scale variation (Table 17.12). The canonical function for the combined experimental material had a correlation of 0.65 with reduction sequence, thus providing a marked improvement on any of the single variables as a means of modeling the representation of reduction stage. Reduction was divided into three stages: 'Beginning' – first 30% of flakes; 'Middle' – middle 40% of flakes; and 'End' – last 30% of flakes (Fig. 17.18a).

When this framework was applied to the non-refitting debitage and flake-tools (Fig. 17.18b), as well as to the refitting debitage as a control, it could be seen that the remaining debitage and flake-tools seem to lack the earliest stages of core reduction and to be evenly distributed across the middle and later stages. The model provides an accurate representation of the refitting groups A and C. Group B is somewhat anomalous, interpreted as abandoned due to percussor breakage, and the model misleadingly indicates debitage from both early and middle stages of reduction as being present. It is at this point that the absence of the western side of the elephant area is particularly frustrating. It is uncertain whether earlier stages of the reduction sequences associated with the non-refitting material were present in the missing part of the site, or whether these were imported to the elephant area from further afield. There are certain gaps within the surviving refitting assemblage, such as the core from refitting group A and some of the flakes from refitting groups B and C. These have probably been selected from the debitage produced for use as tools, and it would have been particularly useful to establish whether they were abandoned at the site or exported further afield. There are, however, a number of flake tools that were abandoned at the site, including Δ.41040 from the Group C reduction sequence. Also present at the site, abandoned without further reduction, are cores Δ.40494, Δ.41100 and Δ.40871, the latter slightly small, but the other two still of substantial size. The overall picture given, albeit slightly hazy due to the missing part of the site, is of a predominantly expedient lithic techno-

Figure 17.17 Experimental model for relationship of selected flake attributes to Clactonian reduction stage: (a) percentage of dorsal cortex; (b) dorsal scar count; (c) flake volume

Table 17.11 Correlation coefficients of flake attributes with reduction order for three Clactonian experiments, independently and combined (Wenban-Smith 1996)

Attribute	*Ex. 1*	*Ex. 2*	*Ex. 3*	*Ex. 1-3*	*Sig.level*
Max Length	-0.29	-0.36	-0.45	-0.36	0.000
Max Width	-0.40	-0.15	-0.36	-0.30	0.000
Max Thickness	-0.28	-0.35	-0.42	-0.34	0.000
Platform length	-0.27	-0.24	-0.36	-0.29	0.000
Dorsal scar count	0.49	0.34	0.44	0.41	0.000
Percentage cortex	-0.48	-0.29	-0.38	-0.37	0.000
Flake volume (cm^3)	-0.39	-0.31	-0.45	-0.38	0.000
Cortical area (cm^2)	-0.51	-0.36	-0.45	-0.43	0.000

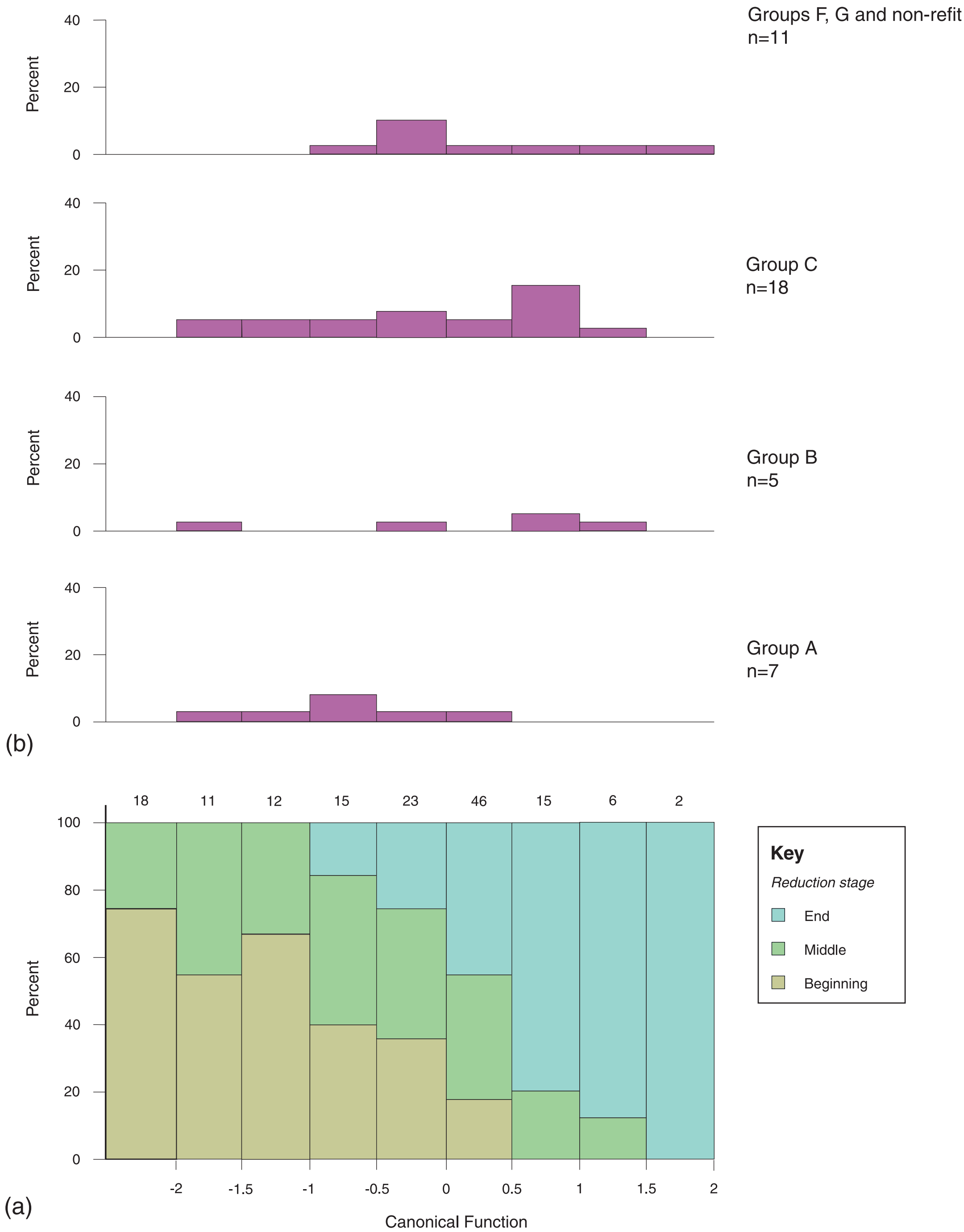


Figure 17.18 Canonical correlation function for flake reduction order: (a) experimental model; (b) applied to debitage from elephant area

Table 17.12 Canonical correlation functions of selected flake attributes with reduction order for three Clactonian experiments, independently and combined (Wenban-Smith 1996)

Attribute	*Ex. 1*	*Ex. 2*	*Ex. 3*	*Ex. 1-3*
Max Length	-0.31	-0.45	-0.85	-0.42
Dorsal scar count	0.79	0.79	0.89	0.80
Percentage cortex	-0.14	-0.10	-0.37	-0.39
Flake volume (cm^3)	-0.37	-0.59	-0.37	-0.39
Cortical area (cm^2)	-0.13	0.33	0.74	-
Correlation coeff.	0.76	0.53	0.75	0.65

logical *chaîne opératoire*, whereby raw material for knapping and adequate percussors are both present in the surrounding landscape, and are collected, used and abandoned as required. However some of the flakes and flake-tools could have been brought to the site having been knapped elsewhere.

The technological strategy seems to be based around the production of sharp-edged flakes of sufficient size to be convenient for handling, some of which were used unmodified as cutting tools, and some of which were secondarily worked with addition of a notch. Although superficially the knapping strategy is an entirely unstructured *ad hoc* reduction approach, with flakes removed in series from a platform until it is exhausted and then a new platform found, often using the alternate scar of the previous removal, there are some flint hints of a more structured volumetric conception of the nodule being worked. In the longer reduction sequence of Group C, rather than random *ad hoc* rotation of the core to continually find newly orientated striking platforms there is a consistent upper side to the core from which most flakes are struck, with occasional deviations when flakes are struck sideways across the primary flaking direction prior to continuation of flaking in the primary direction. Most of the flakes produced seem to be abandoned forthwith as waste, although some are selected for use and modification. It is, unfortunately, entirely uncertain whether some of the larger isolated debitage and utilised flakes found at the site were parts of reduction sequences that were nearby, but were lost before archaeological excavation took place, or whether they were imported to the elephant carcass area from further afield.

DISCUSSION

This chapter has presented the results of more detailed analysis of the lithic collection from the area of the elephant skeleton than in the previously published interim report (Wenban-Smith *et al.* 2006). This has not altered the headline interpretation of that report, namely that there is clear evidence of hominin knapping activity associated with the carcass, most likely focused on its butchery for meat; on the contrary, this interpretation has if anything been reinforced. However, some details presented in the interim report have been revised, and it is important to spell these out. As reported previously, the lithic artefact concentration associated with the elephant was contained within an area of approximately 6 x 4m immediately adjacent to the main concentration of bones (Fig. 17.2). However, the lithic artefact assemblage was smaller than originally thought, once natural pieces and unreliably associated material were excluded, with only 77 artefacts forming the definitive elephant assemblage, of which 12 were chips <20mm long. Furthermore, although the lithic concentration was clearly juxtaposed to the bone concentration, the previous report of an area of lithic concentration between the tusks was found to be incorrect, although there was a mini-concentration of three outlying artefacts from the main scatter beyond the tip of the more south-easterly tusk.

It is uncertain how the elephant arrived at the location. The underlying sediment was not deformed, suggesting it first came to rest on a dry ground surface, and was definitely not mired in swampy ground. However, the general environment of sedimentary deposition associated with its burial is one of swampy/peaty conditions at the edge of a fluctuating water-body. This probably partially submerged the area of the skeleton for a sustained period, sufficient to ensure deposition of peaty clay-silts that helped preserve it until the present day. There is no direct evidence to indicate whether or not the elephant was actively hunted and killed, whether it died naturally on the spot, or whether perhaps the carcass floated in. The latter seems unlikely, as the carcass would have been pretty rancid prior to being sufficiently bloated to become waterborne, and therefore not a very appetizing prospect for even a very hungry hominin. Concerning the possibility of hunting, the elephant was a prime adult, probably male based on its large size. Such animals are less likely, in the modern era, to die in the wild of natural causes than are juveniles or elderly individuals (Haynes 1988). Although it may seem unlikely, considering its size, there is documented evidence of adult elephants being killed by modern humans using simple technology based around a spear (eg Zwilling 1942), and it is known from the finds at Clacton (Wymer 1985), Schöningen (Thieme 1997) and Boxgrove (Pitts and Roberts 1997) that wooden spears were part of the technological capacity of hominins of this era, so hunting cannot be ruled out, particularly if the animal was perhaps already injured. This is considered further in the concluding discussion (Chapter 22).

However it came to the spot, the juxtaposition of the lithic remains, their mint condition and the high degree of refitting strongly suggest a genuine causative association between the lithic remains and the elephant carcass. The lithic clustering and their refitting indicate a lack of disturbance. Within an area of the Phase 6 clay which generally has a sparse presence of lithic artefacts and faunal remains, the association of both the elephant skeleton and the lithic evidence suggests that flint knapping activity and lithic artefact deposition has developed in relation to the presence of the carcass. This interpretation is reinforced by the fact that the main concentration of lithics is immediately beside the main concentration of bones, rather than directly superimposed, suggesting the main area of knapping activity respected the position of the carcass, as shown in the site layout figure (Fig. 17.2).

Interpretation of activity around the carcass is frustratingly hampered by the missing part of the site. In the surviving evidence, there are three longer sequences of reduction (Groups A, B and C), all of which start with early stages of reduction of a (very likely) locally obtained flint nodule. There is evidence of at least one percussor in use, represented by the broken percussor of Group D. There are four flake-tools present in the assemblage, as well as evidence of a missing notched flake-tool represented by a flake from secondary working. There are gaps of perhaps 5-6 flakes in the refitted reduction sequences that it could be suggested represent the selection and movement of tools. When the rest of the assemblage is considered, the total number of pieces of raw material represented is *c* 12-13. There are clearly various imponderables, not only to do with the missing part of the site. It is also uncertain whether the elephant should be regarded as having been exploited on a single occasion, or whether it was subject to repeated episodes of butchery, assuming that exploitation of the elephant's meat or some other body part for food was the prime focus of the hominin activity.

It is likely that the meat, or other body parts, would have remained fresh enough to eat for at least several days after its death, perhaps as long as a week depending upon the prevailing environmental temperature. Once discovered, it would probably therefore have been subject to repeated visits by the hominins in the vicinity. Under this scenario, it is possible on post-discovery return visits that suitable tools for any desired butchery tasks would be obtained *en route* to the carcass, so would not leave such substantial evidence of reduction. It is therefore possible to tentatively speculate that the group-size of the hominins who were included in the initial discovery of, and knapping activity around, the carcass may have been as low as 3-4, based on the number of longer reduction sequences (and without consideration of the unknown missing evidence).

It is also noteworthy that, although the tusks and upper molars of the elephant were present, the jaw and lower molars were absent; the latter in particular would have been likely to survive had they been present despite the poor preservation of many bone elements. As seems to be the case at other elephant butchery sites, for instance Notarchirico in Italy (Piperno and Tagliacozzo 2001), one of the typical hominin exploitations of an elephant carcass is the overturning of its skull and removal of the mandible to get at nutritious soft parts such as the brain, tongue and trunk. The absence of the mandible from the rest of the skeleton provides an additional indication of hominin exploitation for meat.

The relative paucity of lithic remains around the elephant does not make a good basis for recognition of a wider industrial tradition, since they relate to perhaps one specific fortnight of intermittent activity at one location in the landscape. They therefore provide a very specific snapshot rather than a more general view. However, the evidence that there is shows a very clear picture of a simple flake/core technology, with certain flake-products selected for use without modification, and others slightly modified by simple secondary working to form a notch in the cutting edge. Although the primary exploitation of the carcass seems to reflect an expedient approach to raw material provisioning, tool manufacture, use and discard, there is also some indication that there is an accompanying element of more logistically organised behaviour, with tools moved around the landscape in anticipation of use. This is evidenced by the absence of potential cutting tools in the refitted reduction sequences and from the presence of other tools that are not part of any refitting sequences.