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EYSERHEIDE

A MAGDALENIAN OPEN-AIR SITE IN THE LOESS AREA OF THE NETHERLANDS AND ITS ARCHAEOLOGICAL CONTEXT

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6 Spatial distribution of finds

6.1 Introduction

In the preceding chapters 4 and 5, we focused on the flint assemblage of the site of Eyserheide and to the information on Magdalenian lithic use that can be inferred from the characteristics of the flint artefacts (raw materials, typology, technology, use-wear traces). In this chapter, the focus is on the spatial distribution of the archaeological material, as documented during the excavations in 1990-1991. A first analysis of this distribution and interpretation in terms of human behaviour and spatial organisation was carried out by A. Smit (1992). Following this study, we will in this chapter address the role of post-depositional processes and the way in which Magdalenian hunters and gatherers organised and used the camp site of Eyserheide. Point of departure for analysis is the flint artefacts and the unworked stone that were plotted in three dimensions underneath the plough zone. The division of flint artefacts into RMUs and artefact types (see chapter 4) will be used in an attempt to determine activity areas and for instance locations of modification of individual flint nodules.

In the past forty years, interest has increased hugely in the analysis and interpretation of find distributions in Late Upper Palaeolithic sites of Northwest Europe. Since then numerous sites with (presumed) good preservation conditions have been subjected to spatial analysis (see for instance Leroi-Gourhan and Brézillon 1966; Berke et al. 1984; Julien et al. 1988; Stapert 1989, 1990; Bullinger et al. 2006; Leesch et al. 2010). The majority of these are open-air sites of which the spatial distribution of stone tools and lithic debris have been analysed, whether or not in connection with faunal remains and remains of a hearth and/or habitation structure. Magdalenian sites in Northwest Europe have played a prominent role in the development of methods and techniques of intrasite spatial analysis. An early and important example of this is the open-air site of Pincevent, located in the river basin of the Seine c. 70 km southeast of Paris. Because of the clustering of finds around three hearths, Leroi-Gourhan (in: Leroi-Gourhan and Brézillon 1966) proposed for Habitation no. 1 one large structure consisting of three hearths. The results of the excavations of habitation units in Pincevent section 36 formed the foundations of the spatial model which he published six years later (Leroi-Gourhan and Brézillon 1972). This model assumes fixed patterns in the spatial position of archaeological material in the immediate vicinity and on either side of a hearth (A) (fig. 6.1). In the dispersal of the tools, flint and bone debris and ochre, Leroi-Gourhan recognised six zones which are distinguished from each other in the composition and density of finds. Zones B1 and C represent respectively an activity area (B1: *l'espace domestique interne*) and the sleeping area (C) inside a tent or hut structure. In zone B1 the amount of retouched tools is high and ochre occurs. The other zones (B2 and D to G) extend, in the form of successive semi-circular rings, on the other side of the hearth. B2 is designated as *l'espace domestique externe* and contains the material residue of activities deposited outside the habitation structure. Compared to B1, tools and ochre in zone B2 are less numerous. Zones D to F are the result of depositing of stone and bone debris in dumps located at distances of 1 to 2 m (D), 3 to 4 m (E), and 5 to 6 m (F) from the centre of the hearth (*espace d'évacation*). Zone G lies at an even greater distance from the hearth and consists of isolated finds.

After the publication of Leroi-Gourhan and Brézillon in 1972, several other habitation units, consisting of stone artefacts and animal bone material around or in the vicinity of hearths constructed with stones, have been excavated in Pincevent, but also in other locations in the Paris Basin: Verberie (Audouze et al. 1981), Marsangy (Schmider 1984, 1992), and Etiolles (Pigeot 1987). Parts of the spatial model of Leroi-Gourhan were thereby called into question (Audouze 1987b; Julien et al. 1987). An important question was centred on the size, shape and location of the habitation structure in relation to the hearth. Was this hearth in the centre, near the entrance or completely outside the (assumed) structure? Contrary to Leroi-Gourhan and with reference to the results of ethnographic research by Binford (hearth seating model, see 6.8.3), Audouze (1987b) proposes a position of the hearth in the open air, at a few metres from the entrance of the tent. This change in view has however not led to general consensus about the spatial relationship between habitation structures and hearths in Pincevent and other sites in the Paris Basin. The lack of archaeological

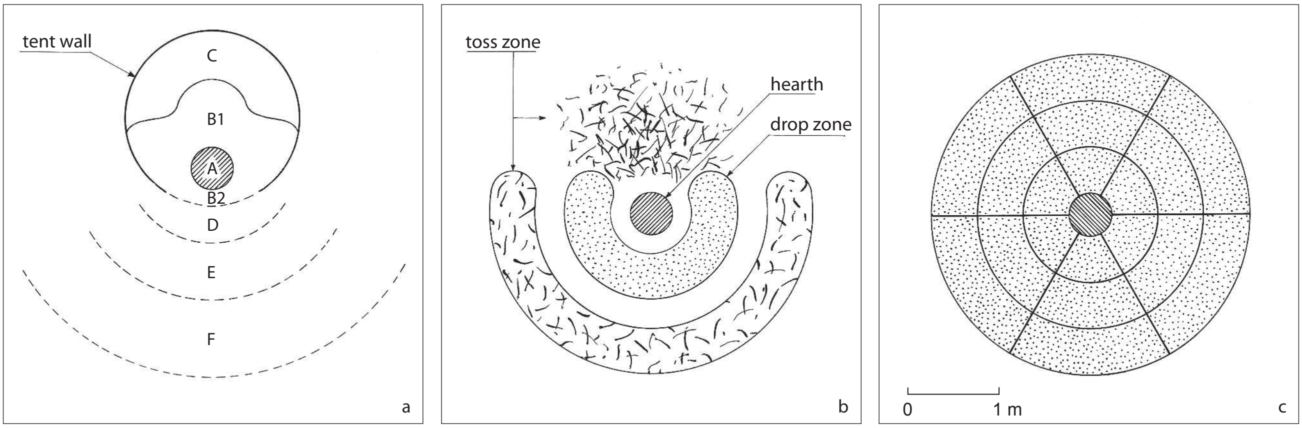


Figure 6.1 a: Tent model of Leroi-Gourhan. A= hearth, B1= activity area with relatively many tools and ochre, B2= dense concentration of (flint) stone and bone waste, C= sleeping area, find poor, D-G= zones with a decrease in the quantity of waste per zone. The diameter of the tent is c. 3 m (after Leroi-Gourhan and Brézillon 1972, 254, fig. 174); b: Binford's hearth seating model. The drop zone corresponds with the area where the persons are seated (close to the hearth) and where a wide range of activities is carried out (after Binford 1978, 1983 fig. 89); c: Stapert's ring and sector method. Division of find concentration with central hearth into rings and sectors (after Stapert 1989).

traces of tent or hut structures, for instance configurations of soil marks (postholes) or circles of stones (tent weights), and limitations of interpretation in particular with regard to find-poor parts of excavated habitation units (interpreted by Leroi-Gourhan as sleeping places) are to a considerable extent the reason for this.

In the German Central Rhineland, clusters of stone artefacts and animal bones around a central hearth have been analysed for Andernach and Gönnersdorf (Bosinski 1979; Stapert and Terberger 1989). In all cases we are dealing with well-preserved and carefully excavated open-air sites from the Magdalenian, whereby the aim was as far as possible an exact documentation of the position of individual finds and structures. In contrast to Pincevent, in both German sites, but also in Etiolles, circles of large stones were found with inside them a central hearth (Etiolles: Julien et al. 1988; Olive et al. 1988; Pigeot 1987). They have been interpreted as remains of circular habitation structures. One of the large concentrations (C1) at Gönnersdorf comprised a circle of postholes, within which a central hearth was present (Bosinksi 1979). At sites where archaeological evidence for habitation structures and hearths is lacking, the spatial analysis is directed to particularly or even exclusively (at locations where organic remains and ochre are not present) dispersals of stone artefacts. Not only characteristics of the artefacts themselves, such as type of artefact and dimensions, were of great value there, but also the results of refitting and use-wear analysis for gaining a further insight into the spatial organisation and use of the camp sites. The analyses are as a rule characterised by application of non-statistical methods in which horizontal distributions of finds, as recorded in general plans are evaluated with the naked eye and interpreted. Following the model of Leroi-Gourhan for section 36 in Pincevent, many of these analyses have led to the reconstruction of a circular habitation structure (hut or tent) in the most find-rich parts of sites. However, in the absence of archaeological traces of the habitation structures themselves, the archaeological furnishing of proof of these reconstructions is usually meagre. As a result, the outcomes of analyses should be treated with the necessary caution (see for instance Orp-le-Grand in Belgium, Vermeersch et al. 1984). An important example of spatial analysis of a Late Upper Palaeolithic site in the Netherlands is the Hamburg site of Oldeholtwolde (Stapert 1982; Johansen and Stapert 2004). The study of this site has led to the development of a new method of spatial analysis, namely the 'ring and sector method'. We will further discuss this method in paragraph 6.8.4.

Compared with well-preserved open-air sites which are covered by fine-grained, low-energy sediments and in which spatial patterns are still more or less intact, less attention has been paid to spatial analysis of surface sites from the Magdalenian. In view of their position on or directly beneath the present-day surface, the archaeological layer has in many cases been ploughed up or otherwise been disturbed, for instance by bioturbation. Organic materials also would have decayed completely as a result of chemical processes. All the same, this category of sites can contain valuable information about the way in which prehistoric hunters have organised and used the camp site. Moreover, surface sites, because of the often strong effects of abiotic and biotic processes, form an important 'training ground' for the research of post-depositional processes. Acquiring knowledge about these processes is indispensable for a spatial interpretation of observed distribution patterns, regardless of the degree of disturbance of a site. This research of surface sites is very important for a good understanding of sites covered by sediments which as a rule are described as well preserved.

In this chapter the focus will be first on the horizontal and vertical distribution of flint artefacts and the unworked stone (6.2 and 6.3). The data presented will serve as basis for a discussion of post-depositional processes and the influence these processes will have had on the spatial position of the finds (6.4). In the next paragraph (6.5), the composition of finds in four distinct clusters (clusters A, B, C, and D) will be considered. Subsequently, attention will be paid to the horizontal distribution of artefacts measured in three dimension belonging to one and the same RMU (6.6) and of retouched tools over the excavated area (6.7). For the sake of the intra-spatial analysis of the most find-rich part of the Eyserheide site (clusters A and B), the hearth seating model of L. Binford and the ring and sector method of D. Stapert will be discussed and applied in paragraph 6.8. The chapter will conclude with a brief discussion (6.9).

6.2 Horizontal distribution

6.2.1 Introduction

The fertile loess area of Dutch Limburg, where the site of Eyserheide is located, has been an agrarian area for a very long time. Many of the higher and rather flat plateaus and their margins have been in use as cultivated fields since the Middle Ages, in particular for cultivating wheat and maize. The plot of land, where the site is located, has at any rate been used since the middle of the 1980s alternately as cultivated field (maize cultivation) and grass land.
Present-day land use has had important consequence for the intactness of the site. Due to repeated ploughing of the top soil, the archaeological layer, which was originally embedded in an intact layer of loess, has been disturbed, and artefacts have ended up on the surface and in the plough zone. Of the total of flint artefacts, 484 specimens (14%) were found at the surface of the field prior to and for a small part after the excavation of 1990-1991 (table 6.1). During the trowelling of the plough zone 792 flint artefacts (23%) were recovered. The majority of the artefacts was collected, also by trowelling, underneath the plough zone: 2140 specimens (63%). This division demonstrates that already at the start of the excavation, more than 1/3 of the documented artefacts were in the top soil (plough zone) disturbed by ploughing.
If we look at the composition of finds per artefact type, it is noticeable that the majority of the complete cores, ten specimens, was collected by Mr Blezer from the surface between 1985 and 1990. Only two pieces came to light in the summer of 1990 during the trowelling of the plough zone. Also only few complete cores (n=4) were measured in beneath the plough zone. The number of fragments of cores originating from the plough zone is on the other hand quite high. In particular fragments of cores of Orsbach flint were encountered in the ploughed top soil. As the breakages (fractured planes) are not patinated, we presumably are dealing here with cores that were hit by the ploughshare and have split along frost cracks into two or more pieces.

Of the retouched tools, 51 specimens come from the surface or from the plough zone (table 6.1). A total of 44 retouched tools were been measured in three dimensions beneath the plough zone. The tools collected by Mr Blezer from the surface are representative, as far as type is concerned, of the (composition of) tools originating from the excavation.

6.2.2 Artefacts from the plough zone

Figure 6.2a-c shows the distribution of the artefacts found in the plough zone according to three size classes and per square of 1 × 1 m. The plough zone finds with maximum dimensions less than 2 cm show a distribution without there being clear clusters (fig. 6.2a). The peak of the distribution though lies in the eastern part of the excavated area, east of the 55 × grid line. This could point to smaller artefacts having been displaced downslope towards the more easterly dry valley (see fig. 2.4). We should bear in mind though that the plough zone was not sieved and that artefacts with small dimensions were missed during the trowelling of this plough zone. This makes it impossible to establish the exact meaning of the distribution as shown in figure 6.2a.

For the plough zone finds with dimensions between 2 and 5 cm, the peak of the distribution lies between gridline 54 and 59 (fig. 6.2b). A number of the western squares corresponds with squares from which many artefacts were measured in three dimensions beneath the plough zone. Compared to the artefacts smaller than 2 cm, the number of 'find-rich' squares with more than 5 artefacts is smaller. Nonetheless, the distribution is still diffuse. Also in the southern part are squares with relatively large numbers of artefacts. Based on the view that during the trowelling of the plough zone larger artefacts were missed less frequently, the reliability of the distribution is greater for artefacts larger than 2 cm (as represented in fig. 6.2b) than for artefacts with smaller dimensions. Neither does the distribution of plough zone finds larger than 5 cm show clearly delimited clusters (fig. 6.2c). Of many squares, the plough zone has yielded not a single artefact with a minimum dimension of 5 cm. It is

	Surface	Plough zone	Loess soil	N
Complete cores	10	2	4	16
Core fragments	31	32	37	100
Complete flakes	68	62	285	415
Flake fragments	119	152	297	568
Complete blades	11	5	51	67
Proximal fragments of blades	25	36	109	170
Medial fragments of blades	28	47	132	207
Distal fragments of blades	28	28	108	164
Blades with non-patinated break	53	47	27	127
Crested blades	2	1	3	6
Crested blade fragments	18	15	38	71
Rejuvenation flakes	10	5	19	34
Retouched tools	26	25	44	95
Flakes and blades with edge damage	5	5	26	36
Burin spalls	0	5	17	22
Chips	50	322	942	1314
Indet	0	3	1	4
Total	484	792	2140	3416

Table 6.1 Numbers of finds (all dimensions) per artefact type and find context: surface, plough zone and non-ploughed part of the loess soil. Counts before refitting of broken pieces.

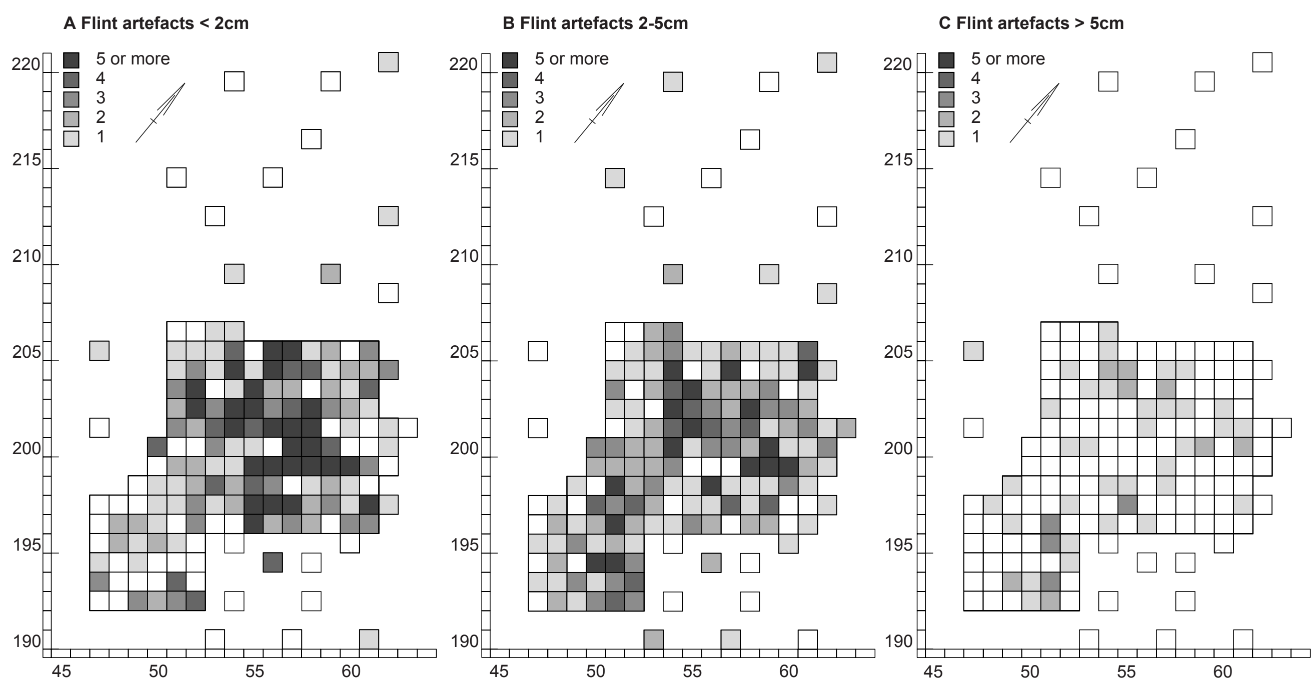


Figure 6.2 Densities of artefacts in the plough zone per square of 1 x 1 m, a= <2 cm, b= 2-5 cm, and c= >5 cm.

also noticeable that four rich squares with three artefacts lie in the southern part of the excavated area. In the northern and eastern part, per square of 1 × 1 m at most two artefacts larger than 5 cm were found in the plough zone. There are no squares with high density of finds here.

From the distribution maps of plough zone finds can be inferred that squares with 5 or more artefacts are (also) located at the periphery of the excavation. For this reason it should be assumed that artefacts are still present in the plough zone beyond this area. Another indication of this is the occurrence of plough zone finds in trial squares from April 1990, even in squares at more than 10 metres from the excavated area (fig. 6.2a-b). The fact that in the years after the excavation artefacts have still been collected from the surface also shows that the site has not been excavated completely.

6.2.3 Artefacts plotted in three dimensions

For an assessment of the dispersal of the artefacts plotted in three dimensions, each square of 1 × 1 m was further subdivided into four small units of 50 × 50 cm and maps were made that show the number of specimens per unit of 50 × 50 cm. Compared to the plough zone finds, the artefacts plotted in three dimensions show a different distribution (figs. 6.3). In some places there are clearly high densities of artefacts, of which the concentration of finds in squares 54/202, 54/203, 55/202, and 55/203 is most noticeable. In these squares with a surface area of 4 m^2, 302 flint artefacts larger than 2 cm were recovered beneath the plough zone (fig. 6.3b). Square 54/202 yielded the most artefacts larger than 2 cm: 130. Also the distribution of artefacts larger than 5 cm shows an increase in density in the number of artefacts in these four squares, though the number of units of 50 × 50 cm with five or more artefacts is smaller (fig. 6.3c) Compared with other parts of the excavation we are clearly dealing here with a cluster of artefacts. On the basis of the position of the artefacts larger than 5 cm, the cluster was further confined to an area of 1.70 × 1.70 m and a surface area of 2.9 m^2. This find-rich area will hereafter be referred to as cluster A (see fig. 3.7).

Cluster A has no clear boundaries but is surrounded by a zone with decreasing numbers of finds. In the remaining parts of squares 54/203, 55/202 and 55/203 and the contiguous squares 53/202, 53/203, 53/204 and 55/204, the numbers of artefacts larger than 2 cm are still relatively high. There is however a clear decrease in the number of artefacts larger than 5 cm. The squares around cluster A, with the exception of squares 52/201, 53/201 and 54/201, have been designated as the periphery of cluster A. This periphery is maximally four metres long and four metres wide, and has a surface area of 11.1 m^2. In one of the squares concerned, square 53/202, relatively many artefacts were measured in (n=53). As will be described later in this chapter (6.4), we are probably dealing with artefacts that originally formed part of cluster A. As a result of bioturbation (tree fall), artefacts have been moved and have secondarily ended up in a tree fall pit.

About three metres south of cluster A, the number of artefacts increased again in squares 52/199, 52/200, 53/199 and 53/200. In particular in the distribution of artefacts larger than 5 cm is this second cluster clearly visible (fig. 6.3c). The cluster measures 1.2 × 1.5 m (surface area 1.8 m^2), and has been designated as cluster B. Between cluster A and cluster B, in three adjacent squares (52/201, 53/201 and 54/201) clearly fewer artefacts larger than 5 cm were plotted in three dimensions. These squares together represent zone A/B.

In the other parts of the excavation, artefacts between 2 and 5 cm and larger than 5 cm were recovered in smaller numbers, and the find density beneath the plough zone is lower. There is mainly a thin distribution of artefacts, while at the periphery of the area, squares commonly occur without finds. About four metres east of cluster A, squares 58/201, 59/201, 60/200 and 60/201 do show a higher density, especially with regard to artefacts with maximum dimensions less than 5 cm (figs. 6.3a-b). Also, compared to adjacent squares, more artefacts larger than 5 cm were plotted in three dimensions. As will be discussed later in this chapter, we are presumably dealing here with a heavily depleted concentration, from where most artefacts as a result of erosion, bioturbation and/or present-day land use (ploughing) have been moved downslope and/or have been incorporated into the plough zone. For the sake of intra spatial analysis, an area of 4 × 4 m has been designated as cluster C.

And finally, the southern part of the excavated area should be pointed out. Here square 49/196 with 38 artefacts larger than 2 cm has yielded significantly more finds than the other squares in this part of the excavation. The finds came to light at the end of the excavation campaign in the summer of 1990. They formed the reason for continuing the excavation in April 1991. Square 49/196 and eleven contiguous squares together form an area of 3 × 4 m and have been designated as cluster D. This zone is heavily disturbed as a result of ploughing and bioturbation (see 6.4).

As has been indicated in the text above, clusters A and B, and to a lesser degree clusters C and D, are also visible in the distribution of artefacts plotted in three dimensions larger than 5 cm (fig. 6.3c). The distribution of artefacts smaller than 2 cm is much vaguer. On the basis of these artefacts, clusters A and B cannot be clearly distinguished from each other. Both clusters together represent in fact a find-rich area

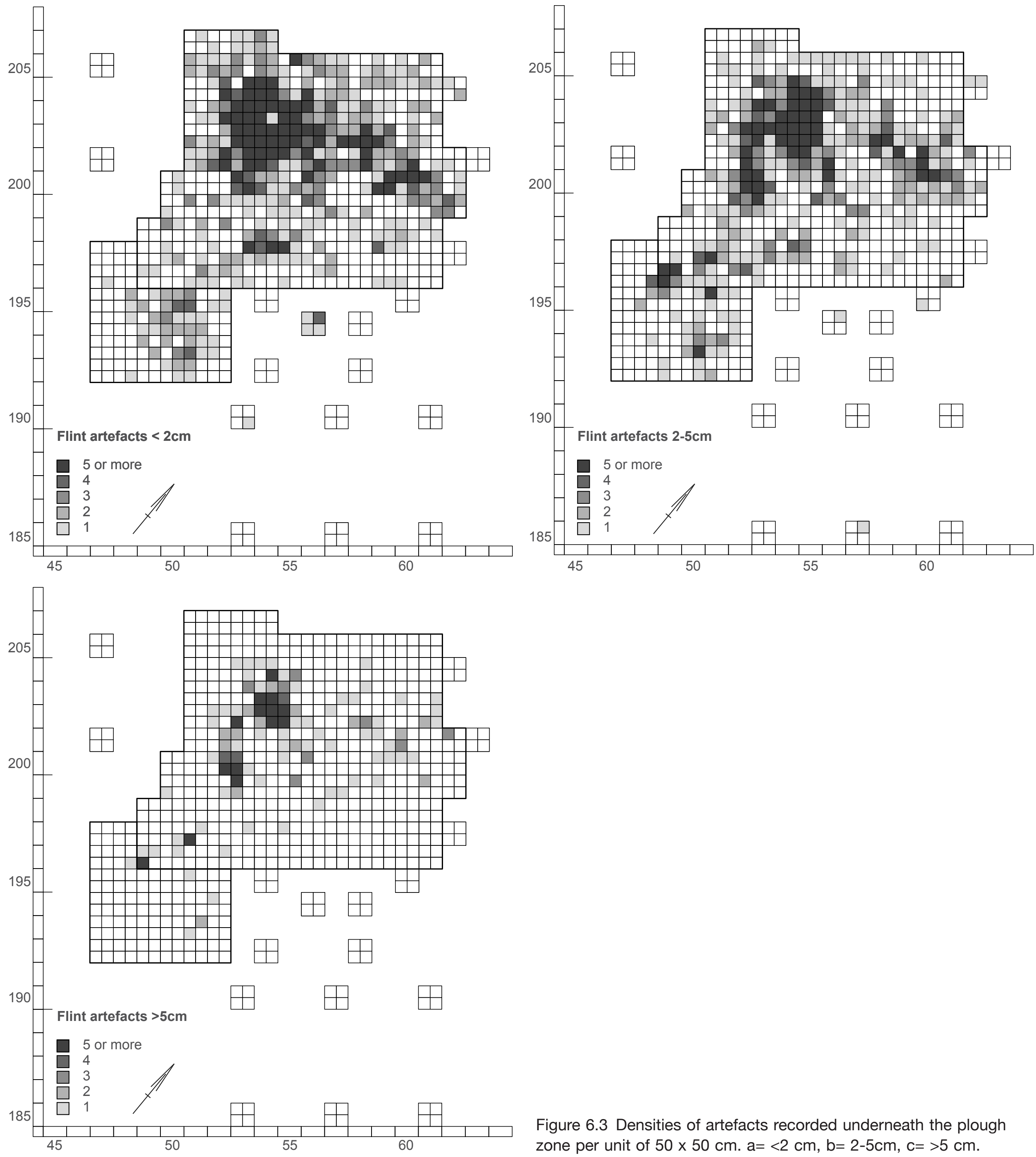


Figure 6.3 Densities of artefacts recorded underneath the plough zone per unit of 50 x 50 cm. a= <2 cm, b= 2-5cm, c= >5 cm.

covering a surface of c. 16 m^2 (fig. 6.3a). Later in this chapter an attempt will be made to give an explanation for this discrepancy. The central question here is whether post-depositional processes (for instance slope wash and bioturbation) could possibly be the cause of the more diffuse distribution of artefacts with small dimensions.

Finally, burnt flint artefacts are only represented by few specimens and show a very diffuse distribution. Even within the four clusters, the numbers are very low and there are no specific locations with large(r) densities of such artefacts. In the case of the site of Eyserheide, burnt artefacts do not form an indication of the presence and location of one or more hearth(s).

6.2.4 *Unworked stone from the plough zone*

From the in total 123 fragments of unworked stone, 30 pieces came from the plough zone (table 6.2). Eight pieces of these were in the plough zone of squares 54/203, 55/202 and 55/203, that is to say in the area that was designated as cluster A on the basis of artefacts *plotted in three dimensions*. Five of these bear traces of heating, among which two fragments (55/203 103 and 55/203 104) of quartzitic sandstone from the Devonian (code 16). Both fragments could be refitted onto a large fragment that came to light in square 56/200, at 3 m at most from square 55/203 (refit group 16.01). This piece (weight: 531 grams) was lying at the base of the plough zone, on the transition to the top of the non-ploughed part of the loess soil. Possibly this piece was displaced a few metres from cluster A in an easterly direction as a result of ploughing.

Two refitted fragments of quartzitic sandstone also bear traces of heating and they originate from the area of cluster A (refit group 43.01). Four other heated fragments have been found in the plough zone and at a short distance from these finds, in the periphery of cluster A. Together with fragments of (heated) stones recovered from beneath the plough zone, they indicate that there must have been a small hearth at the time of the occupation of Magdalenian hunters and gatherers (see 6.8.2).

Fragments of unworked stone also came from the plough zone of zone A/B (n=2) and, at a larger distance from cluster A, from the area of cluster D (n=5) (table 6.2). These are two fragments of a very fine siltstone (code 15), a fragment of quartzitic sandstone from the Devonian (code 16), and four fragments of quartzitic sandstone (codes 41 and 43). Also a number of these fragments bear traces of heating. The remaining eleven fragments were found outside the clusters mentioned, for instance in square 50/192 in the far south and in square 56/200 in the central part of the excavation. It is noticeable that east of the gridline with x co-ordinate 58, no fragments of unworked stone have been encountered in the plough zone, among which in the 16 squares of 1 × 1 m which together represent cluster C. Also the plough zone of the small area of cluster B has not yielded any unworked stone.

6.2.5 *Unworked stone plotted in three dimensions*

Of unworked siltstone (code 15), 38 fragments were found in cluster A in spatial connection with a high density of flint artefacts (figs. 6.6 and 6.7, table 6.2). Moreover, 20 fragments of the same siltstone were found in the periphery of cluster A (n=14) and in the zone between clusters A and B (n=6). On the basis of this close spatial association with cluster A, a relationship between the numerous fragments of siltstone and the use of the location in the Magdalenian seems to be obvious. The total number of fragments of this siltstone is 64. They vary in weight from 0.5 to 455.9 grams.

Of the quartzitic sandstone from the Devonian (code 16), yellow-brown in colour and with a rather smooth top, only a small number of fragments were found underneath the plough zone. They are all partly or completely coloured red as a result of heating. Two fragments come from cluster A and one from the zone between clusters A and B. An important observation is that these fragments could be refitted onto a large fragment from the plough zone (refit group 16.02).

In cluster A and its periphery also fragments were found of fine-grained sandstone from Meuse gravel (code 42), quartzitic sandstone (code 43) and coarse-grained quartzite (code 44). A part of these again bear traces of heating and could be refitted onto fragments from the plough zone.

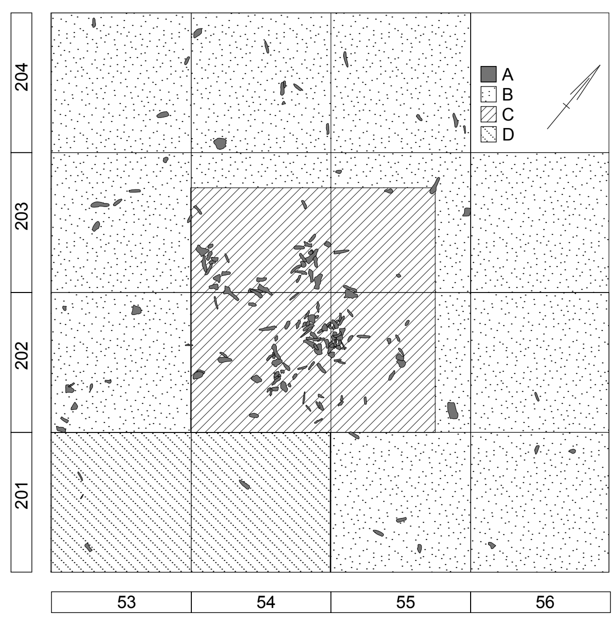


Figure 6.4 Horizontal distribution of artefacts >5 cm and fragments of non-worked stone >5 cm (A) in cluster A (C), the periphery of cluster A (B), and zone A/B (D).

			Loess soil							
	Surface	Ploughzone	Cluster A	Periphery A	Zone A/B	Cluster B	Cluster C	Cluster D	Other sections	N
Siltstone (code 15)	1	6	38	14	6	1	1	.	4	71
Quartzitic sandstone (code 16)	.	5	2	.	1	.	.	1	.	9
Quartzitic sandstone (code 41)	1	6	.	.	.	3	.	.	.	10
Fine-grained sandstone (code 42)	3	6	3	1		.	.	.	.	13
Quartzitic sandstone (code 43)	4	4	2	.	1	.	.	.	.	11
Coarse-grained quartzite (code 44)	1	3	3	2	.	.	.	.	.	9
Total	10	30	48	17	8	4	1	1	4	123
			Ploughzone							
			Cluster A	Periphery A	Zone A/B	Cluster B	Cluster C	Cluster D	Other sections	N
Siltstone (code 15)			.	.	1	.	.	1	4	6
Quartzitic sandstone (code 16)			2	.	.	.	.	1	2	5
Quartzitic sandstone (code 41)			.	.	1	.	.	2	3	6
Fine-grained sandstone (code 42)			2	2	.	.	.	.	2	6
Quartzitic sandstone (code 43)			2	1	.	.	.	1	.	4
Coarse-grained quartzite (code 44)			2	1	.	.	.	.	.	3
Total			8	4	2	0	0	5	11	30

Table 6.2 Numbers of fragments of unworked stone recovered from surface, plough zone and loess soil (a) and from the plough zone (b) in different parts of the excavation.

The presence of fragments of unworked stone bearing traces of heating indicates that in (the centre of) cluster A a fireplace was present at the time of Magdalenian occupation. It is reasonable to assume that the stones formed part of a small hearth. As a result of bioturbation and ploughing of the archaeological layer, a large part of the hearth has been disturbed, which led to fragments of heated stones ending up in the plough zone (see 6.4). Unfortunately, there is no longer an intact or largely preserved hearth.

Outside cluster A and its periphery, the number of stones plotted in three dimensions is significantly smaller (see table 6.2). Within the boundaries of clusters C and D, only two fragments of unworked stone were plotted. It should be pointed out though that the plough zone of cluster D has yielded relatively many pieces. Whether these finds indicate the possible presence of a second hearth a few metres south of cluster A could not be determined.

6.2.6 Ochre? (Bertil van Os)

Among the fragments of very fine siltstone (code 15) are two pieces of which one side is coloured red (fig. 4.36). Both fragments have been found close together in the western part of square 55/202 in the centre of cluster A (fig. 6.6). They had a relatively deep position in the archaeological layer in L4 (193.42 m +NAP) and L6 (193.34 m +NAP). The stones can easily be mistaken for chalk. Further investigation showed however that it is very fine siltstone with the appearance of travertine. The limited density, the eluviation hollows and the lack of visible quartz make it likely that we are dealing here with a diatomite or gravel slate. This type of stone occurs in the Ardennes and, as has the Devonian quartzitic sandstone (code 16), can have been transported by the Meuse and deposited on a terrace along the Meuse. Black minerals are visible in the siltstone. These minerals are ferruginous (see below). It probably concerns goethite (FeO(OH)). This is a very common iron mineral that is formed in an oxidising environment in freshwater, river or lake sediments, and in lake soils. It is the most important mineral in brown ochre. If goethite is heated, it can be changed into hematite. This mineral has after heating a typical red colour and is often the main component of red ochre. Goethite is mainly found in stones and is formed during diagenetic processes by interaction with ferruginous ground water or formation water with the stone.

The composition of the black minerals (including the matrix), the ‘ochre’-coloured flecks and the naked stone without these phenomena have been analysed with XRF (roentgen fluorescence). It has thus been determined what the black dots and red flecks on the fine siltstone are. The outcome of the analyses, together with an analysed chalk as reference, is summarised in table 6.3.

Figure 6.5 Flint artefacts, including two long blades of Simpelveld flint, and fragments of unworked siltstone in square 54/202 in cluster A.

Figure 6.6 Two fragments of siltstone (code 15) bearing traces of heating in the centre of cluster A.

Figure 6.7 Fragments of siltstone in the centre of cluster A.

Sample no.	Site	Find no.	Remarks	SiO_2	CaO	P_2O_5	K_2O	Al_2O_3	TiO_2	Fe_2O_3	MnO	Bal
				%	%	%	%	%	%	%	%	%
877	Eyserheide	55/202 122	.	37	0.338	0.111	1.05	2.54	0.302	12	0.083	47
878	Eyserheide	55/202 142	'ochre'	67	0.337	0.107	1.07	4.77	0.256	4.07	0.038	22
880	Eyserheide	55/202 142	'ochre' absent	68	0.335	0.134	0.437	1.89	0.053	1.15	0.024	28
881	Eyserheide	53/203 45	'ochre' absent	72	0.303	0.157	0.453	2.1	0.091	0.986	0.055	24
882	Eyserheide	53/203 45	black mineral	59	0.334	0.121	0.766	2.63	0.186	2.24	0.771	34
883	Eyserheide	53/203 45	'ochre' absent	68	0.252	0.15	0.401	1.65	0.066	1.08	0.025	28
879	limestone	reference	.	4.19	47	0.062	0.009	0.651	0.066	0.272	0.022	48

Table 6.3 Main components of very fine siltstone (code 15) recovered from the centre of cluster A in Eyserheide.

The results of the analysis confirm the notion that we are dealing with a stone that mainly consists of SiO_2. This is the most important component of sand, siltstone, diatomite or gravel slate. The SiO_2 content is slightly underestimated, probably because the stones were not cleaned and on the surface were still present loess and organic dust, which absorb roentgen radiation. Both the red flecks and the black dots show a high iron content. This is an indication that we are indeed dealing with goethite respectively hematite. The black dots have a slightly higher manganese content than the red flecks. The reaction of goethite to hematite can be described according to the reaction mechanism:

$$2\ FeO(OH) \rightarrow Fe_2O_3 + H_2O$$

The transition (dehydration) occurs at a temperature between 300º and 350º C (Gialanella et al. 2010). The structure of the goethite crystals can however remain intact up to 900º C. The above indicates that the 'ochre' found is probably of natural origin and was formed after heating of the stones whereby the goethite was changed into hematite. This could mean that the stones were used as hearth stones. It is unlikely that 'ochre' was afterwards put on the stone.

6.3 Vertical distribution

The vertical distribution of the artefacts plotted in three dimensions, that is artefacts that were directly underneath the base of the plough zone or deeper in the loess soil, varies greatly. The vertical distribution will be discussed in more detail for the excavated squares adjacent to the west-east profile 1 and the north-south profile 3 (fig. 6.11). For the position of both profiles in the excavated area, the reader is referred to figure 3.7. Data on the number of artefacts and depth of artefacts in these squares have also been included in tables 6.4 (profile 1) and 6.5 (profile 3).

In the squares with y co-ordinate 203 and adjacent to profile 1 (squares 52/203 to 61/203), the vertical distribution of artefacts varies between 10 and 55 cm. In the western part, this spread is greatest and in particular in the squares that form part of cluster A (54/203, 55/203) or its periphery (53/203, 56/203). Although the total vertical spread is here 55 cm, there are particularly large numbers of artefacts in L2 to L5, from 5 to 25 cm beneath the base of the plough zone. At this depth, 159 of 293 artefacts (=54.3%) were found in the four mentioned squares. Further east, towards the dry valley, the number of finds clearly decreases. Moreover, there is a clear 'leap' in the vertical spread of the artefacts: from 50 cm in square 58/203 to maximally 15 cm in squares 59/203, 60/203 and 61/203 (table 6.4). The latter squares are four to five metres east of cluster A.

The squares bordering the north-south profile 3 with x co-ordinate 55 show a similar picture with regard to the area of cluster A and its periphery (table 6.5). In four adjacent squares 55/201, 55/202, 55/203 and 55/204 the vertical distribution is large, in square 55/202 this distribution even amounts to 80 cm. Also here we see larger numbers of artefacts in layers 2 to 5, that is again at a depth between 5 and 25 cm beneath the base of the plough zone. A total of 185 artefacts were found in these four squares in this part of the non-ploughed loess soil. At a deeper level (layers 6 to 15) this number is 62.

Looking finally at the vertical distribution of flint artefacts in some other squares with a high find density, it is found that this distribution outside the zones with disturbances (see 6.4) is relatively limited. In the most find-rich square 54/202 in cluster A, 172 out of 191 flint artefacts had a depth, between 0 and 29 cm below the plough zone (layers 1 to 6, table 6.6). Small and large artefacts have been found together and regularly dispersed at this depth. The layer between 25 and 29 cm (layer 6) contained the most finds

Square	52/203	53/203	54/203	55/203	56/203	57/203	58/203	59/203	60/203	61/203	N
Layer 1	1	3	6	3	.	1	.	2	1	1	18
Layer 2	3	10	17	12	2	3	1	1	.	4	53
Layer 3	5	6	24	15	2	3	.	.	1	2	58
Layer 4	3	6	19	15	3	1	2	.	.	.	49
Layer 5	3	6	12	7	3	2	4	.	.	.	37
Layer 6	.	7	.	11	.	1	2	.	.	.	21
Layer 7	1	8	3	4	4	1	2	.	.	.	23
Layer 8	1	3	.	1	1	.	2	.	.	.	8
Layer 9	.	3	.	4	1	1	1	.	.	.	10
Layer 10	2	6	2	.	.	.	1	.	.	.	11
Layer 11	.	2	.	1	2	.	.	.	.	.	5
Layer 12	.	.	.	.	.	.	.	.	.	.	0
Total	19	60	83	73	18	13	15	3	2	7	293

Table 6.4 Vertical distribution of three-dimensionally recorded artefacts (all dimensions) in squares 52/203 to 61/203 parallel to profile 1, in layers of 5 cm.

Square	55/196	55/197	55/198	55/199	55/200	55/201	55/202	55/203	55/204	55/205	N
Layer 1	.	2	1	2	1	.	5	3	5	5	24
Layer 2	.	2	4	.	1	1	11	12	4	1	36
Layer 3	.	4	1	.	2	4	37	15	4	2	69
Layer 4	.	.	.	.	1	6	34	15	3	.	59
Layer 5	.	1	.	1	.	5	24	7	3	.	41
Layer 6	.	1	.	5	4	4	3	11	5	.	33
Layer 7	.	1	.	1	.	4	.	4	4	.	14
Layer 8	.	.	.	.	.	2	.	1	.	.	3
Layer 9	.	2	.	.	.	2	.	4	.	.	8
Layer 10	.	.	.	.	.	2	1	.	2	.	5
Layer 11	.	.	.	.	.	2	2	1	.	.	5
Layer 12	.	.	.	.	.	3	2	.	.	.	5
Layer 13	.	.	.	.	.	.	1	.	.	.	1
Layer 14	.	.	.	.	.	1	.	.	.	.	1
Layer 15	.	.	.	.	.	.	1	.	.	.	1
Total	0	13	6	9	9	36	121	73	30	8	305

Table 6.5 Vertical distribution of three-dimensionally recorded artefacts (all dimensions) in squares 55/196 to 55/205 parallel to profile 3, in layers of 5 cm.

Square 54/202		Refitted artefacts in RMU's																	Artefacts	Unworked stone
Height	Layer	S1	S3	S4	S6	M1	M3	M5	M7	M8	M9	M11	M12	M19	O3	O4	O12	Other artefacts	N	N
193.63-193.59	L1	.	1	.	1	1	.	1	.	.	1	.	.	1	.	.	.	7	13	2
193.58-193.54	L2	.	.	1	1	.	.	1	.	1	1	.	.	.	.	.	1	19	25	3
193.53-193.49	L3	2	.	.	1	2	.	.	2	.	2	1	.	.	.	.	.	18	28	2
193.48-193.44	L4	3	.	2	.	.	1	2	1	.	2	.	.	.	.	.	.	25	36	7
193.43-193.39	L5	3	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	15	19	5
193.38-193.34	L6	2	1	.	3	.	.	1	1	.	1	.	1	.	2	.	.	39	51	2
193.33-193.29	L7	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	5	7	1
193.28-193.24	L8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
193.23-193.19	L9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.
193.18-193.14	L10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
193.13-193.09	L11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.
193.08-193.04	L12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.
193.03-192.99	L13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	4	.
192.98-192.94	L14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	3	.
192.93-192.89	L15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
192.88-192.84	L16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
192.83-192.79	L17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.
Total		11	2	3	6	3	1	5	4	1	8	1	1	1	2	1	1	140	191	22

Table 6.6 Square 54/202 (cluster A). Vertical distribution of three-dimensionally recorded, refitted artefacts in RMUs and other (non-)refitted artefacts, in layers of 5 cm.

Square 53/200		Refitted artefacts in RMU's										Artefacts	Unworked stone
Height	Layer	S5	M3	M6	M7	M9	O10	M10	M12	M13	Other artefacts	N	N
193.60-193.56	L1	.	.	.	.	.	.	.	.	.	6	6	.
193.55-193.51	L2	.	.	.	.	.	.	.	.	.	5	5	.
193.50-193.46	L3	.	.	1	1	.	.	1	.	.	5	8	.
193.45-193.41	L4	2	.	.	.	.	.	.	.	1	10	13	.
193.40-193.36	L5	15	1	3	1	.	1	.	1	5	26	53	2
193.35-193.31	L6	6	.	.	1	1	.	.	.	.	11	19	.
193.30-193.26	L7	.	.	.	.	.	.	.	.	.	1	1	.
193.25-193.21	L8	.	.	.	.	.	.	.	.	.	2	2	.
193.20-193.16	L9	.	.	.	.	.	.	.	.	.	1	1	.
193.15-193.11	L10	.	.	.	.	.	.	.	.	.	.	.	.
Total		23	1	4	3	1	1	1	1	6	67	108	2

Table 6.7 Square 53/200 (cluster B). Vertical distribution of three-dimensionally recorded, refitted artefacts in RMUs and other (non-)refitted artefacts, in layers of 5 cm.

with 51 specimens. This layer roughly corresponds with the lowest part of the non-ploughed loess soil that is heavily homogenised as a result of Holocene bioturbation. Fragments of unworked stone in square 54/202 give a similar picture with regard to their depth: all stones were found between 0 and 35 cm below the plough zone. At greater depth, almost exclusively smaller artefacts have been found with dimensions between 1 and 4 cm. In square 54/202 artefacts were plotted up to 83 cm beneath the base of the plough zone (or up to 113 cm below the surface). Within the entire excavated area, this square and a few adjacent ones have the greatest vertical distribution of artefacts plotted in three dimensions.

There is a limited vertical distribution in square 53/200, the richest square in cluster B. In this square, 85 of the 108 flint artefacts have been found between 15 and 30 cm beneath the base of the plough zone (layers 4 to 6; table 6.7). The part of the loess soil between 0 and 15 cm below the plough zone contained significantly fewer artefacts (in total 19). In this square, post-depositional processes seemed to have had less influence on the archaeological layer. An explanation for this is that cluster B remained outside the influence of tree falls and/or they had a greater depth in the loess soil (more cover by loess). At a depth of more than 35 cm below the plough zone, only three artefacts all having maximum dimensions smaller than 3 cm have been found.

In the discussion of the post-depositional processes (6.4), we will enter deeper into the possible reason of above-mentioned, noted differences in the vertical distribution of flint artefacts.

6.4 Post-depositional processes

6.4.1 Introduction

Before we go in paragraphs 6.5-6.9 into the spatial distribution of finds measured in three dimensions and the information that can be derived from this distribution in terms of human behaviour, we will focus in this paragraph on post-depositional processes. In the case of Eyserheide, post-depositional processes comprise both natural and anthropogenic processes. Both have been defining for the position, as documented during the excavation, and composition of the finds and thus for the possibilities that the archaeological remains offer for spatial analysis. The following two factors are important: 1. the degree to which different categories of archaeological material have been preserved, and 2. the degree to which the original spatial distribution of this material is still intact.

There are many post-depositional processes that can lead to weathering of archaeological material and erosion of an archaeological layer (see for instance Schiffer 1976, 1987; Wood and Johnson 1978; Colcutt 1992). They can be divided into three groups: abiotic, biotic, and anthropogenic. Examples of abiotic processes are the effect of water, wind, frost and gravity, soil formation (forming and transport of minerals, decalcification), and natural fires. Biotic processes comprise burrowing by macro, meso, and micro fauna, the penetration of roots of trees and plants into the soil, the decaying of roots, and the toppling of trees. Anthropogenic processes are connected with occupation, use and development of the area in which a site is located by people in later phases of prehistory, in historical and/or modern times. Examples are agricultural land use, construction of infrastructure, soil improvement, levelling, and lowering of the water table. An anthropogenic process that can lead to vertical distribution of artefacts during the occupation of a camp site is trampling (Villa and Courtin 1983; Gifford-Gonzales et al. 1985). Post-depositional processes are often poly-cyclic and can reinforce each other. Thus, the ploughing of a slope can cause a high degree of erosion and hence affect an archaeological site. But processes can also nullify each other. An example of this is frost action which makes artefacts come to the surface. As a result of burrowing by animals, artefacts can later be covered again by sediment.

In most cases, sites of prehistoric hunters and gatherers have been subjected to abiotic and biotic processes, whereby original spatial patterns can have been disturbed and well-delimited, dense concentrations can have become less distinct. The degree of disturbance of sites and displacements of artefacts by anthropogenic processes depends much on the depth of the archaeological layer at the time when an area (again) becomes occupied, used or developed. Sites lying on or close to the surface, of which Eyserheide is an example, are evidently more susceptible to disturbances by present-day land use than sites that are hidden under a thick layer of sediments. The degree of disturbance by abiotic and biotic processes of sites covered with sediments depends to a large extent on the time span between on the one hand the time of cultural deposition of the archaeological material and on the other hand the time of deposition of the overlying sediments. The longer the time span is, in other words how longer archaeological traces and materials have been lying at the surface, the greater the chance that a site is affected by post-depositional processes. The position of sites beneath a layer of sediment can be the result of abiotic processes, such as aeolian sedimentation (cover sands, loess and drifting sand) and fluvial sedimentation (gravels, clay and sand), of biotic processes (peat formation), and anthropogenic processes. An example of the latter is the erecting of dikes, banks, and mounds but also sod manuring for agricultural objectives (sod soils) belong to this category.

Well-preserved open-air sites from the Magdalenian consisting of archaeological materials embedded in fine-grained sediments, are rare even on a Northwest European scale. Well-known examples are Pincevent, Verberie and Etiollles southeast of Paris, and Champréveyres and Monruz along Lake Neuchatel in Switzerland. They are located in the immediate vicinity of rivers (Paris Basin sites) and lakes (Swiss sites) where gradual deposition of respectively fluvial and lacustrine sediments under very calm sedimentary conditions has led to optimal conservation of remains of camp sites. The excavated habitation units thus offer excellent opportunities for intra-site spatial analysis and for the investigation of prehistoric human behaviour and spatial organisation of camp sites on a detailed scale (see for instance Pigeot 1987; Olive 1988a; Leesch et al. 2010). A high spatial integrity is indicated by the presence of more or less intact living floors, consisting of precisely delimited hearths, distributions and accumulations of flint knapping debris, and small activity areas where short-term tasks were carried out. An example are locations where tools have been maintained and resharpened, as can be inferred from the occurrence of small retouch debris. In the Dutch system developed for the evaluation of archaeological sites (Deeben et al. 1999), these sites would score high on the criterion of integrity. In Etiolles, organic materials have hardly been preserved and a much lower score would be applicable to the criterion of conservation, or the degree to which archaeological materials have been preserved.

In this paragraph, the effects of abiotic, biotic and anthropogenic processes on the site of Eyserheide will be briefly discussed. In the last part, attention focuses on the disturbing results on the site by modern land use (ploughing).

6.4.2 Slope processes

From the stratigraphical position of artefacts in the Bt horizon of a Holocene loess soil and c. 30 to 60 cm below the present surface (see 6.3), it can be inferred that sedimentation of loess occurred after the occupation of the site in the Magdalenian. A layer of loess has covered the occupation horizon and the associated archaeological material. From a point of view of conservation, this gradual embedding of the finds in a layer of loess was of great importance. During a period of c. 15,000 years, the layer has worked as buffer in the remaining part of the late Pleniglacial, in the Late Glacial and in the Holocene against slope erosion and other post-depositional processes. Without this layer of loess, the site would probably have fallen victim completely to slope wash.

As we discussed in chapter 2, the site of Eyserheide is located on the southern margin of a loess-covered plateau, on the higher part of a plot of land that has alternately been used as cultivated field and as grassland. On the basis of altitude measurements of the present surface, it is known that the percentages of the west-east slope vary from 2.4% to 3% and of the north-south slope from 0.7% to 1.0% (respectively profile A and profile B in fig. 6.8). The percentages of the west-east slope are such that we should take into account movement of archaeological material towards the dry valley. This valley has cut into the margin of the plateau c. 50 m northeast of the excavation spot (see also fig. 2.4). In particular between the time of occupation and the time of (renewed) deposition of loess, archaeological residues would have been vulnerable to slope erosion, for instance as a result of surface water washing away on a frozen sub-soil during the end of the Pleniglacial and/or the cold phases of the Late Glacial. In view of the open character of the late Pleniglacial landscape and the high, wind-sensitive location of the site on the margin of the plateau, the wind could have shifted (wind erosion) in particular small artefacts, including micro debitage.

In the Holocene, from the arrival of agriculture and large-scale deforestation in the Neolithic, slope erosion probably brought the archaeological layer closer to the surface. On the basis of characteristics of the (truncated) Holocene loess soil, we should take into account erosion of the A horizon, the E horizon and possibly also the top of the Bt horizon. The artefacts that were (possibly) present in this part of the Holocene soil would have been either washed downslope or incorporated into the plough zone.

To obtain an insight into the effects of geological processes and wind erosion on the site, the sediment was sieved of eleven squares (53/201 to 53/204, 54/202 to 54/204, and 55/201 to 55/204) of 1 × 1 m (fig. 3.4). The squares correspond to the central and most find-rich part of the excavation, i.e. to the area of cluster A and its periphery. Only sediment collected from underneath the plough zone was sieved. The sieve residue of these squares contained 133 flint chips smaller than 10 mm and 60 chips with maximum dimensions between 10 and 19 mm (table 6.9). Also collected in the sieve residue were 10 artefacts larger than 2 cm. During the trowelling of the same squares, 169 artefacts smaller than 10 mm and 159 artefacts between 10 and 19 mm came to light underneath the plough zone, so in total 328 pieces (table 6.9). For artefacts smaller than 10 mm this gives a ratio between artefacts plotted in three dimensions (n=169) and artefacts collected from the sieve residue (n=133) of 1: 0.79, and for artefacts between 10 and 19 mm a ratio of 1: 0.38 (159 plotted artefacts versus 60 artefacts from the sieve residue). Using these ratios, a (rough) assessment can be made of the size distribution of flint artefacts at the start of the excavation in 1990. What is meant by this is the distribution of artefacts according to size

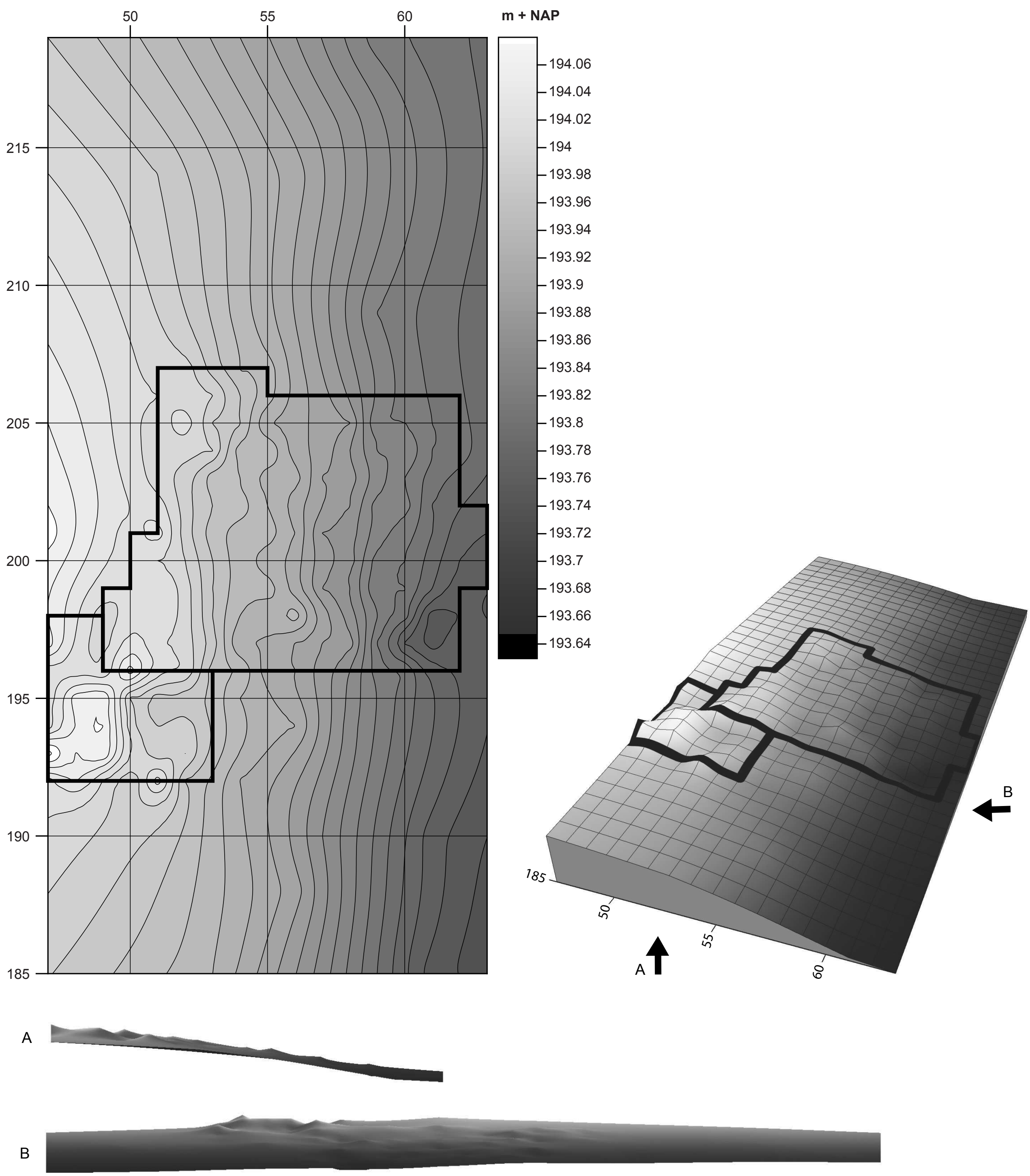


Figure 6.8 Limits of the excavated area projected onto a contour map. The contour map is based on height measurements of the surface taken with a theodolite (compared to NAP) at the corners of the excavated squares of 1 x 1 m.

Square	Simpelveld flint	Valkenburg flint	South-Limburg flint	Orsbach flint	Burnt	N	Neolithic artefacts	Unworked stone
53/201	1	.	9	9	1	20	.	.
53/202	.	.	6	8	.	14	.	.
53/203	5	.	4	10	.	19	.	.
53/204	5	.	14	7	1	27	1	.
54/202	.	.	10	11	1	22	.	.
54/203	1	.	10	9	1?	21	.	.
54/204	.	.	3	6	1	10	.	.
55/201	.	.	9	8	.	17	.	.
55/202	.	.	13	4	2	19	1	.
55/203	2	.	9	3	.	14	.	.
55/204	2	.	6	9	1	18	1	2
Total	16	0	93	84	8	201	3	2

Table 6.8 Sieving results. Numbers of artefacts per flint type per sieved square of 1 x 1 m, and numbers of burnt artefacts, Neolithic artefacts and fragments of unworked stone.

	Artefacts collected from sieve				Artefacts recorded three-dimensionally			
Square	<10mm	10-19mm	>20mm	N	<10mm	10-19mm	>20mm	N
53/201	14	6	.	20	9	11	8	28
53/202	12	2	.	14	26	19	53	98
53/203	12	7	.	19	13	22	25	60
53/204	19	6	2	27	9	8	9	26
54/202	15	6	1	22	24	37	130	191
54/203	11	8	2	21	10	8	66	84
54/204	6	3	1	10	17	11	23	51
55/201	10	6	1	17	2	9	25	36
55/202	13	6	.	19	33	18	70	121
55/203	14	.	.	14	25	12	36	73
55/204	7	10	3	18	1	4	26	31
Total	133	60	10	201	169	159	471	799

Table 6.9 Numbers of artefacts originating from the sieve residue (left) versus numbers of three-dimensionally recorded artefacts (right) per square of 1 x 1 and in three size classes (<10 mm, 10-19 mm and >20 mm).

which would have been recorded during the excavation, had the sediment of all excavated squares, including that of the plough zone, been sieved with a sieve with a mesh of 4 × 4 mm. An important assumption here is that the ratios between finds plotted in three dimensions and finds from the sieve residue, as determined for eleven squares of 1 × 1 m in the central part of the excavation, are representative for the other parts of the excavated area, including the upper part of the loess soil disturbed by ploughing.

In table 6.10 we have divided all 3416 artefacts from the Magdalenian into size classes of 1 cm and by find context (surface, plough zone and non-ploughed part of the loess soil). The table shows that the category of 10 to 19 mm occurs most often (n=962) and takes up 28.2% of the total. Artefacts smaller than 10 mm are less numerous with 529 specimens (15.5%). If we add both categories together, then artefacts smaller than 20 mm take up 43.7% of the flint artefacts. Next, in table 6.11 is given the expected size distribution of artefacts based on extrapolation of the results of the sieve investigation and the above ratios. In this expected distribution, chips smaller than 20 mm take up 54% of the (newly determined) total of artefacts (n=4214). The conclusion is that through sieving of the sediment of all squares indeed more small artefacts would have been collected (which is in line with the expectation), but there is not a great increase in artefacts smaller than 20 mm: from 43.7% (documented) to 54% (expected). On the one hand, this may be seen as indication of a careful way of excavating and of the idea that during trowelling of the sediment relatively few small artefacts have been missed. On the other hand, the expected size distribution indicates that the (original) composition of the artefacts by size has changed as a result of post-depositional processes. Karlin and Newcomer (1982) describe a small lithic scatter in Pincevent consisting of 537 artefacts, of which 60 flakes, 20 blades, and 15 bladelets. The largest number of artefacts (more than 400) is formed by chips smaller than 1 cm^2. Such chips are released when retouching tools and preparing the striking platform of cores. Assuming a closed find complex (in other words, we are dealing with the products of one core), the proportion of small chips (minimally 74%) is significantly higher than has been determined for the site of Eyserheide.

The distribution of artefacts according to size in nearby Magdalenian sites in the loess area between Meuse and Rhine (see chapter 7) also gives an indication of the degree of (in) completeness of the flint assemblage of Eyserheide. In the Belgian site of Orp-le-Grand, the sediment of find-rich squares was sieved with a sieve with a 4 mm mesh

Maximum dimension (in mm)	Surface	Plough zone	Loess soil	N	%
1-9	4	84	441	529	15.5
10-19	62	291	609	962	28.2
20-29	107	188	389	684	20
30-39	87	102	256	445	13
40-49	91	65	183	339	9.9
50-59	59	37	104	200	5.9
60-69	30	14	65	109	3.2
70-79	21	5	37	63	1.8
80-89	7	3	24	34	1
90-99	6	.	15	21	0.6
100-109	4	2	6	12	0.4
110-119	1	.	7	8	0.2
120-129	3	.	2	5	0.1
130-139	1	.	2	3	0.1
140-149	.	1	.	1	0.1
150-159	1	.	.	1	0.1
Total	484	792	2140	3416	100.1

Table 6.10 Numbers of artefacts per size class and find context (surface, plough zone, recorded three-dimensionally in loess soil).

<table>
<tr><th></th><th colspan="4">Eyserheide</th><th colspan="4">Mesch</th></tr>
<tr><th></th><th colspan="2">Documented artefacs</th><th colspan="2">Expected artefacts</th><th colspan="2">Documented artefacts</th><th colspan="2">Expected artefacts</th></tr>
<tr><th>Maximum dimension (in mm)</th><th>N</th><th>%</th><th>N</th><th>%</th><th>N</th><th>%</th><th>N</th><th>%</th></tr>
<tr><td>1-9</td><td>529</td><td>15.5</td><td>947</td><td>22.5</td><td>565</td><td>9.2</td><td rowspan="2">13634</td><td rowspan="2">77.3</td></tr>
<tr><td>10-19</td><td>962</td><td>28.2</td><td>1328</td><td>31.5</td><td>2057</td><td>33.6</td></tr>
<tr><td>20-29</td><td>684</td><td>20</td><td>698</td><td>16.6</td><td>1394</td><td>22.8</td><td>1892</td><td>10.7</td></tr>
<tr><td>30-39</td><td>445</td><td>13</td><td>445</td><td>10.6</td><td>764</td><td>12.5</td><td>764</td><td>4.3</td></tr>
<tr><td>40-49</td><td>339</td><td>9.9</td><td>339</td><td>8</td><td>443</td><td>7.2</td><td>443</td><td>2.5</td></tr>
<tr><td>50-59</td><td>200</td><td>5.9</td><td>200</td><td>4.7</td><td>324</td><td>5.3</td><td>324</td><td>1.8</td></tr>
<tr><td>60-69</td><td>109</td><td>3.2</td><td>109</td><td>2.6</td><td>226</td><td>3.7</td><td>226</td><td>1.3</td></tr>
<tr><td>70-79</td><td>63</td><td>1.8</td><td>63</td><td>1.5</td><td>147</td><td>2.4</td><td>147</td><td>0.8</td></tr>
<tr><td>80-89</td><td>34</td><td>1</td><td>34</td><td>0.8</td><td>66</td><td>1.1</td><td>66</td><td>0.4</td></tr>
<tr><td>90-99</td><td>21</td><td>0.6</td><td>21</td><td>0.5</td><td>37</td><td>0.6</td><td>37</td><td>0.2</td></tr>
<tr><td>> 100</td><td>30</td><td>1</td><td>30</td><td>0.7</td><td>97</td><td>1.6</td><td>97</td><td>0.6</td></tr>
<tr><td>Total</td><td>3416</td><td>100.1</td><td>4214</td><td>100</td><td>6120</td><td>100</td><td>17630</td><td>99.9</td></tr>
</table>

Table 6.11 Documented and expected distribution of Magdalenian artefacts per size class. Expected numbers were obtained by extrapolation of data from sieved squares. Data on Mesch are from Rensink 1991, table 1.

(Vermeersch et al. 1987, 11). In one of the two sectors, sector East, the number of flakes and fragments of flakes smaller than 2 cm (*esquilles*) amounts to over 71.000 (!). In sector West, the sediment of fewer squares was sieved but still 7300 chips were retrieved. The percentages for both sectors are 85% and 73% respectively. On the basis of extrapolation of data from sieved squares in the Dutch site of Mesch, the expected amount of flint chips smaller than 2 cm is 13.634 or 77% (Rensink 1991, see also table 6.11). Also these percentages are significantly higher than that (54%) assumed for the site of Eyserheide, if all the sediment had been sieved.

Finally, during the excavation in 1990, five samples were taken underneath the plough zone in order to determine the presence of micro debitage, among which a sample of 1800 cm^2 originating from square 55/201 immediately south of cluster A. This sample was sieved over a 1 mm mesh and contained four small chips of flint (maximum dimensions 2 mm, 3 mm, 4 mm, and 6 mm). Two samples from square 53/202, where there is a tree fall pit (see 6.4.5.), contained two small artefacts, viz. a chip of 5 mm at c. 10 cm beneath the plough zone and a small chip of 2 mm at a deeper level and associated with the filling of the tree fall pit. Two nearby squares, 54/203 and 55/203, each also yielded only one small chip of flint of respectively 3 and 2 mm.

From the above data we conclude that a (important) part of the small fraction of flint chips was no longer present at the start of the excavation in Eyserheide. Slope wash and/or wind erosion have presumably displaced (very) small artefacts to beyond the boundaries of the excavated area, already shortly after Magdalenian hunters and gatherers left the camp site. Besides, we should take into account displacements of small artefacts that were found underneath the plough zone as a result of post-depositional processes, as can be inferred from the diffuse distribution of artefacts smaller than 2 cm in the area of clusters A and B (fig. 6.3a). The distribution of larger artefacts is less diffuse, in particular artefacts larger than 5 cm were found much more concentrated (fig. 6.3c). An explanation for this difference is that small-sized chips are lighter and thus more ‘sensitive’ to displacement due to slope wash and/or wind erosion, but also for instance due to bioturbation (see 6.4.5.). Hence, they are moved earlier and further.

The size distribution of artefacts larger than 2 cm approaches that of Pincevent section 36, for which a good state of preservation is assumed. When we compare this distribution with that of Eyserheide, it is noticeable that both graphs correspond quite well for artefacts larger than 6 cm (Smit 1992, figure 1). In Eyserheide, artefacts between 2 and 3 cm are proportionally better represented than in Pincevent section 36, while in the latter unit artefacts between 3 and 6 cm show higher percentages. It is not known whether these differences are related to differences in raw material use, the effects of post-depositional processes and/or should be regarded as a result of different ways of excavating.

6.4.3 *Chemical weathering*

In Dutch Limburg, the upper three metres of the loess is completely decalcified as a result of Holocene soil formation (Mücher 1973; Vleeshouwer and Damoiseaux 1990). Taking into consideration the association of most artefacts with the Bt horizon of a Holocene loess soil, the archaeological layer of the site of Eyserheide was, in any case from the beginning of Holocene soil formation, within a metre beneath present surface. As a result of this position and solution and eluviation of chalk, organic materials of prehistoric age have decayed completely. This situation applies to almost all Palaeolithic and Mesolithic sites in the Pleistocene sand and loess area of the Netherlands, with a position of the archaeological material in decalcified sediments and above groundwater level. Only very exceptionally are non-modified organic remains and objects of bone, teeth or antler from the Palaeolithic or Mesolithic found (for instance, Zutphen-Ooijerhoek, see Groenewoudt et al. 2001) in stream valleys with a continuing high groundwater level and/or calcareous sediments. Organic objects or remains from these periods are not known from the loess-covered hills of Dutch Limburg.

The fact that organic remains have not been preserved obviously imposes limits on an interpretation of the site of Eyserheide in terms of functional use, and nature and season(s) of occupation. Thus due to the absence of faunal remains, information on exploited hunting game by the inhabitants of the camp site is lacking. Also about the use of (specific types of) organic implements of bone, teeth, antler and/or ivory we are completely in the dark. Chemical weathering has further led to patination of the flint artefacts especially of South-Limburg flint, Simpelveld flint and Valkenburg flint. Most of these are largely or completely patinated: an investigation into use-wear traces on these artefacts is therefore not useful. An exception is formed by the artefacts of Orsbach flint. Artefacts of this type of flint are, as far as can be seen with the naked eye, usually not or less patinated. This observation was the reason for having a small selection of retouched tools of Orsbach flint investigated for use-wear traces already at the time of excavation in 1990 (A. van Gijn of the Faculty of Archaeology in Leiden). As a result of the positive results of this analysis, K. Sano carried out use-wear analysis on c. 60 artefacts of Orsbach flint in 2008-2009, as part of his PhD research at Cologne University, Germany. In chapter 5 an account is given of the methodology and results of this research.

6.4.4 *Frost and drought processes*

The influence of frost on the archaeological finds can be inferred from the occurrence of frost cracks in large artefacts in particular. As discussed in chapter 4, several cores were split along frost cracks into numerous fragments. With 100 pieces, these fragments are well represented in the flint assemblage, especially when compared to the much lower number of complete cores (table 4.1). Cores of Orsbach flint in particular were susceptible to frost action. As comparatively many fragments came from the surface or the plough zone, the ploughshare has presumably been an important cause of the splitting of cores. The fracture planes of these split fragments are non-patinated.

For the Magdalenian site of Orp-le-Grand, it has been determined on the basis of refitting that distances over which frost-split fragments have been displaced were relatively limited (Vermeersch et al. 1984). In sector East they do not exceed 8 cm in a vertical direction and rarely 20 cm in a horizontal direction. Only in three cases are there displacements of between 20 and 70 cm. In sector West, the maximum distance between refitted, frost-split fragments is 55 cm. A comparable analysis of the site of Eysherheide is impeded by the fact that frost-split artefacts came especially from the surface and the plough zone. Refitted fragments found underneath the plough zone and with patinated fracture planes occur less often. Moreover, the documented distribution of finds in Eyserheide immediately underneath the plough zone is strongly determined by biotic processes which also could have caused horizontal and vertical movements (see 6.4.5). For these reasons it is difficult to accurately determine the influence of frost action (gelivation) on the archaeological layer.

During the end of the late Pleniglacial and/or the cold stages of the Late Glacial, frost and/or drought possibly led to a network of cracks (polygons) in the loess soil. An indication of the (former) presence of such cracks are thin bands of lighter coloured sediment which were formed after the period of soil formation in the Holocene and stand out at some depth beneath the plough zone. In relatively undisturbed parts of the Bt horizon of the Holocene soil, these polygons were clearly visible, for instance in square 53/200 (fig. 6.9). They are the result of illuviation and eluviation of clay or reduction of the soil in (former) frost and/or drought cracks. It is plausible that the polygon structures in the loess soil have influenced the vertical distribution of the archaeological material. In particular smaller artefacts could have been displaced from higher parts in the loess soil, by the influence of water seeping out, in a vertical direction. The fact that artefacts plotted in three dimensions have been found in an oblique or upright position can presumably be partially attributed to the subsiding of artefacts into frost and/or drought cracks.

Frost action can also have led to the upfreezing of artefacts. From observations in arctic areas is known that in particular large stones end up higher in the soil and even on the surface

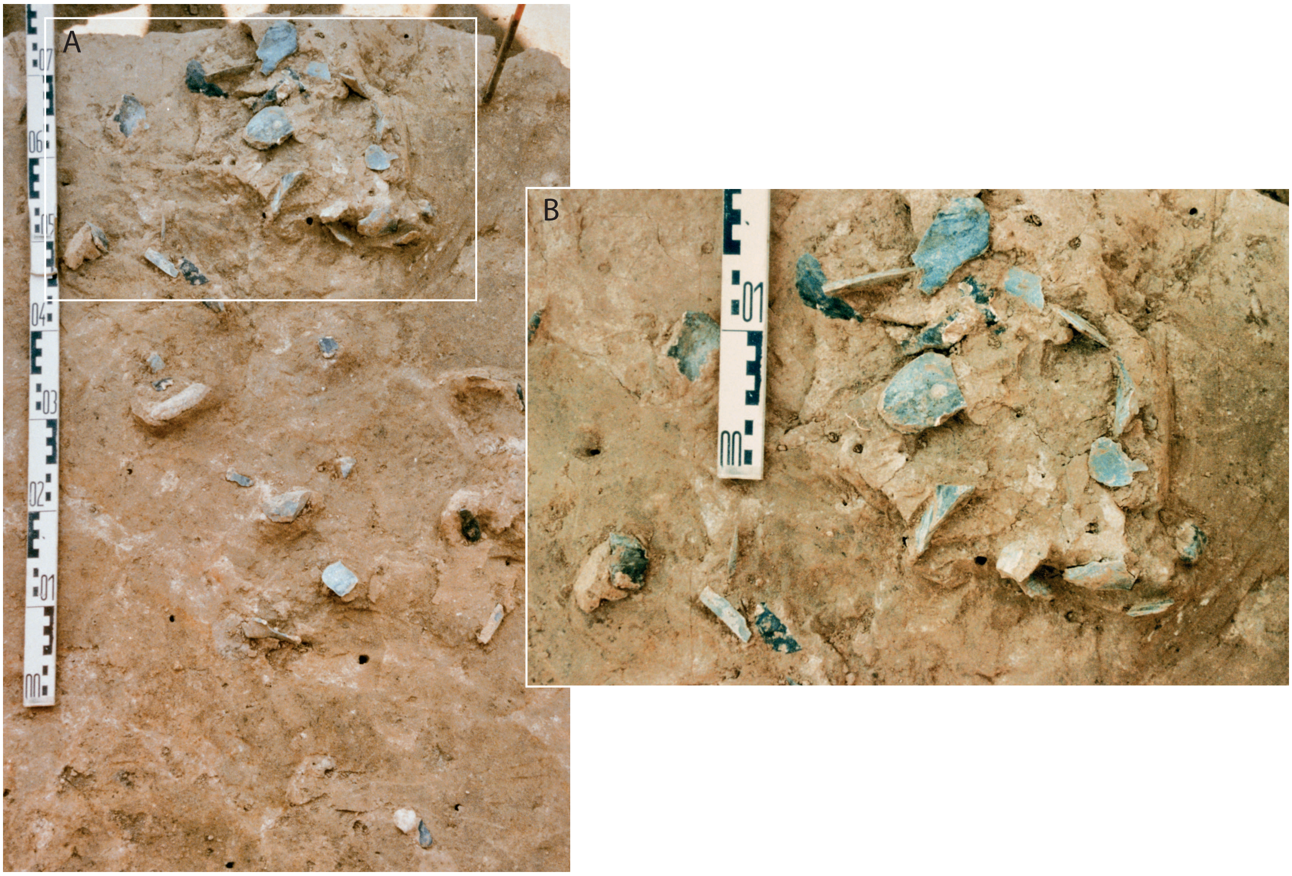


Figure 6.9 Distribution of flint artefacts and fragments of unworked stone in square 53/200 in cluster B. The thin bands with lighter coloured sediment in the Bt-horizon point to (former) frost and/or drought cracks

by the influence of frost (Schiffer 1987, 286). The fact that 12 out of 16 complete cores and 63 out of 100 core fragments, but also larger fragments of unworked and heated stone, come from the surface or the plough zone, is possibly an indication that this process of upfreezing of artefacts has occurred on the site of Eyserheide (table 6.1).

6.4.5 Biotic processes

For all part of the excavation we should take into account horizontal and vertical movements of unworked stone and flint artefacts as a result of bioturbation. Via tunnels of burrowing animals such as insects, worms and moles, small artefacts can end up deeper in the soil. Artefacts with larger dimensions can also have been moved along tunnels of rabbits and channels of tree roots. The occurrence of artefacts at more than 80 cm beneath the present surface, for instance in square 54/202 in the centre of cluster A (table 6.6), can thus be explained. Especially in places where the Bt horizon of the Holocene soil is interrupted by tree-fall pits with looser sediment (see below), the disturbing role of bioturbation on the archaeological layer has been large. Both plant roots and animals by preference seek out looser sediment whereby artefacts can have been displaced (again) in a horizontal and vertical direction.

Tree-fall pits have been demonstrated as discolorations in profiles and in the horizontal plane. Not only is the sediment lighter in colour, the amount of clay is significantly lower there. There is often a loose and crumbly structure. They form as it were discontinuities in the Bt horizon and thus in the non-ploughed part of the archaeological layer. In view of its occurrence immediately underneath the plough zone, and the dimensions and irregular boundaries of the discolorations, they have been interpreted as remains of tree falls (Kooi 1974; Crombé 1993). The fact that they are visible as discolorations in the Bt horizon of the Holocene soil demonstrates that they are younger than the period of (Holocene) soil formation. The presence of Neolithic artefacts in a number of tree-fall pits indicates that the pits originated during or after the period of the Neolithic. They have thereby acted as 'artefact traps' of artefacts from the Magdalenian and the Neolithic.

Because at Eyserheide we used a grid-system of squares of 1 × 1 metre, we should bear in mind that tree fall pits were not everywhere recognized as such underneath the plough zone. Thanks to the description and drawing of profiles and planes, a good impression has been obtained though of the depth, size and boundaries of them. We can also assume that the pits were originally larger than the sizes outlined in the Bt horizon during the excavation. Because of the ploughing of the upper part of the loess soil, the shallow parts of tree fall pits were incorporated into the plough zone and were no longer recognisable as such. Artefacts that had been embedded in these parts, form part of the collection of finds from the plough zone and surface. At a deeper level though, artefacts found in tree fall pits were originally also part of the archaeological layer but as a result of disturbance of this layer by tree falls, they may have ended up at a deeper level. This happened at the moment when the roots were pulled loose from the loess soil. Into the pit that was thus created artefacts fall back after some time as a result of weathering of the root ball. Artefacts can also, when they were originally on the edges of the pit, end up in the pit itself. By their location in a secondary position, an unknown number of artefacts has remained beyond the reach of the plough and has not been incorporated into the plough zone.

Squares comprising tree fall pits and/or heavily disturbed sediment have been marked with shading in figure 6.12. In the central part, we are dealing with 25 squares of 1 × 1 m which correspond with c. 20% of the total surface of this part of the excavation. In the southern part were 30 squares of 1 × 1 m disturbed as a result of bioturbation.

Figure 6.10 Irregular outline of natural disturbance (tree fall pit) with lighter coloured and speckled sediment in square 53/203 directly west of cluster A.

For gaining a better insight into the extent of the disturbances, planimetric drawings, in a number of cases at different depths, were made of the squares concerned. The most important locations with a loess soil disturbed by bioturbation are discussed below:

Area (south)west of cluster A:
A relatively large area showing evidence of disturbances by bioturbation was located immediately west and southwest of cluster A (fig. 6.13). In eight contiguous squares of 1 × 1 m, several disturbances were observed here which are the result of bioturbation. Partly these are mole tunnels, but also zones were recognized with loose, white and spotted sediment in which locally brown coloured, clay-rich sediment is visible. In a first instance it was not clear what the size of the disturbances was and to what extent they would continue towards cluster A and the western edge of the excavated area. Thus, in square 52/203 no disturbances were recognised immediately beneath the plough zone, but there were though drought fissures that were filled in with lighter coloured sediment (6.4.4). It emerged that the disturbance, as observed in squares 53/202, 53/203 and 53/204, continued into square 52/203 at a deeper level.

That this part of the excavation suffered badly from bioturbation is underlined by the adjacent squares 51/201 and 51/202. Also here clear discolorations are outlined, from a depth of c. 20 cm underneath the plough zone. In the western part of the nearby square 53/202 a small cluster of finds came to light in a small but disturbed area of 20 × 40 cm. The other parts of this square showed a 'normal' Holocene loess soil consisting of a red-brown Bt horizon with a few lighter coloured bands, which together formed parts of polygons. The disturbance was plotted at 27 cm below the base of the plough zone, and presumably would have been larger in size higher up in the soil profile. No planimetric drawing is available of adjacent square 52/202, probably because no disturbance had been recognized here during the trowelling of the sediment.

The area of cluster A with the above disturbance corresponds with the southwestern part of profile 1. On the north face of squares 52/203 and 53/203, a pit was identified in this profile in which whitish coloured sediment was present (fig. 6.11). The pit has been interpreted as the remains of a tree fall, of which remains have also been retrieved in the surrounding squares. Between measuring points 53/204 and 54/204, this tree fall takes up c. 75% of profile 1. The fill consists of deoxidized (bleached) sediment, in particular in the lowest part is light grey to white sediment present. Another feature

Figure 6.11 Schematic representation of field drawings of profiles 1 to 3. A= plough zone, B= tree fall pit, C= burrowing tunnels and other traces of bioturbation, D= loess soil.

is that the sediment is spotted and contains locally smeared, red-brown oxidation spots. In the fill are also visible large spots, probably parts of animal tunnels and/or root channels. Some of these are black-grey in colour, which indicates illuviation of humus into these parts of the loess soil.

From the base of the tree fall, c. 80 cm below the present surface, is visible a succession of thin layers of deoxidized and (red)brownish sediment. The small layers are no more than 2 to 3 mm thick and locally show interruptions. In this part of the soil were also small places with enrichment of clay, which in diameter have a length of no more than 5 mm. They occur dispersed at this depth. In a number of cases there are vertical bands of clay visible, the length of which is maximally 15 cm and the width maximally 3 mm. These clay bands were possibly formed along former drought fissures.

It is not clear whether west of cluster A we are dealing with remains of a large tree fall pit or two (or more) smaller pits (fig. 6.13). In view of the nearness of cluster A, we should take into account that flint artefacts and unworked stone, which originally formed part of cluster A, have been moved as a result of bioturbation in a westerly and northwesterly direction. An example of this is the small cluster of artefacts in the western part of square 53/202. They were possibly moved sideways and up with the root ball and ended up c. 1 to 1.5 m west of cluster A.

Area of cluster C:

A few metres east of cluster A is the area, somewhat downslope and towards the dry valley, that has been designated as cluster C. During the excavation of squares 58/202, 59/201, 60/200, and 60/201 it became clear that the sediment of these and a few adjacent squares was very disturbed (fig. 6.12). A large discoloration was clearly identified in profile 5 between measuring points 57/202 and 59/202 and in the horizontal plane of squares 57/202 and 58/202 (fig. 6.15). We are dealing here with a natural pit which immediately underneath the plough zone had a size of minimally 1.6 m. Its base was irregular and reached to a

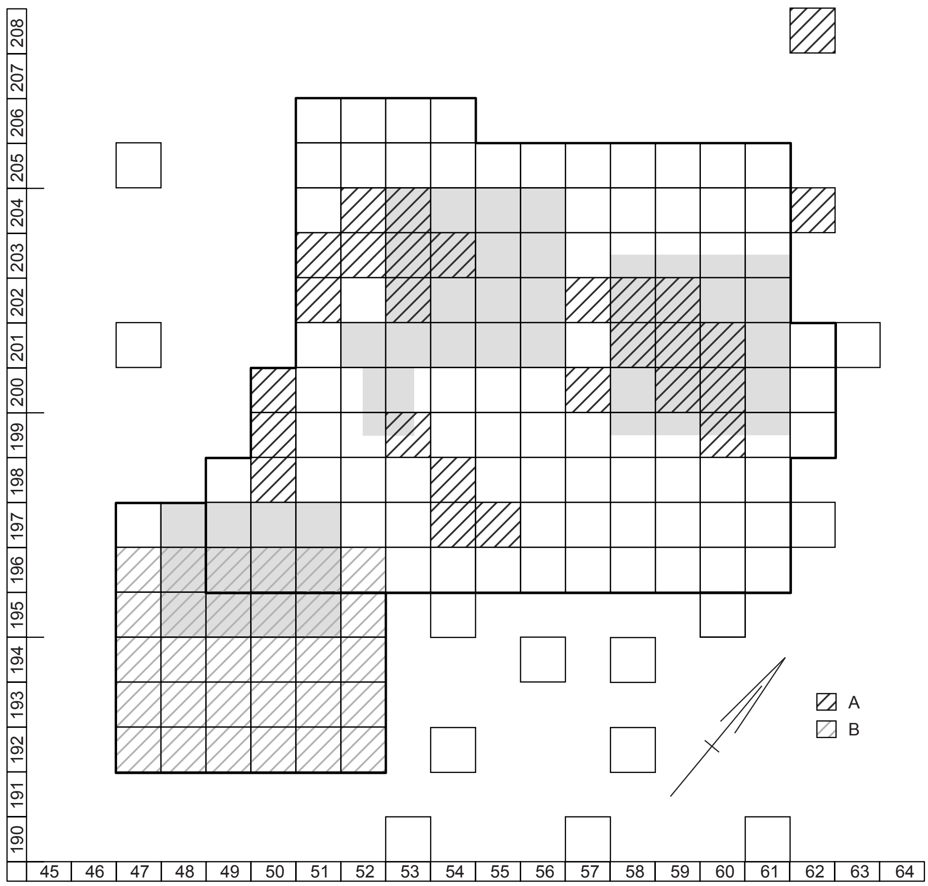


Figure 6.12 Position of squares with disturbances as a result of bioturbation (tree falls) (A) and of disturbed southern part of the excavation (B). The position of the clusters is marked in grey.

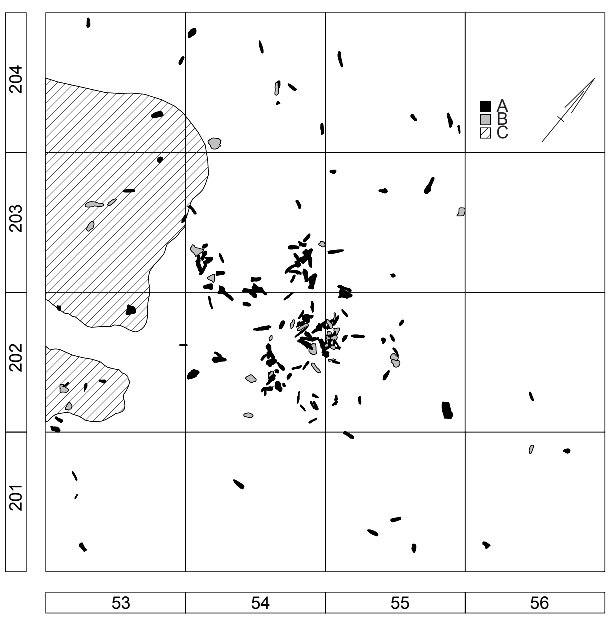


Figure 6.13 Position of finds in cluster A and its periphery: A= flint artefacts >5 cm, B= fragments of unworked stone >5 cm, and C= disturbed loess soil as a result of a tree fall.

depth of at least 55 cm under the base of the plough zone. This pit consisted of lighter coloured, clay-poor sediment in which traces of bioturbation in the form of burrowing tunnels of animals and root channels commonly occurred. In view of these features, also in this part of the excavation the presence of a tree fall is assumed. As a result of this tree fall, the original Holocene loess soil (with the occurrence of the characteristic, red-brown and clay-rich Bt horizon) was heavily disturbed.

Other disturbed areas:
Disturbances by bioturbation were visible in square 49/196 and in squares that were excavated in its vicinity (47/192, 48/193, 47/194, and 48/194). Although traces of tree falls are lacking or were not recognised as such, a strong degree of disturbance was observed in the entire southern part of the excavation.

And finally, dispersed over the excavation, in individual squares or in a small number of adjacent squares, disturbances of the loess soil have been observed. Examples are squares 54/197, 54/198, and 55/197 (fig. 6.12). On the basis of profile 2 and the planimetric drawings that were made of these squares, we are also dealing in this zone with disturbances that were created as a result of a tree fall. Also in this location lighter coloured sediment was outlined in the profile and in the horizontal plane. Another example are trial squares 62/204 and 62/208 on the northern margin of the excavation. Both squares were heavily disturbed as a result of bioturbation. There are rust-brown spots and white/grey parts with relatively loose sediment, in which worm channels are visible. The artefacts plotted in three dimensions all came from this disturbed sediment.

Figure 6.14 Cluster A: artefacts and fragments of unworked stone in oblique and upright position as a result of bioturbation (root channels and burrowing tunnels).

For the sake of intra-spatial analysis, it is important to determine to which extent artefacts have been moved in the soil as a result of bioturbation. In order to clarify the extent of vertical movement, tables have created which give an overview of the depth position (in layers of 5 cm) of artefacts found underneath the plough zone (see also Crombé 1993, table 1). From these tables it was found that there exists a clear connection between on the one hand the presence of remains of tree falls and on the other hand the depth and dimensions of artefacts. In squares with tree falls, the vertical distribution of stone artefacts is less concentrated and more random, both with regard to depth and dimensions, than in squares where indications for such tree falls are lacking. As an example of a square with a tree fall pit, square 53/203 can be mentioned. In this square artefacts with dimensions between 0 and 6 cm (n=59) were lying at different depths and more or less randomly dispersed and mixed up, with relatively large numbers of artefacts (n=22) at a depth between 60 and 85 cm beneath present surface (layers 7 to 11; table 6.12). Artefacts larger than 4 cm came especially from the deeper parts of the pit, as were three large fragments (total weight 828 grams) of siltstone (code 15). Both characteristics, the dispersed position and the occurrence of large artefacts at a depth of more than 60 cm beneath the present surface, support the notion of a tree fall and the functioning of the pit as artefact trap. The position of a complete core of Orsbach flint in adjacent square 53/204 at a depth of 25-30 cm underneath the plough zone is possibly also related to this tree fall.

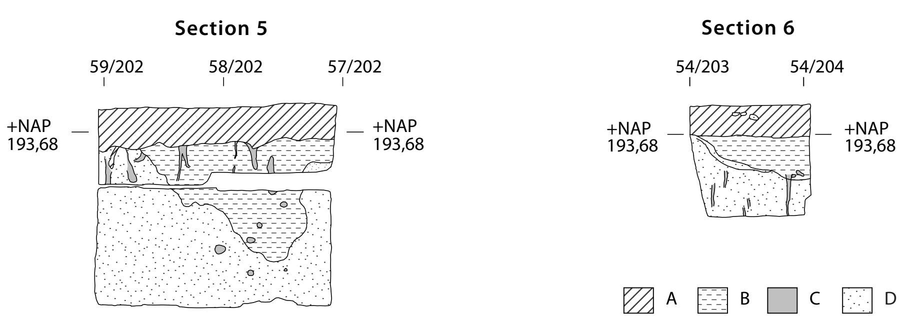


Figure 6.15 Schematic representation of field drawings of profiles 5 and 6. For legends, see figure 6.11.

Square 53/203		Maximum dimensions in mm										Artefacts	Unworked stone
	Layer	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	N	N
193.62-193.58	L1	.	2	.	1	.	.	.	.	.	.	3	.
193.57-193.53	L2	4	6	.	.	.	.	.	.	.	.	10	.
193.52-193.48	L3	3	2	.	.	1	.	.	.	.	.	6	.
193.47-193.43	L4	2	3	1	.	.	.	.	.	.	.	6	.
193.42-193.38	L5	1	3	2	.	.	.	.	.	.	.	6	.
193.37-193.33	L6	1	1	3	.	.	2	.	.	.	.	7	1
193.32-193.28	L7	1	1	1	2	3	.	.	.	.	.	8	.
193.27-193.23	L8	1	.	1	.	1	.	.	.	.	.	3	1
193.22-193.18	L9	.	.	2	.	.	.	.	.	.	1	3	1
193.17-193.13	L10	.	3	2	.	1	.	.	.	.	.	6	.
193.12-193.08	L11	.	1	.	1	.	.	.	.	.	.	2	.
Total		13	22	12	4	6	2	.	.	.	1	60	3

Table 6.12 Square 53/203 (periphery of cluster A, tree fall feature). Vertical distribution of three-dimensionally recorded artefacts per size class, in layers of 5 cm. The last column shows the vertical distribution of fragments of unworked stone.

In contrast to square 53/203, square 54/202 in cluster A has not yielded any indications of a tree fall pit. The vertical distribution of the artefacts plotted in three dimensions is clearly more regular. Of 191 artefacts that were collected from underneath the plough zone, 179 pieces (= 94%) were found between 30 and 65 cm below the present surface (layers 1 to 7; table 6.13). Also fragments of stone come from this depth. Of the flint artefacts, 12 pieces were found deeper in the loess soil, i.e. deeper than 70 cm below ground level. With the exception of a distal fragment of a blade (length 6.1 cm), these artefacts are all smaller than 4 cm.

The distances over which artefacts have been displaced in a horizontal direction are usually not considered to be large (i.e. 5 metres or more). This is shown amongst others by the small size of clusters A and B. Moreover, numerous artefacts could be refitted that were found at a distance of less than 2 m from each other. A good example are the artefacts that form part of RMU S5 (refit groups S5.01 to S5.04) of Simpelveld flint in cluster B. In the discussion of the spatial distribution of RMUs we shall go more deeply into distances between refitted artefacts and their meaning (see 6.6).

6.4.6 Anthropogenic processes

From the composition of the artefacts according to find context can be inferred that in particular large artefacts (cores) and large stone fragments were ploughed up from the archaeological layer and have ended up in the plough zone or at the surface (see table 6.1).

During the excavation, all flint artefacts found beneath the plough zone were measured in three-dimensions. This method of recording has the advantage that the relationship between the distribution of artefacts and post-depositional processes in the part of the archaeological layer not disturbed by ploughing can be studied thoroughly. Moreover, application of the method makes it possible, on the basis of simulations, to gain insight into the consequences of deeper ploughing on the distribution of the artefacts plotted in three dimensions. What would have happened to this distribution had the plot of land in Eyserheide been ploughed not to 25 to 30 cm, but deeper? Which spatial patterns would have remained visible and which would have disappeared?

The effects of deeper ploughing the plot in Eyserheide on the archaeological layer is made clear when we show the distribution of flint artefacts at different depths (10 cm, 20 cm, and 30 cm) beneath the plough zone. This procedure has been applied to the central part of the excavated area by ‘leaving out’ in the first case the upper 10 cm of the vertical distribution, in the second case the upper 20 cm, and in the third case the upper 30 cm. Thus maps were obtained of three

Square 54/202		Maximum dimensions in mm													Artefacts	Unworked stone
Height	Layer	0-9	10	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	N	N
193.63-193.59	L1	1	.	1	3	1	1	2	1	1	1	1	.	.	13	2
193.58-193.54	L2	2	5	6	4	4	3	.	.	.	.	1	.	.	25	3
193.53-193.49	L3	7	6	2	2	6	.	3	1	1	.	.	.	.	28	2
193.48-193.44	L4	1	5	7	3	6	5	2	2	1	3	.	.	1	36	7
193.43-193.39	L5	3	2	3	5	1	3	1	1		.	.	.	.	19	5
193.38-193.34	L6	8	12	8	4	5	5	3	2	1	1	1	1	.	51	2
193.33-193.29	L7	1	3	2	1	.	.	.	.	.	.	.	.	.	7	1
193.28-193.24	L8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
193.23-193.19	L9	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.
193.18-193.14	L10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
193.13-193.09	L11	.	1	.	1	.	.	.	.	.	.	.	.	.	2	.
193.08-193.04	L12	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.
193.03-192.99	L13	.	1	1	2	.	.	.	.	.	.	.	.	.	4	.
192.98-192.94	L14	.	1	1	.	.	.	1	.	.	.	.	.	.	3	.
192.93-192.89	L15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
192.88-192.84	L16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
192.83-192.79	L17	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.
Total		24	37	32	25	23	17	12	7	4	5	3	1	1	191	22

Table 6.13 Square 54/202 (cluster A). Vertical distribution of three-dimensionally recorded artefacts per size class, in layers of 5 cm. The last column shows the vertical distribution of fragments of unworked stone.

hypothetical distributions of finds prior to the excavation, in case the field had been ploughed respectively 10 cm, 20 cm and 30 cm deeper (fig. 6.16).

In order to get a good picture of the consequences of ploughing deeper, first the 'real' numbers of artefacts plotted in three dimensions per unit of 25 × 25 cm are indicated (fig. 6.16a). This distribution clearly shows the position of the two important clusters A and B. The number of artefacts in the selected area is 1028 (100%). They were underneath the plough zone with an average thickness of 25 cm in this part of the excavation.

In the hypothetical case of ploughing 10 cm deeper, almost a quarter (22%) of the total number of artefacts are lifted out of their positions and incorporated into the plough zone. The remaining part (78%) remains beyond the reach of the plough and for the time being untouched. The distribution shows that clusters A and B essentially do not change with regard to their size (fig. 6.16b). There is a decrease though in the number of artefacts, in particular in the central part of cluster A.

In figure 6.16c the find distribution is presented which would have been obtained had the plot at Eyserheide been ploughed 20 cm deeper. In that case more than half (56%) of the artefacts falls victim to the plough. The distribution reveals that cluster A has been heavily thinned out, only in the eastern part is still a small find-richer area. Despite a decrease in the number of finds, cluster B remains clearly visible though. This means that cluster A at 20 cm deeper ploughing is more susceptible to the disturbing actions of the plough than cluster B.

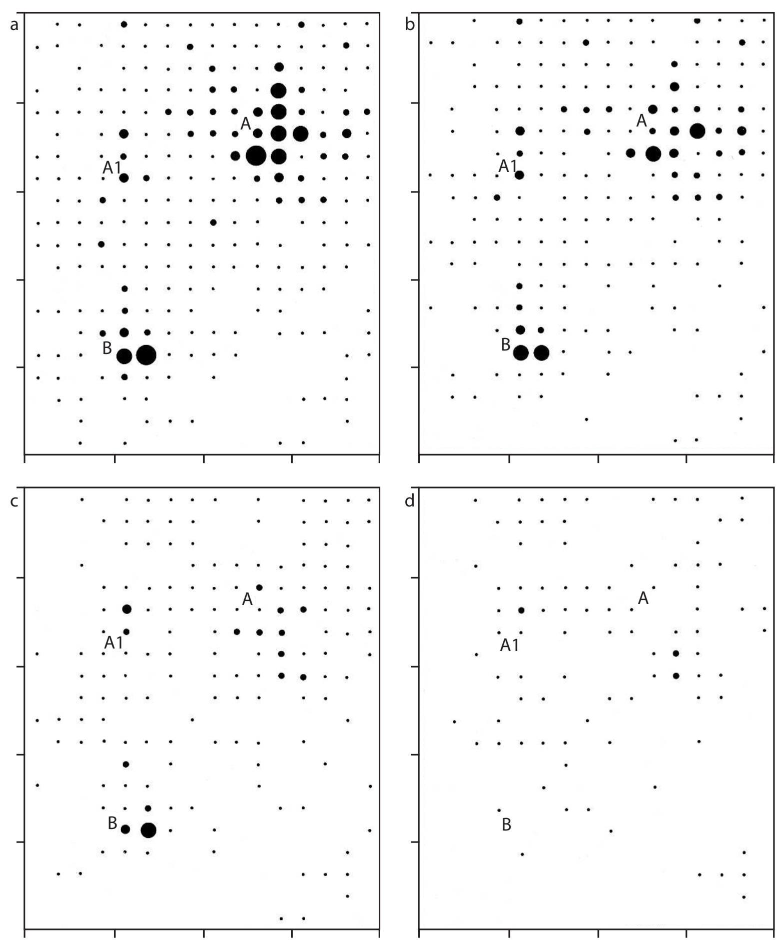


Figure 6.16a-d Number of artefacts plotted in three dimensions per unit of 25 x 25 cm in the central part of the excavation. a= actual numbers of plotted artefacts, b-d= numbers of plotted artefacts if the plot of land would have been ploughed 10 cm, 20 cm and 30 cm deeper respectively.

In the case of ploughing 30 cm deeper, the distribution of artefacts has become very faint: almost nothing is still visible of the patterns documented during the excavation. Clusters A and B are no longer recognisable as such and the area of cluster B is even completely devoid of finds (fig. 6.16d). In this situation, there are only 148 (14%) left of the total number of artefacts found underneath the plough zone. The other 880 artefacts (86%) have all been incorporated into the plough zone.

From the above discussion can be inferred that deeper ploughing of the plot at Eyserheide would have had far-reaching consequences from an archaeological point of view. In the first place, the percentage of artefacts plotted in three dimensions decreases strongly, from 78% after ploughing 10 cm deeper to only 14% after ploughing 30 deeper. This decrease implies automatically that the number of plough zone finds – and hence the visibility of the site at the surface – increases. With continuous land use these finds would have ended up dispersed over the field and would not or hardly have been of value to spatial analysis. Furthermore, as the field is ploughed deeper, the spatial patterns underneath the plough zone are increasingly thinned out. In the case of a depth of 10 cm the damage is still not too bad and the patterns stay largely intact. At ploughing 30 cm deeper on the other hand, there is only a heavily thinned-out and diffuse find distribution, and clusters A and B can no longer be distinguished. The decision to deep plough the plot only once would have been a catastrophe from an archaeological point of view. It is clear that in that case no data could be derived from the distribution regarding which activities were carried out where in the camp site.

6.4.7 Discussion

In this paragraph we have paid attention to a series of post-depositional processes that, from the moment when hunters and gatherers of the Magdalenian left the camp site, have had an influence on the composition and spatial distribution of the find material. From the discussion can be concluded that the original archaeological layer and distribution of unworked stone and flint artefacts were affected to a considerable degree. The occurrence of finds in natural pits (tree falls) and the fact that almost one third of the documented artefacts was collected from the surface or from the plough zone are importance evidence. The effects of the falling over of trees are clearly recognisable in both characteristics of the loess soil (remains of tree falls) and the vertical distribution of the artefacts. It is clear that both natural and anthropogenic processes have moved artefacts from an *in situ* context to a location in a secondary position. Moreover, small chips (smaller than 2 cm) are less numerous than can be expected in the case of a complete assemblage consisting of debris of the flint working. And finally, no features (soil marks) have been recognised or were present that are related to the Magdalenian phase of occupation.

6.5 Characteristics of clusters

6.5.1 Introduction

In the preceding paragraph, several post-depositional processes were discussed, which have led to disturbances of the archaeological layer of the Magdalenian site of Eyserheide. Already considerable time before artefacts and unworked stone ended up in the ploughed top soil did geological, chemical and biotic processes influence the original composition and position of the archaeological material. Compared to other open-air sites from the Magdalenian (for instance Pincevent, Etiolles, Gönnersdorf, Neuchâtel-Monruz, Hauterive-Champréveyres), the spatial integrity of the Eyserheide site should be regarded as low. Compared with these sites, the distribution of the archaeological material is less suitable for intra-site spatial analysis. But it has also become clear that not all parts of the excavation were affected in the same way or equally intensive. There are for instance contiguous squares in which indications are lacking of tree fall pits or other disturbances of the archaeological layer. For these parts, there is a good chance that specific activities, for instance the working of specific flint nodules or the cleaning of hides, can still be recognised in the distribution of the archaeological finds. Also the research of other excavated Magdalenian sites in the Dutch-Belgian loess area subscribe to the notion that spatial information can be obtained from sites disturbed by ploughing (see chapter 7).

In this paragraph, the intrinsic characteristics of the four distinguished clusters A to D in the site of Eyserheide are the focus. As discussed in paragraph 6.2.3, the clusters were determined on the basis of the larger densities of flint artefacts recorded three-dimensionally in the parts concerned of the excavation. For an overview of the location of the clusters, the reader is referred to figure 3.7.

6.5.2 Cluster A and its periphery

Cluster A consists of square 54/202 and the adjacent parts of squares 54/203, 55/202, and 55/203. The cluster has been excavated completely and, based on the position of the artefacts and stones larger than 5 cm, it is slightly oval in shape (fig. 6.13). The small cluster has a diameter of 1.7 m, and yielded from underneath the plough zone 273 flint artefacts larger than 2 cm, among which 9 retouched tools and 8 used blades and flakes (table 6.14). Complete cores are lacking, but seven fragments of cores of Orsbach flint were found in cluster A. With an average of 94.5 flint artefacts per square metre we are dealing with a high density. As we will discuss later in this chapter (6.8.4), retouched tools in the

Artefact type	Simpelveld flint	%	Valkenburg flint	%	South-Limburg flint	%	Orsbach flint	%	N	%
Cores	.	.	.	.	.	.	.	.	.	.
Core fragments	.	.	.	.	.	.	7	6.5	7	2.6
Flakes	26	48.1	1	100	59	53.2	53	49.5	139	50.9
Rejuvenation flakes	.	.	.	.	3	2.7	2	1.9	5	1.8
Burin spalls	.	.	.	.	.	.	1	0.9	1	0.4
Blades	18	33.3	.	.	37	33.3	34	31.8	89	32.6
Crested blades	8	14.8	.		4	3.6	3	2.8	15	5.5
Retouched tools	.	.	.	.	6	5.4	3	2.8	9	3.3
Blades and flakes with edge-damage	2	3.7			2	1.8	4	3.7	8	2.9
Total	54	99.9	1	100	111	100	107	99.9	273	100

Table 6.14 Numbers of three-dimensionally recorded artefacts >2 cm per flint type and artefact type in cluster A.

form of burins, end scrapers and retouched blades were found in particular in the western half of the cluster. Mainly in the central part, 48 fragments of unworked stone were measured in three dimensions, of which 38 fragment of a yellow-white siltstone (code 15). The sizes of these fragments vary from less than 1 cm to 12.9 cm, and the heaviest specimen weighs 456 grams. Compared with other parts of the excavated area, also the plough zone of these squares yielded more finds. We should therefore allow for a concentration disturbed and thinned-out by ploughing. Presumably, an important quantity of the surface finds originally formed part of cluster A.

The large quantity of (fragments of) flakes and blades points to the working of cores in this part of the excavated area. South-Limburg flint and Orsbach flint with respectively 111 and 107 artefacts larger than 2 cm are the most important RMUs in cluster A. But also a considerable number of artefacts of Simpelveld flint were found, namely 54 specimens. From the position of artefacts assigned to RMUs can be inferred that at least three cores of Simpelveld flint, six cores of South-Limburg flint and four cores of Orsbach flint were worked in cluster A (see 6.6.6). This number of *minimally* 13 worked cores is striking in view of the small size of the cluster and the relatively small number of 273 artefacts found underneath the plough zone.

In the group of South-Limburg flint and Orsbach flint flakes are dominant, and blades and fragments of blades are represented by smaller numbers. Of Simpelveld flint comparatively many blades (n=18) and crested blades (n=8) were found. They point to repeated carrying out of actions related to core preparation and blade production in cluster A. Despite the emphasis on waste products of the flint working, (complete) cores are lacking: only core fragments of Orsbach flint split along frost cracks occur among the finds of cluster A. This could indicate that the majority of the cores were not discarded in cluster A itself but in its periphery or in other locations. Another possibility is that cores were ploughed up from the archaeological layer at cluster A. In that case, they form part of plough zone and/or surface finds.

The periphery of cluster A has a surface area of 11.1 m^2 and surrounds this cluster in the west, north and east. Compared to cluster A, fewer flint artefacts larger than 2 cm were found in this zone, namely 210 (table 6.15). The average find density is 18.9 artefacts per m^2. As can be expected, this zone has not only in a spatial perspective but also with regard to raw material composition a direct relation with cluster A. Artefacts of Orsbach flint occur frequently (n=107) in the periphery of cluster A. More than 50% of the artefacts originating from this area were manufactured of this flint. There is a difference in this respect with cluster A, where the

Artefact type	Simpelveld flint	%	Valkenburg flint	%	South-Limburg flint	%	Orsbach flint	%	N	%
Cores	.	.	.	.	.	.	1	0.9	1	0.5
Core fragments	1	3.1	.	.	.	.	7	6.5	8	3.8
Flakes	15	46.9	.	.	44	62	53	49.5	112	53.3
Rejuvenation flakes	.	.	.	.	2	2.8	.	.	2	1
Burin spalls	.	.	.	.	.	.	2	1.9	2	1
Blades	14	43.8	.	.	19	26.8	32	29.9	65	31
Crested blades	1	3.1	.	.	2	2.8	4	3.7	7	3.3
Retouched tools	.	.	.	.	2	2.8	5	4.7	7	3.3
Flakes and blades with edge-damage	1	3.1	.	.	2	2.8	3	2.8	6	2.9
Total	32	100	0	0	71	100	107	99.9	210	100.1

Table 6.15 Numbers of three-dimensionally recorded artefacts >2 cm per flint type and artefact type in the periphery of cluster A.

majority of the artefacts has been described as South-Limburg flint (mainly Meuse terrace flint). The proportion of artefacts of Simpelveld flint is, compared with cluster A, more or less equal. The number of retouched and 'used' tools (n= 13) in the periphery of cluster A is lower than in cluster A itself. In the periphery of cluster A, seven core fragments of Orsbach flint and one core fragment of Simpelveld flint were recovered from underneath the plough zone. Also a complete core of Orsbach flint forms part of the finds of the periphery. As complete specimens are practically lacking, the question remains unanswered whether cores worked in cluster A were discarded in the periphery. Also here, cores were possibly ploughed up from the archaeological layer and ended up at the surface or in the plough zone.

Zone A/B has been distinguished as a separate zone bordering on cluster A. The zone consists of three contiguous squares 52/201, 53/201 and 54/201, and separates cluster A from the more southerly cluster B. The zone is clearly less find-rich than cluster A and (most parts of) its periphery. In the squares concerned, 38 flint artefacts larger than 2 cm were measured in three dimensions (table 6.16). This means an average find density of 13 artefacts per m^2. In the raw material composition, the occurrence of a blade and a tool of Valkenburg flint is noticeable. The zone consists mostly of artefacts of South-Limburg flint (n=15) and Orsbach flint (n=14). Cores and core fragments are lacking in this part of the excavation.

6.5.3 Cluster B

About three metres south of cluster A, a second cluster (B) of flint artefacts came to light. This small location covering an area of 1.5 × 0.8 m yielded 119 artefacts larger than 2 cm (table 6.17). Not only the horizontal but also the vertical distribution of these finds was very limited. By far the most specimens were at a depth of 15 to 30 cm below the base of the plough zone, covered by a thin layer of loess and clearly beyond the reach of the plough. Of the four raw material groups, Simpelveld flint occurs most often (n=45), followed by South-Limburg flint (n=37) and Orsbach flint (n=29). The proportion of Simpelveld flint is considerably higher here than in cluster A. In addition, there are eight artefacts of Valkenburg flint.

The number of retouched tools and flakes/blades with edge damage ('use retouch') larger than 2 cm is 11, i.e. 9% of the total number of artefacts in cluster B. No complete cores were found, though three fragments of cores of Orsbach flint were retrieved. The number of artefacts smaller than 2 cm is low.

6.5.4 Cluster C

Outside the area of clusters A and B, fewer artefacts were found underneath the plough zone. Also the plough zone

Artefact type	Simpelveld flint	%	Valkenburg flint	%	South-Limburg flint	%	Orsbach flint	%	N	%
Cores	.	.	.	.	.	.	.	.	.	.
Core fragments	.	.	.	.	.	.	.	.	.	.
Flakes	2	28.6	.	.	8	53.3	7	50	17	44.7
Rejuvenation flakes	.	.	.	.	.	.	.	.	.	.
Burin spalls	.	.	.	.	.	.	.	.	.	.
Blades	4	57.1	1	50	6	40	6	42.9	17	44.7
Crested blades	1	14.3	.	.	.	.	.	.	1	2.6
Retouched tools	.	.	1	50	1	6.7	1	7.1	3	7.9
Flakes and blades with edge-damage	.	.	.	.	.	.	.	.	.	.
Total	7	100	2	100	15	100	14	100	38	99.9

Table 6.16 Numbers of three-dimensionally recorded artefacts >2 cm per flint type and artefact type in zone A/B.

Artefact type	Simpelveld flint	%	Valkenburg flint	%	South-Limburg flint	%	Orsbach flint	%	N	%
Cores	.	.	.	.	.	.	.	.	.	.
Core fragments	.	.	.	.	.	.	3	10.3	3	2.5
Flakes	35	77.8	2	25	16	43.2	10	34.5	63	52.9
Rejuvenation flakes	1	2.2	1	12.5	.	.	.	.	2	1.7
Burin spalls	.	.	.	.	.	.	.	.	.	.
Blades	6	13.3	4	50	16	43,2	8	27.6	34	28.6
Crested blades	1	2.2	1	12.5	1	2.7	3	10.3	6	5
Retouched tools	1	2.2	.	.	1	2.7	3	10.3	5	4.2
Flakes and blades with edge-damage	1	2.2	.	.	3	8.1	2	6.9	6	5
Total	45	99.9	8	100	37	99.9	29	99.9	119	99.9

Table 6.17 Numbers of three-dimensionally recorded artefacts >2 cm per flint type and artefact type in cluster B.

itself yielded fewer finds in these parts. There are two areas nonetheless where there is a higher density of flint artefacts than in other parts of the excavation. An area with a surface area of 16 m^2 is located a few metres east of cluster A and has been designated as cluster C. Although we cannot speak of a 'real' cluster, this area is distinct from the surrounding squares by having more artefacts larger than 2 cm, namely 125 (table 6.18). In cluster C, in particular artefacts of South-Limburg flint (n=82) occurred, among which several flakes with large dimensions. An important part of these has been described as Meuse terrace flint (RMU M15) on the basis of a fluvial rolled brown cortex, the white to white-beige colour of the patina and other features (among which inclusions) of the flint. The number of artefacts of Orsbach flint (n=28) and Simpelveld flint (n=14) is clearly lower. Two tools were found in cluster C, one specimen of which was made of Valkenburg flint. No other artefacts of this type of flint were recovered from cluster C.

On the basis of refitting data and the presence of a large, non-anthropogenic pit, it is likely that cluster C was disturbed to a great extent (see 6.4.5). The surface area over which finds have been made is considerable. Although this relatively large size can be seen as an indication of cluster C (originally) having been larger than cluster A, horizontal displacement of artefacts as a result of post-depositional processes is obvious.

6.5.5 Cluster D

Cluster D is located in the southern part of the excavation and covers an area of 12 m^2. Although the average find density is only 6.6 artefacts per m^2, this cluster is important from the perspective of spatial analysis and the determination of locations of knapping of RMUs. In this zone, at a few metres from clusters A and B, five (fragments of) retouched tools larger than 2 cm were found underneath the plough zone. Square 49/196 distinguishes itself by a remarkably high find density. During the last week of the excavation campaign in 1990, this square yielded 38 Magdalenian artefacts larger than 2 cm. Because of this high number we considered the presence of a new concentration of flint artefacts, of which square 49/196 could form a part of the periphery. The excavating of squares in the southern part of the excavation in April 1991 showed however that this was not the case.

Cluster D consists mainly of artefacts of South-Limburg flint (n=31) and Orsbach flint (n=24) (table 6.19). In both groups, flakes are the most frequently occurring artefact type, but also blades occur relatively often. In the group of Simpelveld flint (n=19), blades (n= 11) are even better represented than flakes. This can point to blade production and/or transport of selected knapping products of this flint. Compared to

Artefact type	**Simpelveld flint**	**%**	**Valkenburg flint**	**%**	**South-Limburg flint**	**%**	**Orsbach flint**	**%**	**N**	**%**
Cores	.	.	.	.	.	.	1	3.6	1	0.8
Core fragmens	.	.	.	.	1	1.2	5	17.9	6	4.8
Flakes	8	57.1	.	.	56	68.3	11	39.3	75	60
Rejuvenation flakes	.	.	.	.	1	1.2	1	3.6	2	1.6
Burin spalls	.	.	.	.	1	1.2	.	.	1	0.8
Blades	5	35.7	.	.	21	25.6	8	28.6	34	27.2
Crested blades	1	7.1	.	.	2	2.4	1	3.6	4	3.2
Retouched tools	.	.	1	100	.	.	1	3.6	2	1.6
Flakes and blades with edge-damage	.	.	.	.	.	.	.	.	.	.
Total	14	99.9	1	100	82	99.9	28	100.2	125	100

Table 6.18 Numbers of three-dimensionally recorded artefacts >2 cm per flint type and artefact type in cluster C.

Artefact type	Simpelveld flint	%	Valkenburg flint	%	South-Limburg flint	%	Orsbach flint	%	N	%
Cores	.	.	.	.	1	3.2	.	.	1	1.3
Core fragments	.	.	.	.	.	.	2	8.3	2	2.5
Flakes	6	31.6	2	40	14	45.2	12	50	34	43
Rejuvenation flakes	.	.	.	.	.	.	.	.		
Burin spalls	.	.	.	.	.	.	.	.		
Blades	11	57.9	2	40	12	38.7	8	33.3	33	41.8
Crested blades	1	5.3	.	.	1	3.2	1	4.2	3	3.8
Retouched tools	.	.	1	20	3	9.7	1	4.2	5	6.3
Flakes and blades with edge-damage	1	5.3	.	.	.	.	.	.	1	1.3
Total	19	100.1	5	100	31	100	24	100	79	100

Table 6.19 Numbers of three-dimensionally recorded artefacts >2 cm per flint type and artefact type in cluster D.

cluster A, the number of worked RMUs is low in cluster D. Also for this part of the excavation, we should bear in mind the remnants of a concentration heavily disturbed by bioturbation and ploughing. Because of these disturbances, it is difficult to determine what the original size and artefact composition would have been.

6.6 Distribution of RMUs

6.6.1 Introduction

In this paragraph we shall enter more deeply into the distribution of artefacts belonging to one and the same RMU. From tables 6.20-6.22 can be inferred that refitted artefacts that form part of RMUs were collected in different find contexts. The distribution of artefacts according to find context (surface, plough zone and the underlying loess sediment) can differ significantly per RMU. This indicates that original distribution patterns of RMUs were disturbed to different extents as a result of the ploughing of the plot of land. The percentages of 'ploughed artefacts' in large compositions of refitted artefacts range from 9% (S5) to more than 50% (M15, M19). These differences are possibly related to the original depth of the artefacts and to the micro relief at the time of the Magdalenian occupation. At some places, the covering layer of loess could have been thicker than at other places. Besides, more erosion has possibly occurred locally, in particular in the eastern part where the gradient of the slope towards the dry valley is slightly steeper. And finally, it cannot be excluded that deeper ploughing has taken place in some parts of the site, with the result that there more artefacts have ended up in the plough zone than in other locations.

6.6.2 Simpelveld flint (table 6.20)

RMU S1 (fig. 6.17):

This composition around core 259A 108 comprises 41 refitted artefacts, eight specimens of which were recovered from the surface or the plough zone. The other 33 artefacts were found underneath the plough zone. RMU S1 thus offers good possibilities for spatial analysis, though also artefacts of this RMU can have been moved by abiotic (slope erosion) and biotic (bioturbation) processes in a vertical and/or horizontal direction. The position of the finds indicates working of RMU S1 in cluster A, in or near squares 54/202 and 55/202. In particular in the centre of cluster A flakes, blades and fragments of blades of this RMU occurred amidst numerous fragments of unworked natural stone. The artefacts in refit group S1.00 show that successive operations of core reduction (core and striking platform preparation, blade production, striking platform rejuvenation, etc.) were carried out at one and the same spot. Products have been found of all stages of working of RMU S1 in cluster A and in its periphery. The complex mode of core reduction, whereby use

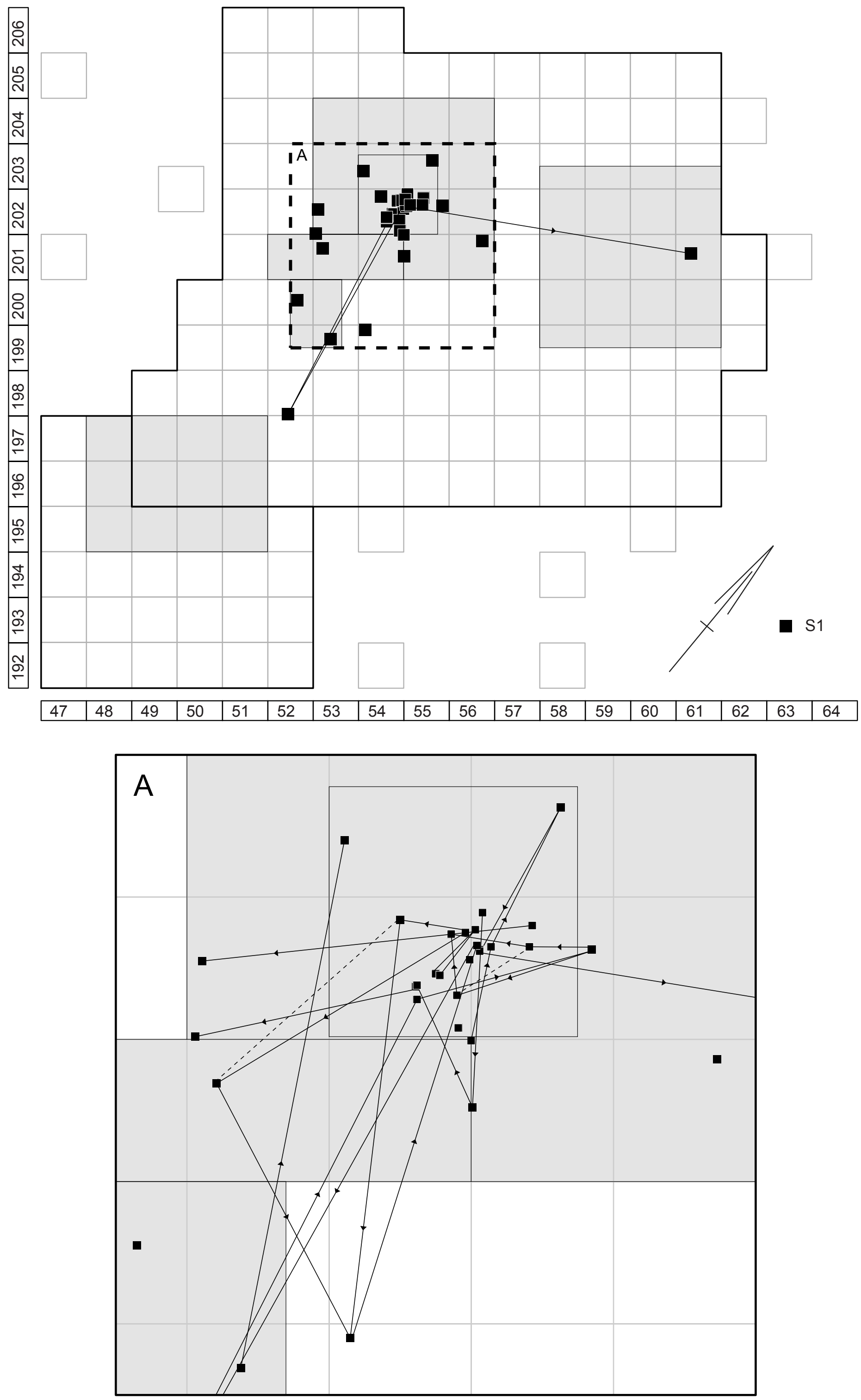


Figure 6.17 RMU S1, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line= broken pieces. Grid co-ordinates are at metre intervals.

			Three-dimensionally recorded and refitted artefacts in loess soil							
RMU	Surface	Plough zone	Cluster A	Periphery cluster A	Cluster A/B	Cluster B	Cluster C	Cluster D	Other sections	N
S1	5	3	21	6	1	2	1	.	2	41
S2	9	7	.	1	.	.	.	5	2	24
S3	4	4	4	3	.	.	2	.	2	19
S5	1	2	.	.	.	27	.	1	3	34
S308	5	5	4	1	1	.	.	.	1	17
S309	.	1	6	1	1	.	.	.	.	9
V1	1	2	.	.	1	.	.	.	.	4
Total	25	24	35	12	4	29	3	6	10	148

Table 6.20 Spatial distribution of three-dimensionally recorded, refitted artefacts >2 cm of Simpelveld flint (RMUs S1-S3, S5, and S308 and S309) and Valkenburg flint (RMU V1). The first two columns indicate the numbers of artefacts collected from the surface and plough zone.

was made of two opposite core faces and four striking platforms, and the length and regularity of the blades point to an experienced flint worker.

Only a few artefacts of RMU S1 were found outside cluster A or its periphery. It is striking that the two artefacts that were found furthest from this cluster, namely south of cluster B (KA5) and in cluster C (KC1), are two non-retouched flakes. Both artefacts form part of two series of refitted artefacts which were almost exclusively recovered from cluster A and its periphery. For this reason they are no indication of core reduction at some metres from cluster A. The slightly lower position of cluster C does not exclude that artefact KC1 was moved downslope as a result of geological processes. There are no indications of intentional transport of knapping products of RMU S1 from the area of debitage to other locations in the excavated area. Blades that are missing in refit group S1.00 could possibly be present in the plough zone outside this area.

RMU S2 (fig. 6.18):
Compared with RMU S1, many artefacts of RMU S2 were collected from the surface or in the plough zone. In total we are dealing with nine surface finds and seven plough zone finds, the original position of which can no longer be ascertained. Of the other refitted artefacts (n=8), five pieces were measured in three dimensions in cluster D, in the vicinity of square 49/196. These artefacts reflect a stage of core preparation (KA8) at the top of the core and of blade production (KB4 to KB1) from the front of the core. In any case, RMU S2 thus seems to have undergone working in the southern part of the excavated area. Also the provenance of artefacts from the plough zone point to working of RMU S2 in this part. The find-rich square 49/196 is possibly the remnant of a relatively dense cluster of flint artefacts, which as a result of bioturbation and ploughing have ended up dispersed over the southern part. The fact that 16 out of 24 refitted artefacts of RMU S2 were incorporated into the plough zone, underlines the thought that this part of the excavation has to a large extent been disturbed as a result of ploughing.

A proximal blade fragment with a length of 9.2 cm (KB3) lies completely eccentric of the other artefacts measured in three dimensions of RMU S2. The artefact was recovered north of cluster A. We could be dealing here with an artefact that was struck from core 259A 321 in cluster D and was subsequently carried to cluster A for further working and/or use.

RMU S3 (fig. 6.19):
This RMU consists of 19 refitted artefacts, of which less than half (n=8) was recovered from the surface and from the plough zone. The spatial distribution of the artefacts

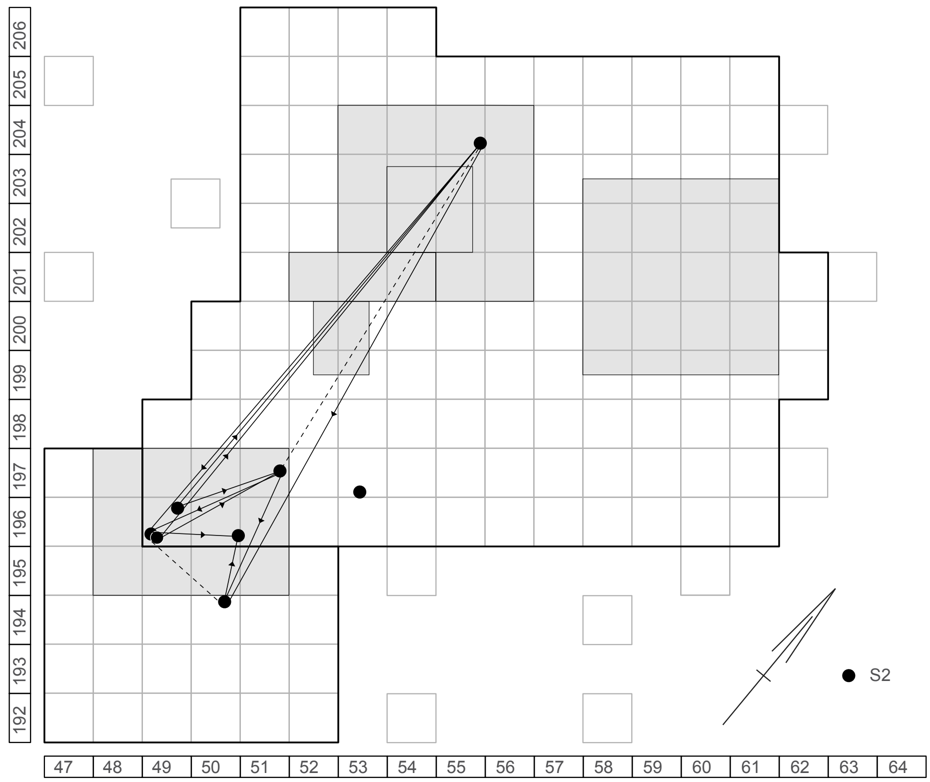


Figure 6.18 RMU S2, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

recorded-three dimensionally points to working of core 259A 107 in and around cluster A. There, in an area of 2 × 3 m, seven artefacts from RMU S3 were found. The artefacts are related to both blade production from striking platform 1 (KA8 to KA6, KA4) and preparation of striking platform 2 at the base of the core (KB7, KB6, KB3). Besides, four artefacts were found at a few metres from cluster A and its periphery, among which a failed blade (KA2) and a complete blade with a length of 5.5 cm (KA1). There are no indications of intentional transport of tools or other artefacts of RMU S3 within the boundaries of the excavation.

RMU S5 (fig. 6.20):
Compared with other RMUs in the group of Simpelveld flint, the distribution pattern of RMU S5 is much less disturbed by ploughing. Of a total of 34 refitted and eight assigned artefacts, only six pieces were not found underneath the plough zone. Nearly all artefacts were lying very concentrated in the southern part of square 53/200 in cluster B. A total of 31 artefacts of RMU S5 were found here, of which 27 pieces form part of refit groups S5.01 to S5.04. With the exception of two conjoined blade fragments (refit group S5.03), these are rather large flakes related to core preparation. As the core is missing it is not known to which part(s) of the core this preparation was applied. The position of most artefacts over an area of less than 1 m^2 can be explained in two ways. Either part of the reduction of RMU S5 was carried out in cluster B, or we are dealing with a location where knapping debris of this RMU was dumped.

In contrast to most other RMUs, there is no spatial relationship between RMU S5 and cluster A or its periphery. One metre west of cluster B, two flakes have been recorded three-dimensionally that form part of refit group S5.01. In addition, two flakes were lying in the southern part of the excavation, at a distance of three to five metres from cluster B. They form part of refit groups S5.02 and S5.04 which largely consist of refitted series of artefacts recovered from cluster B.

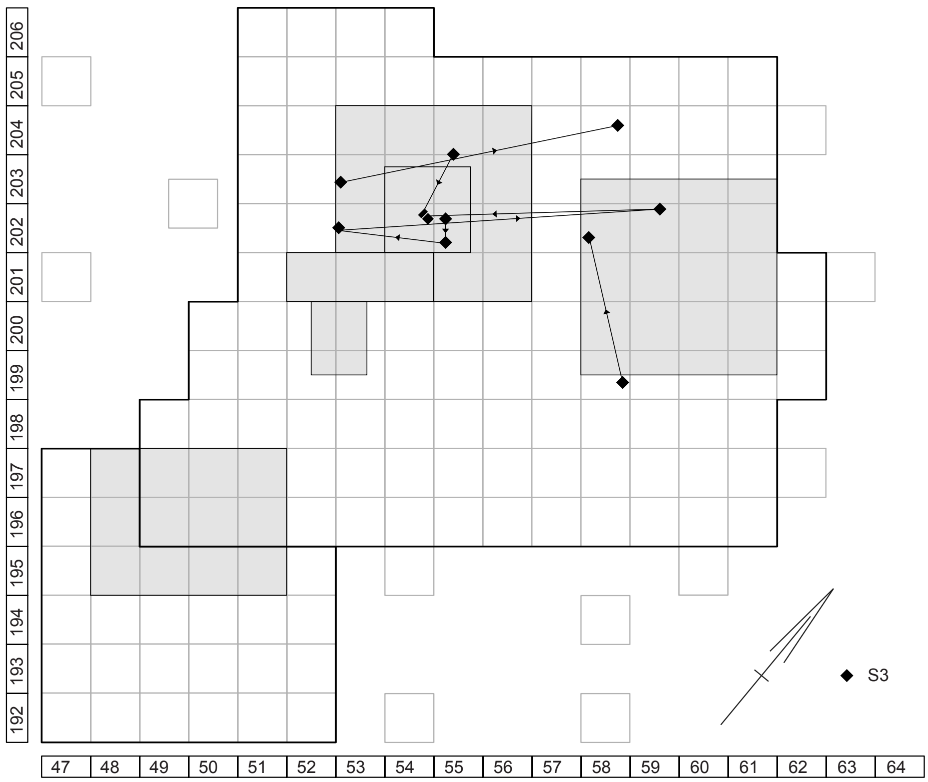


Figure 6.19 RMU S3, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

S301 to S319 (figs. 6.21-6.23):
Other artefacts of Simpelveld flint form part of smaller compositions of refitted artefacts (refit groups S301 to S319). Refit group S308 consists of a series of nine blades (PA10 to PA2) and a flake (PA1). Three blades are composed of conjoined broken pieces which largely originate from the surface and from the plough zone. Taking into consideration the position of (fragments of) artefacts measured in three dimensions, cluster A can be assumed as location of blade production of S308 (fig. 6.21). From this cluster originate a blade with edge damage ('used blade'), a complete blade, a proximal part of a blade (zone A/B), and a distal fragment of a blade. The distribution of the plough zone finds of S308 is clearly greater (for instance, squares 50/199 and 57/204). Presumably this distribution is the result of regular ploughing of the plot of land, whereby artefacts could have been moved over several metres. The distribution pattern of S309 (fig. 6.22) is very comparable with that of S308 (fig. 6.21). Of nine refitted flakes, six pieces were found in cluster A (in square 54/202), and two specimens in the periphery of cluster A and in zone A/B. This distribution points to S309 also having been worked in cluster A (perhaps the refitted artefacts of S308 and S309 represent the knapping products of one and the same core?). No artefacts belonging to this refit group were recovered from other parts of the excavation.

The knapping products of S308 and S309 show a comparable distribution to that of refitted artefacts belonging to RMUs S1 and S3. In addition, artefacts from refit groups S301 to S307, and S310 to S319 have been found in cluster B, cluster C and cluster D (fig. 6.23). As mentioned earlier, cluster D is also the location where RMU S2 had undergone modification. There is a possibility that one or more small compositions of refitted artefacts of Simpelveld flint in fact belong to RMU S2, but they could not be refitted onto artefacts of refit group S2.00.

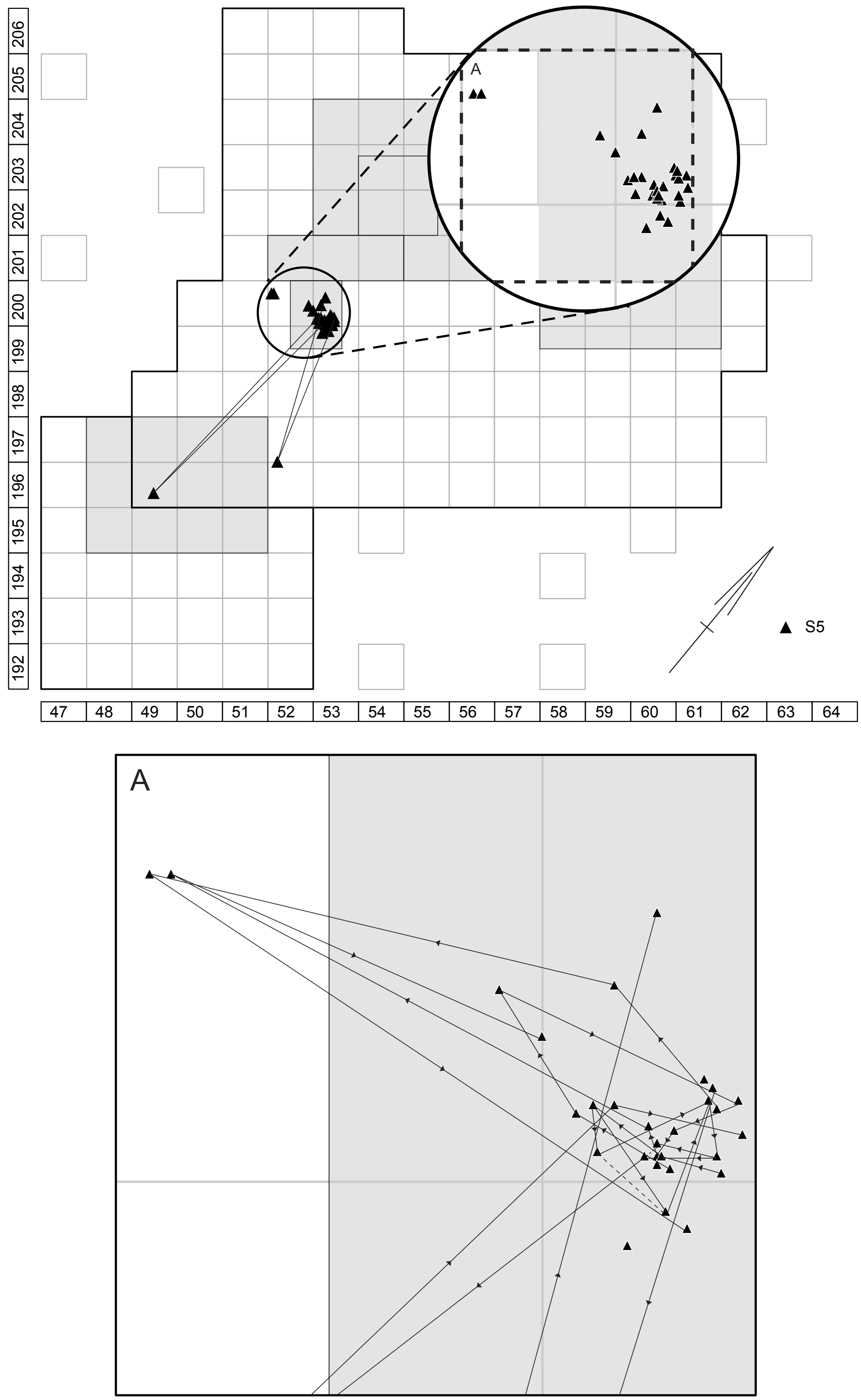


Figure 6.20 RMU S5, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

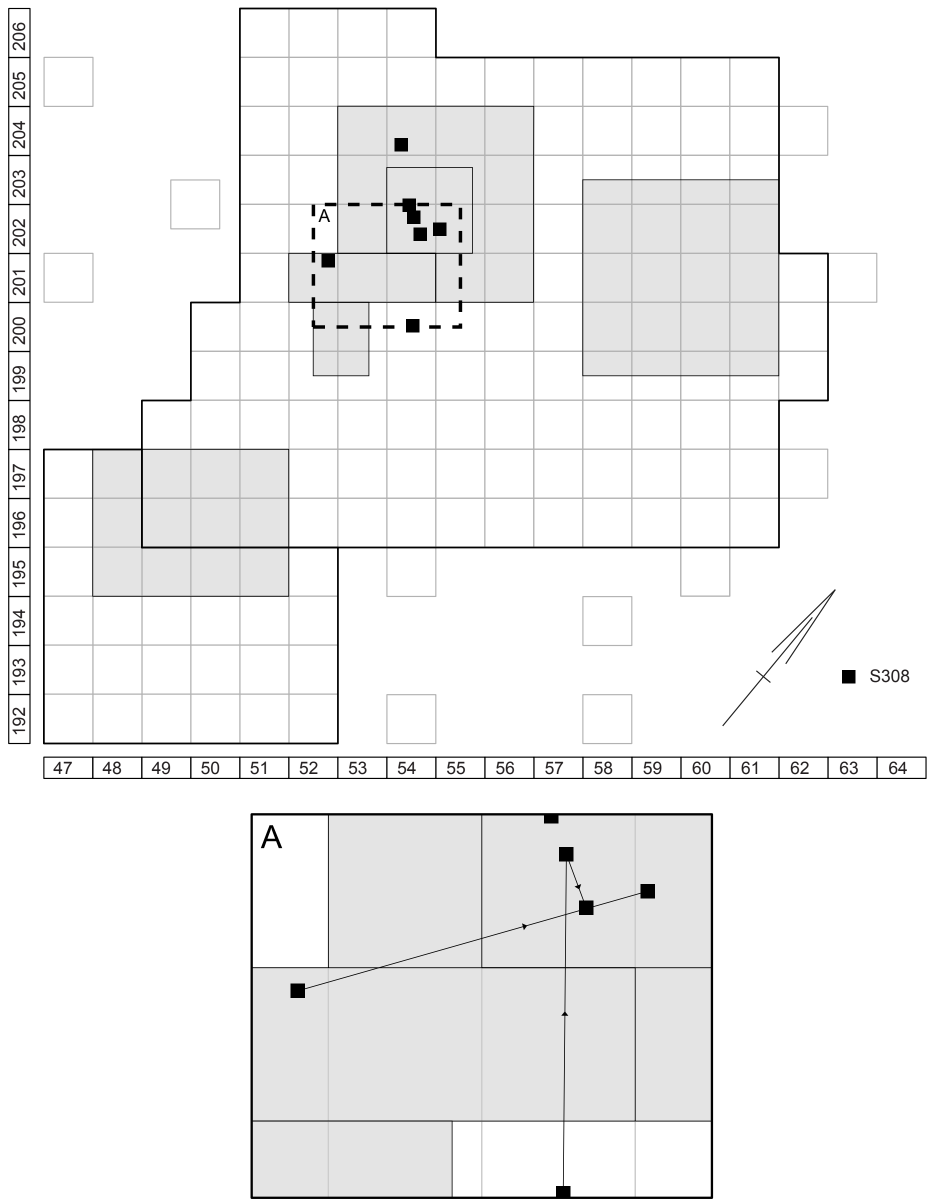


Figure 6.21 S308, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

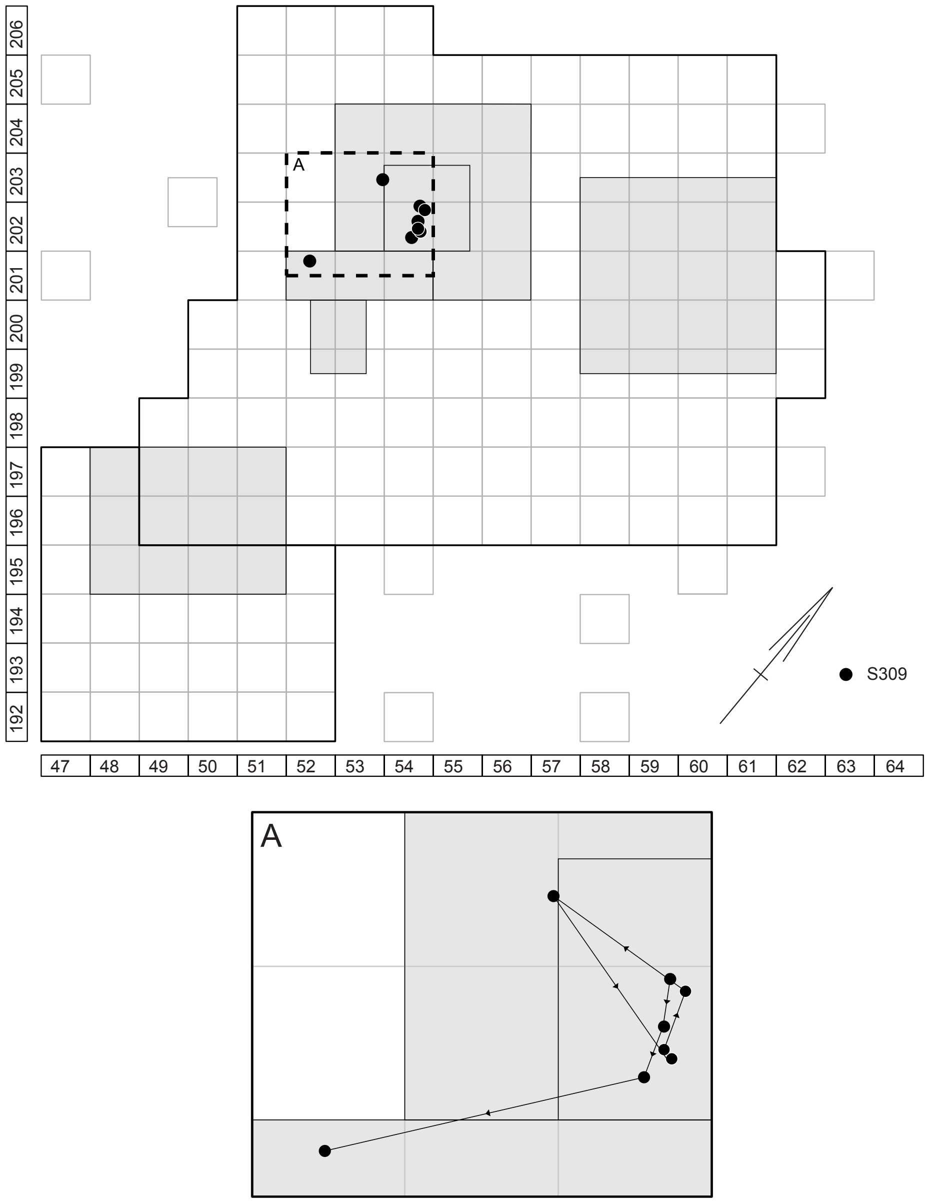


Figure 6.22 S309, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

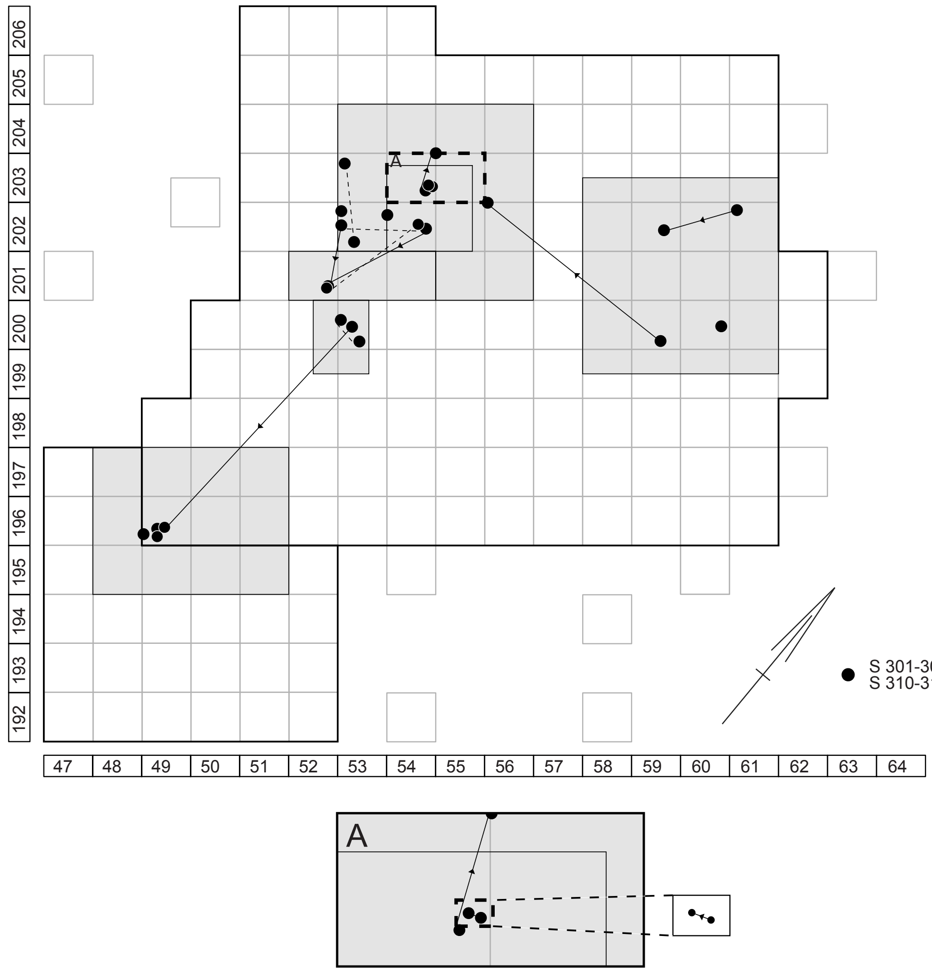


Figure 6.23 S301-S307 and S310-S319, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

6.6.3 Valkenburg flint

RMU V1 (fig. 6.24; table 6.20):

Three out of four artefacts belonging to refit group V1.00, among which core 259A 165, were collected from the surface and the plough zone. The fourth artefact is a blade-like flake that could be refitted onto the core. This artefact was found in zone A/B.

V401 to V405 (fig. 6.24):

Artefacts of Valkenburg flint mainly occurred in the southern part of the excavated area, in cluster B (n=8), in cluster D (n=5), and in squares in the vicinity of both clusters. Refit group V401 consists of three flakes, of which two pieces were lying close to each other in cluster B and one piece over three metres further south in cluster D. Two conjoined fragments of a blade (refit group V403) and a fragment of a crested blade refitted onto a distal part of a blade (refit group V405) originated from cluster B. Both cluster A and cluster C yielded one artefact of Valkenburg flint only, respectively a complete flake and a truncated blade.

6.6.4 South-Limburg flint (table 6.21)

RMU M1 (fig. 6.25):

The distribution of refitted artefacts of RMU M1 points to working of core 259A 322 in cluster A and/or in the periphery. Over an area of 25 m^2, seven artefacts of this RMU were recorded three-dimensionally in this area and its immediate vicinity, which could all be refitted onto the core.

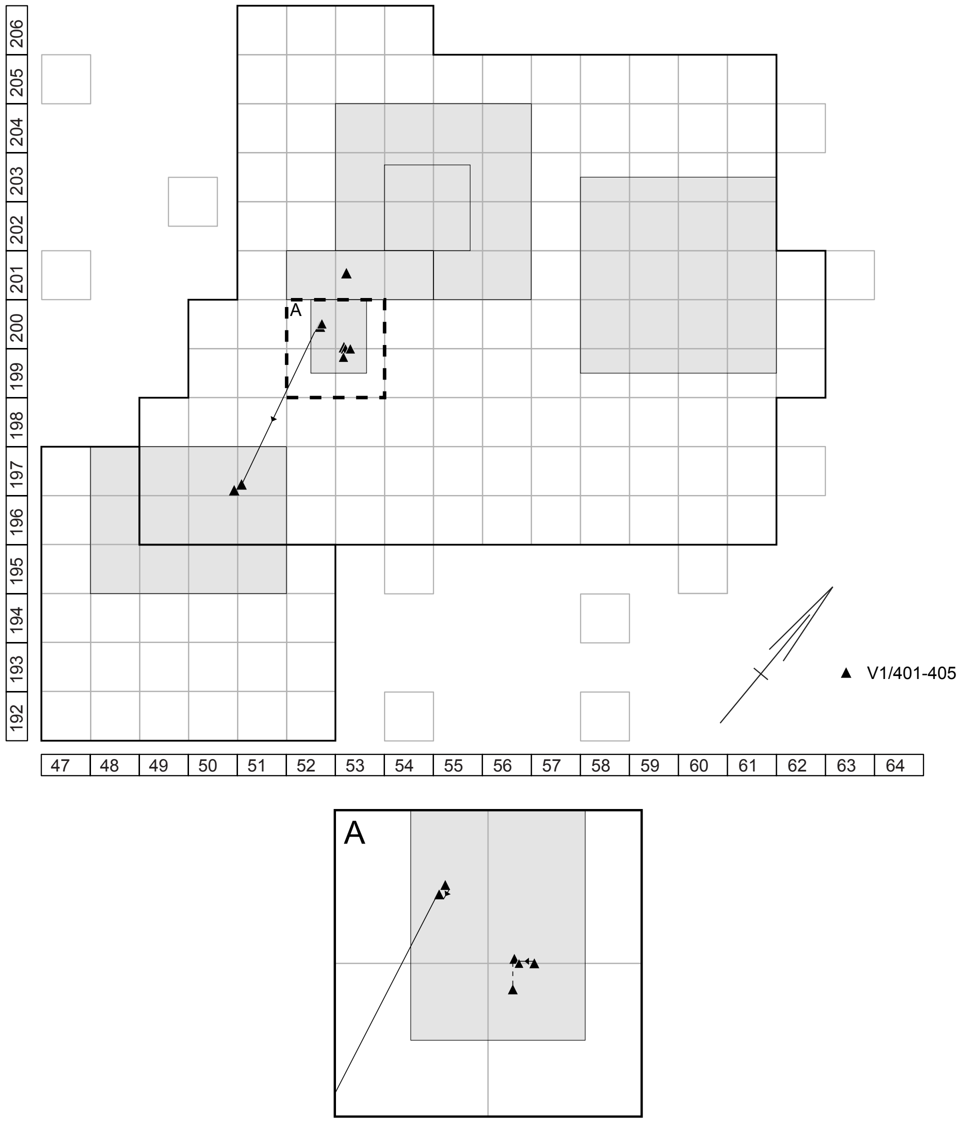


Figure 6.24 RMU V1 and V401-405, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

Among these are flakes with cortex remains and a retouched blade fragment. Four artefacts were lying close together in the southern part of cluster A, a short distance from numerous fragments of unworked siltstone (code 15). The flakes with cortex remains indicate that the core was prepared on the spot. Blade production and the manufacture of at least one tool could be demonstrated by the occurrence of a retouched blade fragment (54/202 36) in cluster A. One artefact recovered from the western part of the excavation (square 51/205) could be refitted to artefacts from cluster A. The distance between this artefact and the nearest refitted artefact in cluster A is 4.2 m. Of the non-refitted artefacts assigned to RMU M1, five pieces originate from cluster A and its periphery. Cluster B yielded a distal fragment of a blade and a flake of RMU M1. Other artefacts, all flakes smaller than 2 cm, were lying in zone A/B and in cluster C. The artefacts from clusters B and C could not be refitted. Of the in total 26 refitted and assigned to RMU M1 artefacts, 10 pieces were collected from the plough zone and from the surface. This number demonstrates that the original distribution of artefacts of RMU M1 was heavily disturbed by ploughing.

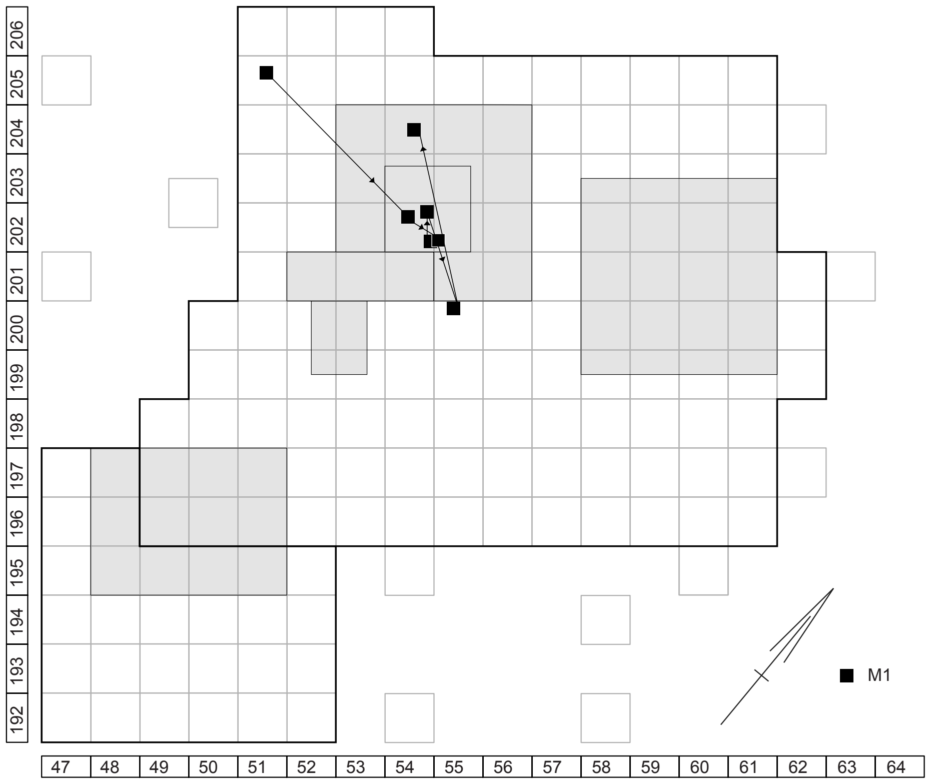


Figure 6.25 RMU M1, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

RMU M2 (fig. 6.26):
This RMU consists of four conjoined fragments of a crested blade and one refitted flake. These fragments together form a large broken piece of a crested blade with a length of c. 24 cm. Of this artefact, a medial part was found in cluster A and the distal part and another medial part in the periphery of cluster A. The conjoined broken pieces were lying in three contiguous squares of 1 × 1 m north and east of the centre of cluster A. A refitted flake (57/204 8) which was struck from the crested blade, was lying at a distance of 2 to 3 metres north of the mentioned broken pieces. A flake that could not be refitted but was assigned to RMU M2, was found just east of cluster B.

It is plausible that within the excavated area only a large crested blade and a few small flakes were removed from the core. Earlier and later stages of core reduction in the form of refitted or assigned artefacts were not demonstrated.

RMU M3 (fig. 6.27):
This RMU consists of 39 artefacts, of which 18 specimens were measured in three dimensions in the area of cluster A and its periphery. We are dealing here with ten refitted and eight assigned artefacts. The spatial distribution of the refitted artefacts is limited to an area of 3 × 2.5 m. The corresponding core (57/199 12) was found a few metres east, but in the plough zone.

Of the artefacts refitted onto the core, six specimens were found in the periphery of cluster A. They were lying in particular west and south of cluster A and partially in the part of the periphery disturbed by a tree fall (squares 53/202, 53/203 and 53/204). Among these artefacts are both flakes and fragments of blades. From this can be inferred that RMU M3 has undergone both core preparation and blade production in or near cluster A. Also due to the presence of the tree fall, the artefacts were rather dispersed, which made it impossible to demonstrate the exact location of working. Remarkable is a fragment of a flake (57/202 9) and the proximal part of a blade (58/203 2) lying at the periphery of cluster C and a few metres outside the distribution of the other artefacts. The fragments could be refitted onto respectively a fragment of a flake and the medial part of the blade that were found in the periphery of cluster A at

			Three-dimensionally recorded and refitted artefacts in loess soil							
RMU	Surface	Plough zone	Cluster A	Periphery cluster A	Cluster A/B	Cluster B	Cluster C	Cluster D	Other sections	N
M1	4	.	4	1	.	.	.	.	2	11
M2	1	.	1	2	.	.	.	.	1	5
M3	2	6	3	6	.	1	.	.	3	21
M4	1	1	2	.	.	.	1	.	.	5
M5	2	2	10	3	.	.	1	.	2	20
M6	6	5	.	.	.	3	.	4	2	20
M7	3	.	8	2	1	4	.	.	.	18
M8	5	3	4	3	.	.	4	.		19
M9	6	5	13	4	.	1	1	.	2	32
M10	4	2	.	.	.	1	.	4	1	12
M11	3	2	2	.	.	.	5	.	.	12
M12	.	2	1	.	.	2	.	1	1	7
M13	6	1	.	.	2	6	.	1	.	16
M14	.	.	.	.	.	.	.	.	.	0
M15	8	6	2	.	.	.	10	.	2	28
M17	1	3	1	.	1	.	1	.	2	9
M18	2	.	.	.	.	.	.	.	1	3
M19	11	9	2	.	1	.	.	2	1	26
M21	2	.	.	.	.	1	.	.	.	3
M23	.	.	.	.	.	.	.	.	1	1
Total	67	47	53	21	5	19	23	12	21	268

Table 6.21 Spatial distribution of three-dimensionally recorded, refitted artefacts >2 cm of South-Limburg flint (RMUs M1-M15, M17-M19, M21 and M23). The first two columns indicate the numbers of artefacts collected from the surface and plough zone.

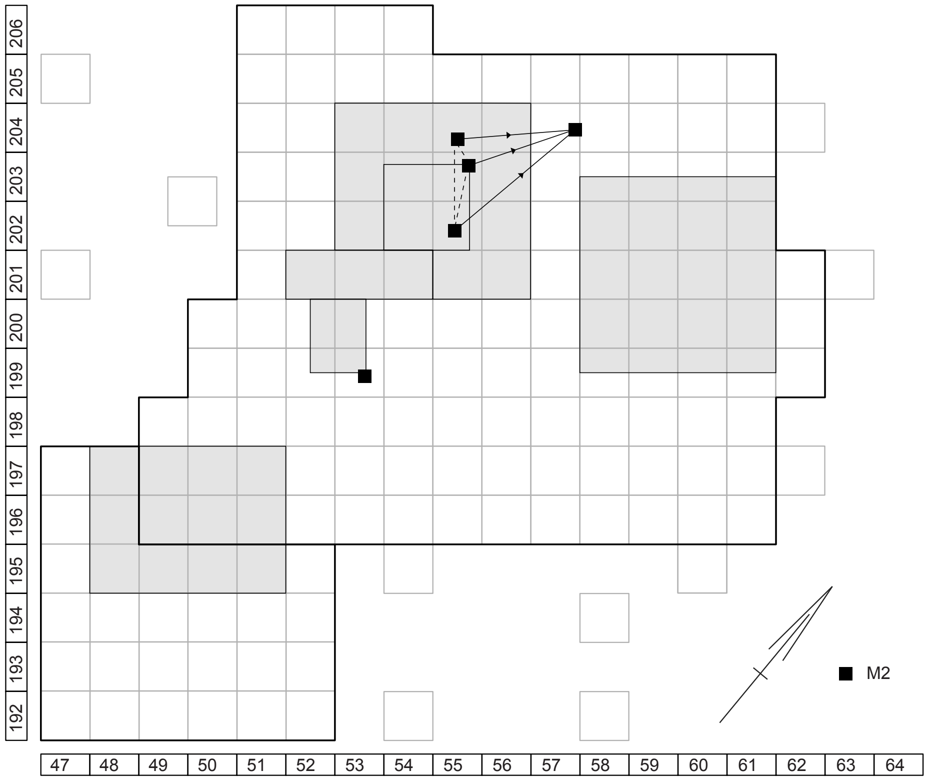


Figure 6.26 RMU M2, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

distances of 4 and 5 metres further (south)west. A fragment of a large flake (53/200 70) was recovered from cluster B and could be refitted onto a flake from square 55/199. Possibly core 57/199 12 was also worked at some distance from cluster A. But we should also bear in mind the possibility of horizontal movement of artefacts as a result of post-depositional processes. The provenance of 13 artefacts from the plough zone and from the surface shows that a part of the original distribution of artefacts belonging to RMU M3 was affected as a result of ploughing.

RMU M4 (fig. 6.28):
This RMU is very incomplete, also because only a small part of the core has been recovered. This fragment was collected from the surface. The core has a non-patinated fracture plane and a clearly recognizable brown cortex. RMU M4 is composed of twelve artefacts measured in three dimensions, of which three specimens could be refitted onto core fragment 259A 323. Two refitted artefacts come from cluster A and one from cluster C. The position of both first-mentioned artefacts points to blade production and/or use of blades in the western part of cluster A. Of nine assigned artefacts, four pieces were also found in cluster A and its periphery. These artefacts (two fragments of blades, and two fragments of flakes) underline the notion that RMU M4 was modified in this part of the excavation.

Outside cluster A and its periphery, a flake (zone A/B), a flake smaller than 2 cm (cluster B), a proximal part of a blade and a flake smaller than 2 cm (cluster C), and a proximal fragment of a blade (remaining zone) were found underneath the plough zone. How this wide distribution of artefacts, dispersed over three clusters and beyond, should be explained is not clear. Possibly RMU M4 was modified in different parts of the excavated area. But artefacts could also have been moved horizontally over many metres as a result of post-depositional processes. As mentioned, the core is only documented by a small fragment that was collected from the surface. The small number of conjoined artefacts do not make it possible to say anything with certainty on location(s) of modification.

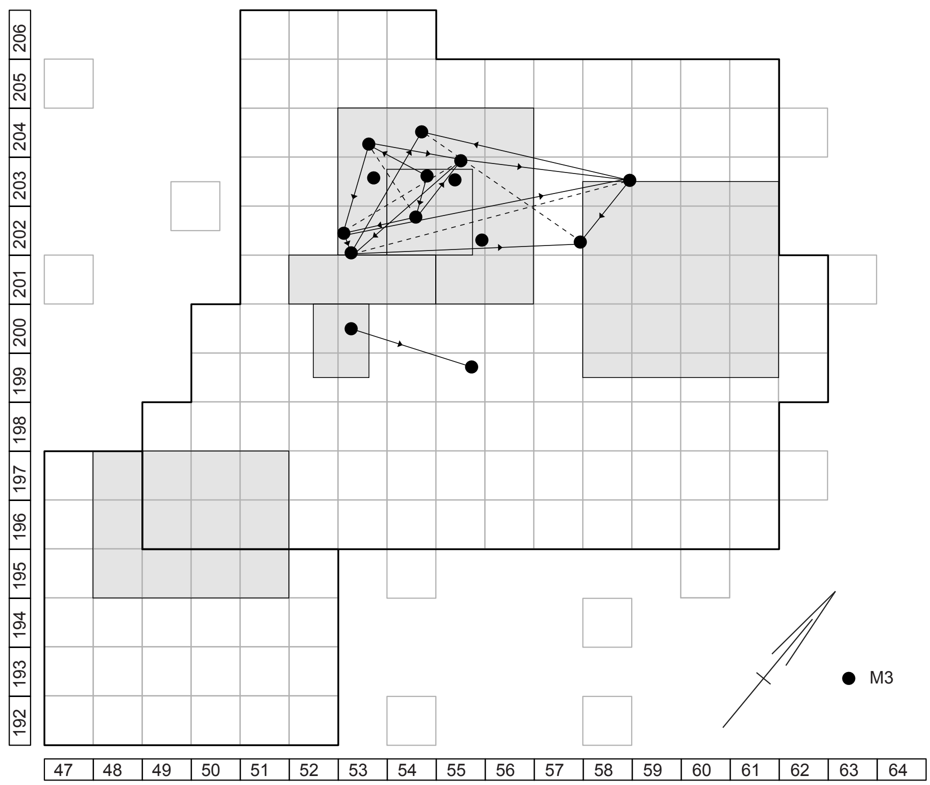


Figure 6.27 RMU M3, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

RMU M5 (fig. 6.29):
This RMU comprises 40 artefacts measured in three dimensions, of which 15 pieces could be refitted (refit groups M5.00 to M5.05). Of these artefacts, ten specimens were found in cluster A and three specimens in its periphery. The distribution of these artefacts is not more than 3 m^2. Artefacts from cluster A are represented both in refit group M5.00, of which core 259A 205 forms part, and in the other refit groups. Most of these are flakes with dimensions between 3 and 6 cm. These flakes have cortex remains and largely derive from the western part of cluster A. One specimen has been retouched. In addition, a complete blade and two blade fragments of RMU M5 were collected in this part of the excavation. Worth mentioning is that refitted artefacts in squares 54/202 and 54/203 were collected in an area of c. 1 × 0.5 m. Also the position of several non-refitted artefacts points to modification, including production of blades, in cluster A and/or its immediate vicinity.

Three refitted and twelve assigned artefacts show a relationship with other parts of the excavation. Zone A/B yielded two flakes and the proximal part of a blade, and cluster C two fragments of flakes and a complete flake and blade. Artefacts were also found outside the clusters, among which two specimens in square 57/202 which form part of refit groups M5.00 and M5.02. The meaning of these artefacts at a few metres from cluster A is not clear. Also to RMU M5 applies that the original distribution of artefacts has been disturbed as a result of ploughing. This can be inferred from the occurrence of four refitted and twelve assigned artefacts in the plough zone and at the surface.

RMU M6 (fig. 6.30):
RMU M6 corresponds with refit group M6.00 and consists of eleven artefacts recorded three-dimensionally and refitted onto core 259A 373. Compared to the earlier discussed RMUs, the distribution of knapping products of this flint

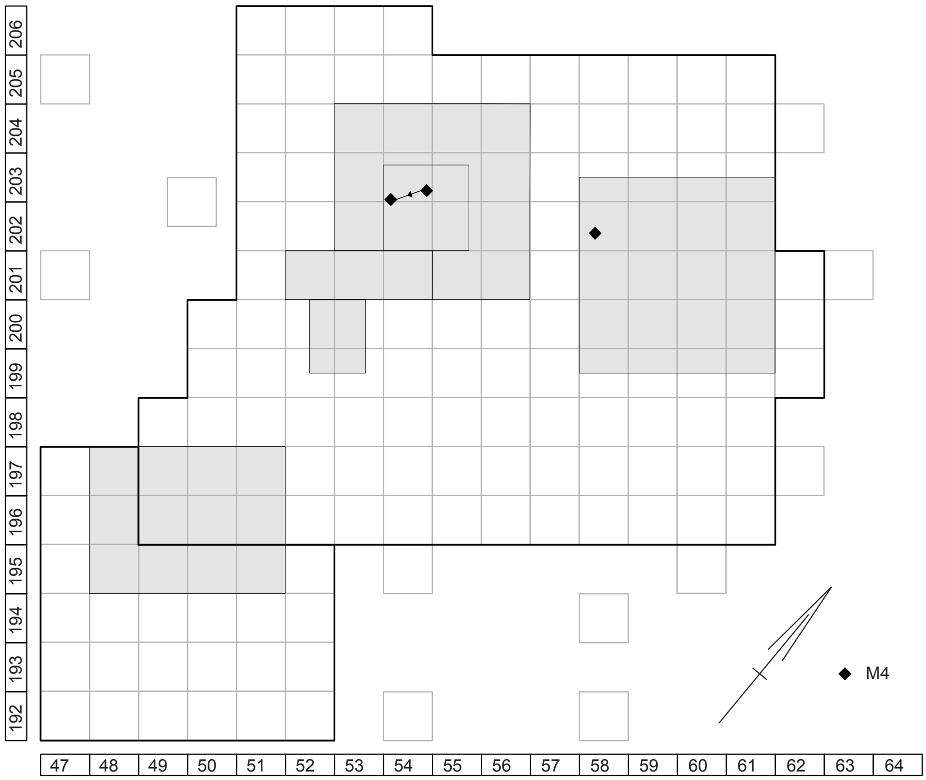


Figure 6.28 RMU M4, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

nodule is clearly different. None of the artefacts was found in cluster A or in the periphery of this cluster. Apparently, the modification of RMU M6 and the use of products of this RMU took place entirely outside the main activity area (= cluster A) of the excavation. The artefacts were recovered in cluster B (n=4), cluster D (n=5), and the here adjoining southern part (n=2). This distribution points to modification, in the form of core preparation and blade production, in the area south of cluster A and to a relationship between clusters B and D.

Four conjoined broken pieces, together part of two blades, were found in cluster B. They point to removal of blades from core 259A 373 on the spot or to selected blades having been carried away from cluster D to this location in order to be used. Both blades are not complete: the 'missing' parts were found in cluster D and even further south, in square 50/193. Also other artefacts were collected from this part of the excavation, among which scraper 51/197 10 in cluster D. With this, there seems to be a connection between on the one hand cluster B and on the other hand cluster D and the southernmost part of the excavation. Between both locations there is a relatively 'empty' area where no artefacts of RMU M6 came to light.

The relatively large dispersion of the artefacts in the southern part could be related to the high degree of bioturbation in this part of the excavated area. Other processes, such as throwing away artefacts or slope wash, could also have played an important role. Another possibility is that end products, among which two end scrapers, were not used in the place where they were made but in the vicinity. Which stages of core reduction were carried out where exactly is difficult to determine. Moreover, twelve artefacts of this RMU were collected from the surface and from the plough zone. The conclusion is that also in the case of RMU M6 we are dealing with the remains of an originally denser distribution of artefacts, of which clusters B and D both formed part.

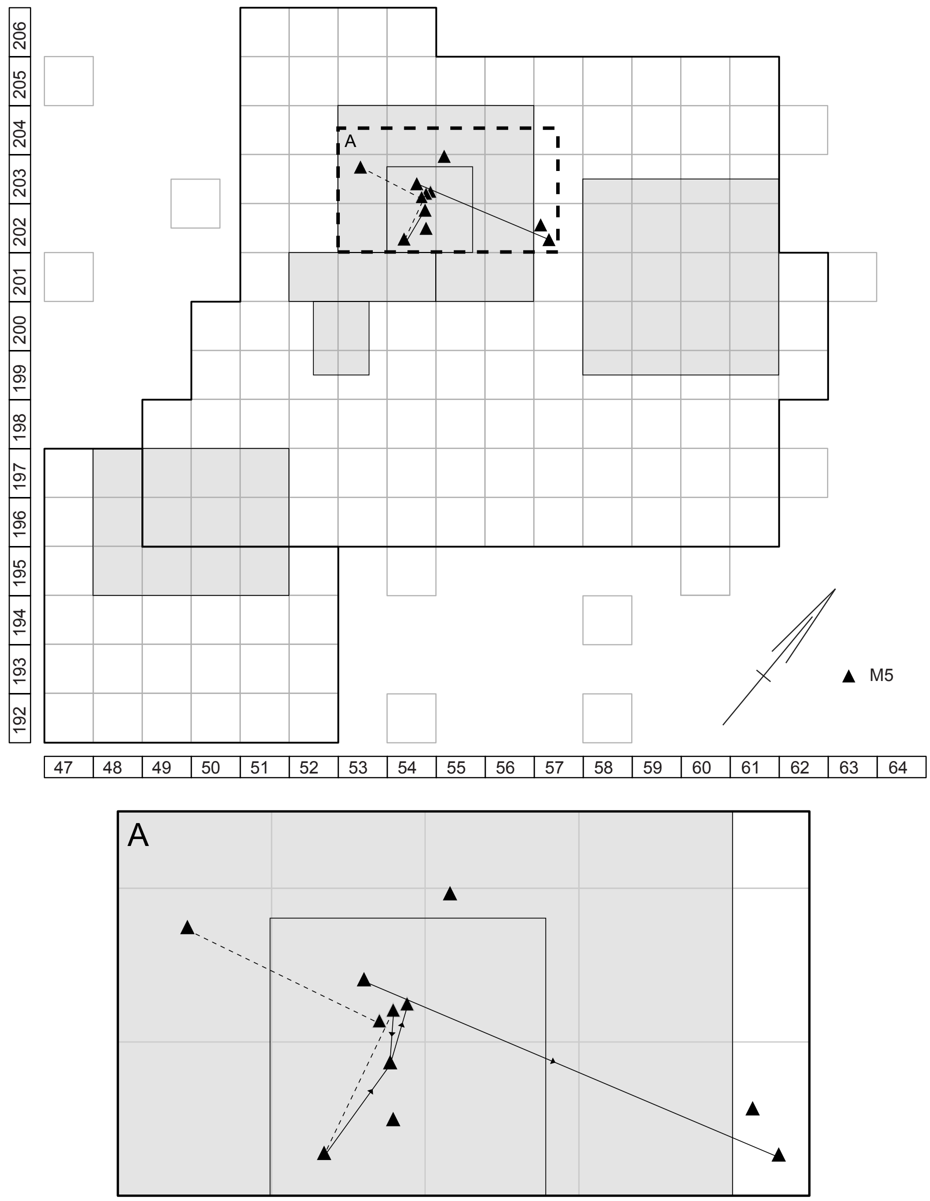


Figure 6.29 RMU M5, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

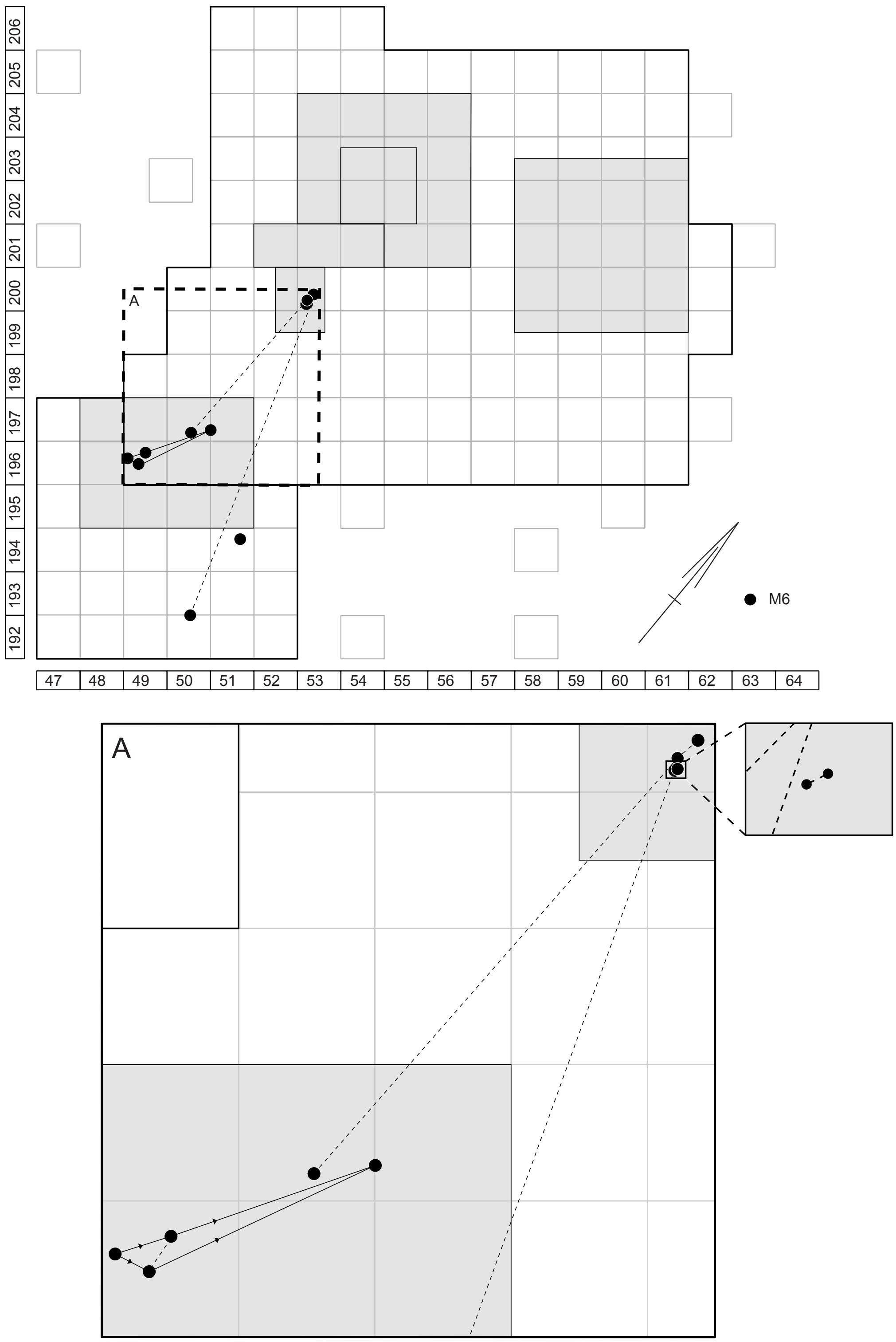


Figure 6.30 RMU M6, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

RMU M7 (fig. 6.31):
The distribution of the artefacts belonging to RMU M7 is mainly connected to the area of cluster A and the periphery. There ten refitted artefacts were lying close together, in an area of c. 2 × 1.5 m. Moreover, one or more artefacts from this find-rich part are represented in all refit groups (M7.01 to M7.05). Among the refitted artefacts are two large flakes, a core rejuvenation flake, and proximal, medial and distal parts of blades with large dimensions. The artefacts came to light in the centre and in the western part of cluster A. They point to core preparation and blade production in this part of the excavation. Unfortunately, the core itself was not found.

Four refitted artefacts of this RMU originated from cluster B, consisting of twice a distal end of a blade and a fragment of a blade and a flake. The fact that these artefacts dorsally/ventrally could be refitted onto artefacts recovered from cluster A indicates a relationship between clusters A and B. The distance between artefacts in both clusters is 1.5 to 3 m. The position of these artefacts is possibly related to the partial working of RMU M7 in cluster B. Another possibility is that a selection of fragments of blades was carried to cluster B to be used there (see also RMU M6, but then from cluster D!). A relationship with cluster C or cluster D could not be determined on the basis of the refitting evidence. Cluster C yielded a medial part of a blade and a fragment of a flake which were assigned to RMU M7. They do not form part of the compositions of refitted artefacts.

RMU M8 (fig. 6.32):
This RMU consists of twelve refitted artefacts plotted in three dimensions: nine fragments of flakes, two fragments of crested blades and one medial fragment of a blade. An important part (n=8) was found in the centre of cluster A and in the northwest part of the periphery of this cluster. East of there, at c. 6.5 metres and separated by an empty zone, four refitted artefacts were found in the area of cluster C. These are three flakes larger than 3 cm and the distal end of a crested blade. Taking into consideration the position of the refitted artefacts, it is suggested that RMU M8 was reduced in or near cluster A and in cluster C. Refit groups M8.01 and M8.03 contain artefacts from both cluster A and its periphery and from cluster C. A medial blade fragment that could be refitted onto core 259A 239 (surface find) was found in cluster A (refit group M8.00). Two broken pieces which together form a complete blade, also form part of this refit group and they were collected from the plough zone of squares 57/202 and 57/203. Both squares are located between the periphery of cluster A and cluster C.

The existence of a relationship between cluster A and cluster C is further demonstrated by the occurrence of non-refitted artefacts of RMU M8 in these clusters. Other parts of the excavation yielded a fragment of a frost-cracked artefact, two flakes and a medial fragment of a blade. They were mainly in the vicinity of cluster C. And finally, we should point to five surface finds and three plough zone finds > 2 cm belonging to RMU M8.

RMU M9 (fig. 6.33):
This RMU consists of 33 refitted artefacts, i.e. the largest composition of refitted artefacts within the group of Meuse terrace flint. With the exception of two artefacts, they all belong to refit group M9.00. The core has only been preserved partially in the form of three conjoined fragments with non-patinated fracture planes. Apart from one artefact, artefacts of this RMU were found within an area of c. 4 × 3.5 m. A total of 22 artefacts were found underneath the plough zone, of which 14 specimens in cluster A and four specimens in its periphery. These are mainly flakes with maximum dimensions between 3 and 6 cm, among which a decortication flake and flakes with few or no cortex remains. There are also fragments of blades, a part of a crested blade, and two retouched tools. The artefacts were lying more or less dispersed over the area of cluster A, with a few pieces lying very close together in its centre. Together with two non-refitted artefacts originating from the same area, they point to core preparation and production of blades in this find-rich part of the excavation.

Outside cluster A, knapping products of RMU M9 occurred in cluster B (complete flake without cortex) and in cluster C (proximal part of a blade). Both artefacts form part of refit group M9.00 and link clusters B and C to cluster A and the periphery. East of cluster A, three artefacts were found close together in squares 56/200 and 56/201. One specimen of these could be refitted onto an artefact recorded three-dimensionally in cluster A.

Also from this RMU originate relatively many artefacts from the surface or from the plough zone, among which eleven artefacts which form part of refit group M9.00 (=33%).

RMU M10 (fig. 6.34):
Refit group M10.00 consists of core 51/197 2, two flakes, two blades, and a burin that were found in the southern part. Taking into consideration the position of these artefacts, the knapping of RMU M10, including the removal of (a few) blades and preparation flakes, took place in cluster D. One refitted, complete blade was found in cluster B. This artefact points to a spatial relationship between cluster B and the southern part of the excavation, including the area of cluster D. It is plausible that this blade was carried to cluster B and there discarded (after use?). The same probably applies to a non-refitted medial fragment of a blade that was

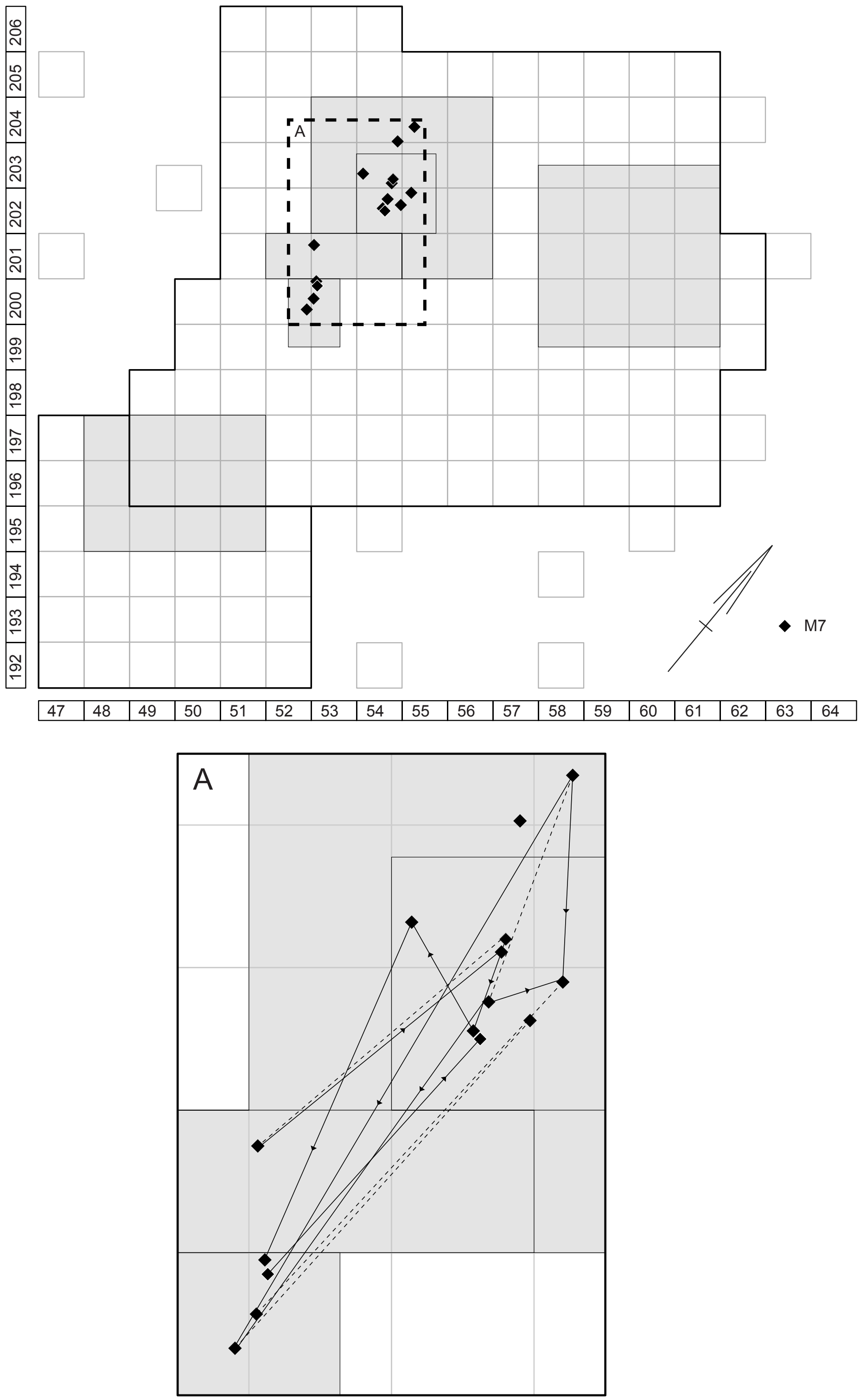


Figure 6.31 RMU M7, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

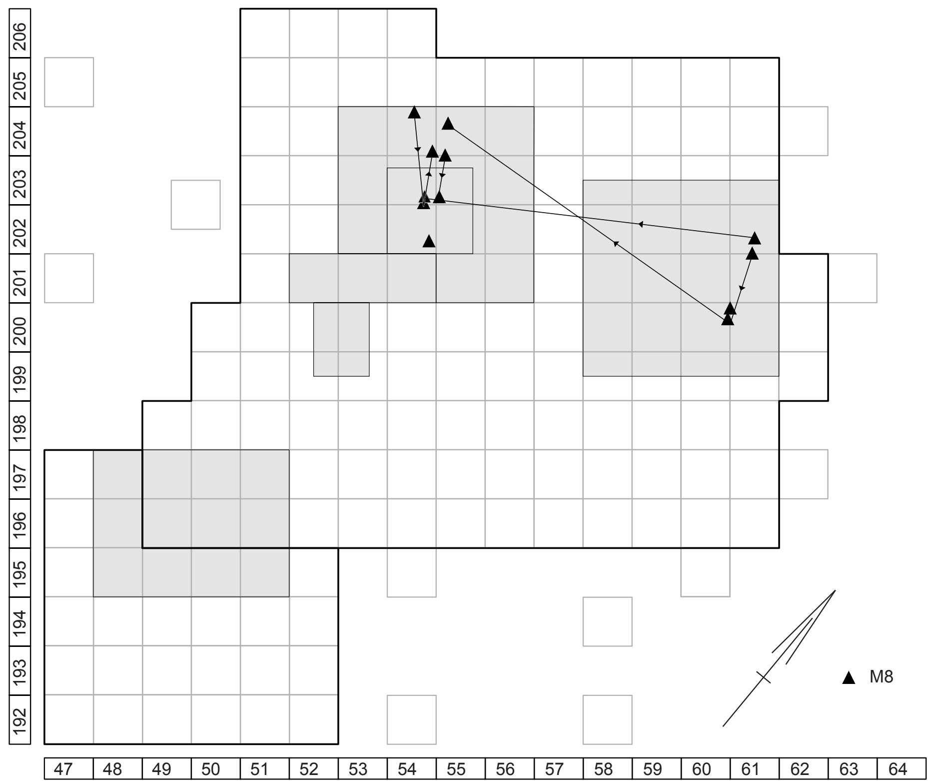


Figure 6.32 RMU M8, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

found in square 52/200. The position of a dihedral burin in square 50/193 could be an indication of the use of retouched tools of RMU M10 at the southern edge of the excavation, just south of the location where this RMU was probably worked.

RMU M11 (fig. 6.35):
The distribution of artefacts belonging to RMU M11 is mainly connected with the eastern part of the excavation, east of x-co-ordinate 58. Artefacts from cluster C are present in refit groups M11.01 and M11.02. Unfortunately, the core is lacking in the flint assemblage of Eyserheide. Both refit groups represent small compositions of preparation flakes (usually without cortex). Refit group M11.01 also contains a complete blade (61/199 1) which was found in cluster C. The distal part of another refitted blade (length > 17 cm) came to light in cluster A. This cluster further yielded a fragment of a remarkably large and thick decortication flake, which forms part of refit group M11.02. In contrast to other RMUs, artefacts of RMU M11 are lacking in the periphery of cluster A.

Because of the occurrence of the decortication flake mentioned above, RMU M11 was possibly tested in cluster A, by the removal of a core tablet and possibly a few striking platform preparation flakes. Subsequently, preparation and rejuvenation of the striking platform and blade production were carried out in cluster C. A total of 20 refitted and assigned artefacts recorded three-dimensionally originated from this part of the excavation. Among the small number of artefacts from cluster A are two distal fragments of a blade with dimensions larger than 10 cm. In addition, a (non-refitted) medial fragment of a blade was found in cluster B. We could possibly be dealing here with the transport of selected artefacts from cluster C to the area of clusters A and B to be used there. The distance from these artefacts to other artefacts of RMU M11 recorded three-dimensionally in cluster C is 4 to 8 metres.

RMU M12 (fig. 6.36):
It concerns the distribution of the small refit group M12.00, consisting of three refitted flakes on core, and refit group M12.01, consisting of conjoined fragments of two blades.

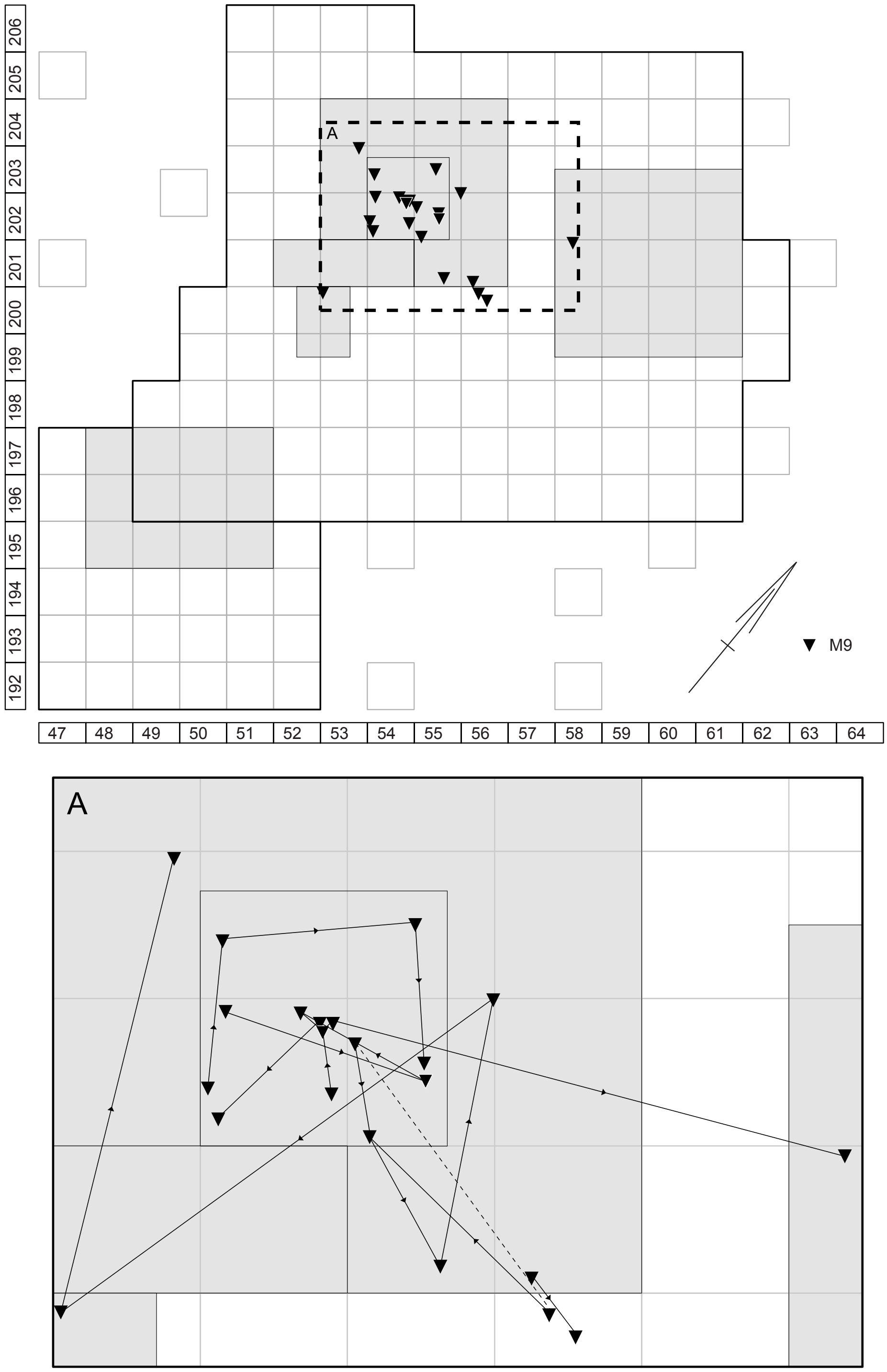


Figure 6.33 RMU M9, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

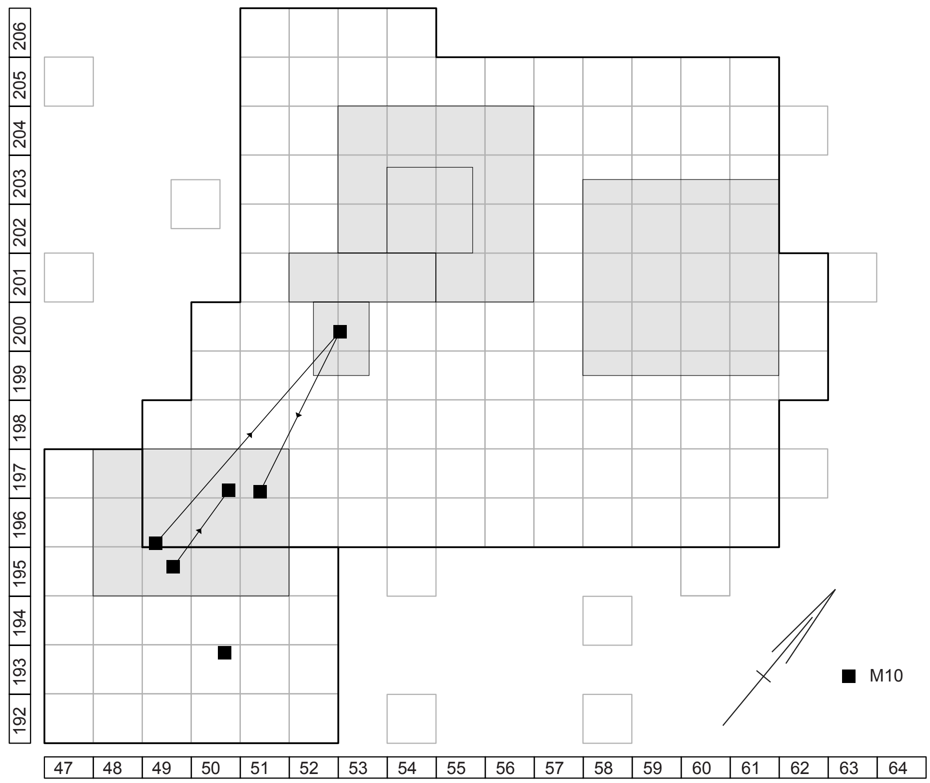


Figure 6.34 RMU M10, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

No blades could be refitted onto the core. Although the number of refitted artefacts is small, we are dealing with a large distribution in the central and southern part of the excavation. Two flakes that could be refitted onto the core originated from cluster B. A third refitted flake was found in square 50/193, c. 7 m south of this cluster. Of refit group M12.01, the distal part of a crested blade was found in cluster A. Onto this blade could be refitted the proximal part of a blade that originated from square 49/196 in cluster D, over 5 m south of cluster A. How this spatial distribution and these large distances between refitted artefacts should be explained is, also because of the small number of artefacts, not clear. Also assigned and measured-in artefacts originated from different parts of the excavation, among which a small flake (length 2.3 cm) from cluster C. Of RMU M12, seven artefacts were collected from the plough zone and the surface. Also the distribution of this RMU shows that an important part of the archaeological layer was disturbed by ploughing.

RMU M13 (fig. 6.37):
Of ten artefacts refitted onto core 259A 208 (refit group M13.00), five specimens were recorded three-dimensionally in cluster B. The distribution of these artefacts is limited to an area of 50 × 70 cm. It concerns a complete blade, two fragments of blades and two flakes. In view of their position, it seems that the modification of RMU M13 was (also) carried out in cluster B. One artefact of refit group M13.02 also points to a relationship with cluster B, but there are also refitted artefacts recovered from zone A/B (blade and flake), the periphery of cluster A (two fragments of a scraper), and cluster D (flake). The distribution of the majority of these finds is limited to an area of 5 m^2. The flake that was found in cluster D was lying c. 5 m south of cluster B and clearly outside this distribution. This artefact could be refitted onto a flake in square 53/200, which underlines the importance of cluster B in the distribution of RMU M13. Possibly the broken blade scraper was also made there and subsequently used and discarded in the periphery of cluster A.

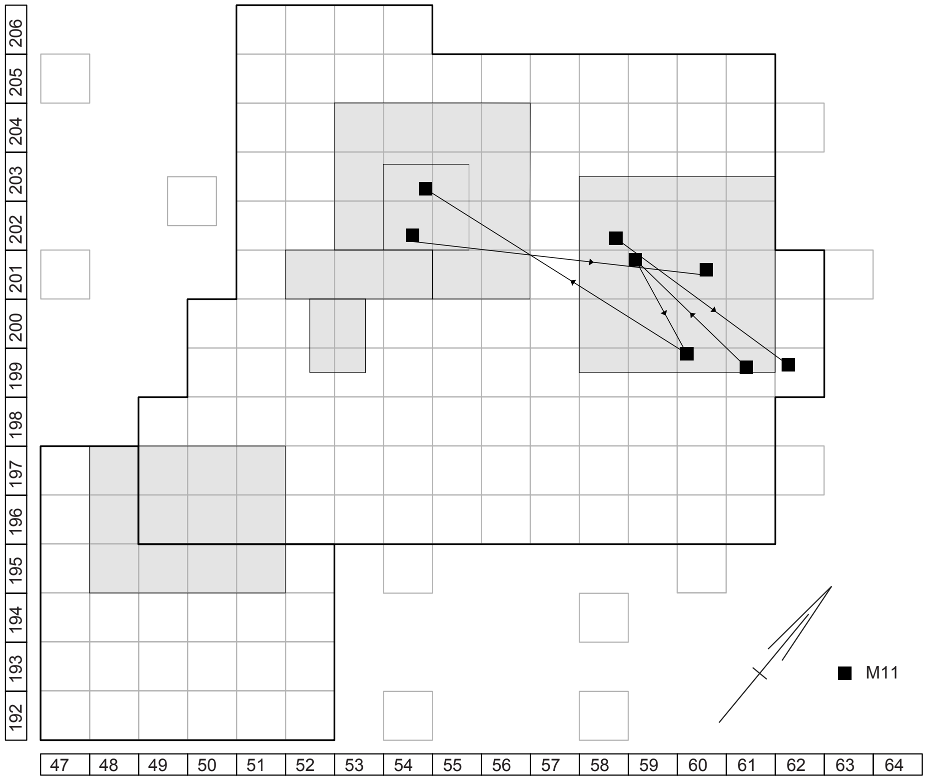


Figure 6.35 RMU M11, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

RMU M14:
This RMU consists of six non-refitted artefacts, of which a fragment of a flake and a medial fragment of a blade were found in cluster C. A proximal fragment of a blade originates from the plough zone of square 58/202 that forms part of cluster C. The plough zone of square 54/204 yielded a fragment of a small flake in the periphery of cluster A. No core of this RMU was retrieved. Because of the small number of artefacts and the lack of refits, it cannot be determined where RMU M14 was modified. Taking into consideration the position of two artefacts recorded in three dimensions, a relationship with cluster C is the most obvious.

RMU M15 (fig. 6.38):
The largest composition within RMU M15 is refit group M15.00 which consists of eleven artefacts, among which blade core 259A 209. The majority of the artefacts of this refit group originates from the area of cluster C, c. 4 to 5 m east of cluster A. Looking at the position of these artefacts, among which three large refitted flakes, the core was worked in the eastern part of the excavation. Refitted flakes belonging to the small refit groups M15.01 and M15.03 were also found in cluster C or in its immediate vicinity. Cluster A yielded a proximal fragment of a broad blade with edge damage (‘use retouch’) and a complete flake of more than 7 cm. The former artefact could have been carried from cluster C to be used there, however for the larger flake this possibility of transport is less likely. The fact that 15 refitted artefacts were collected in the plough zone or at the surface, demonstrates also in this case that an important part of the original find distribution was disturbed by ploughing and was incorporated into the plough zone.

The relationship between RMU M15 and cluster C is underlined by the position of 21 non-refitted flakes, three blade fragments and a fragment of a burin spall in this part of the excavation. But also a few artefacts were found in cluster A, among which two distal fragments of blades, and in the periphery of cluster A and in cluster B. We should bear in mind that in RMU M15 the products are represented of two or even more cores. We are dealing here with a white

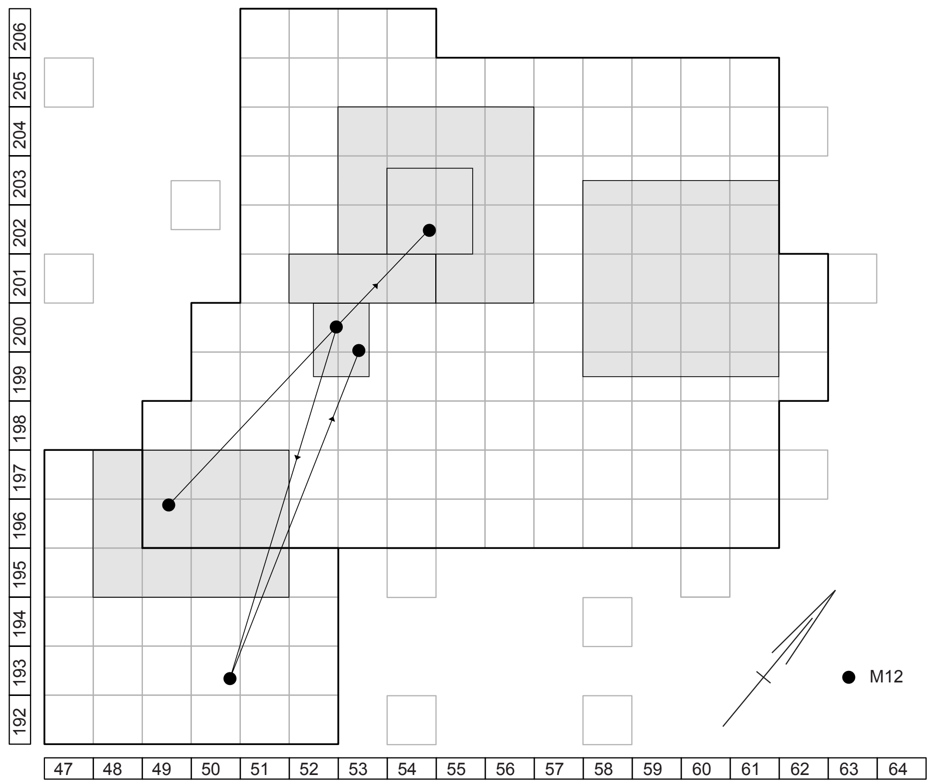


Figure 6.36 RMU M12, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

patinated (terrace) flint, of which many artefacts have been found without cortex remains.

RMU M17 (fig. 6.39):
Of this RMU, the core and three preparation flakes which could be refitted onto the core (refit group M17.00) were found underneath the plough zone. A refitted tool, backed bladelet 259A 319, has been documented as surface find. The core was found in square 56/200 immediately east of the periphery of cluster A. Two refitted flakes were found at a short distance from the core, in square 57/200 and square 54/201. The latter square forms part of zone A/B. Cluster A yielded one flake refitted onto the core. Other refitted artefacts were collected from the surface and plough zone, but a flake was also found in square 60/200 that forms part of cluster C. The distribution of three-dimensionally recorded artefacts points to working of the core in the central part (cluster A and periphery) and/or eastern part (cluster C) of the excavation. A connection between RMU M17 and the mentioned parts is further underlined by the position of non-refitted artefacts which were assigned to RMU M17 based on characteristics of the flint. Of these, five pieces were found in cluster A and the periphery, and two pieces in cluster C. Both cluster B and the southern part of the excavation, among which cluster D, yielded no products of RMU M17.

RMU M18 (fig. 6.40):
This RMU consists of 29 non-refitted fragments of flakes and blades with cortex parts and a small composition of three refitted flakes (refit group M18.01). They have been described as a separate RMU on the basis of a red-brownish colour of the flint which is translucent at the edges. With the exception of seven surface finds and one plough zone find, all artefacts were found beneath the plough zone. They were lying dispersed over the area of cluster A and its periphery and over the area of cluster C. Two artefacts were at some distance south of this zone: a refitted flake in square 53/197 and an assigned flake in square 61/196. It is striking that in particular large flakes and blade fragments occur in cluster C, while in (the periphery of) cluster A most artefacts are smaller than 3 cm (compare M15). The largest flake measures 6.9 × 8.7 cm and comes from cluster C.

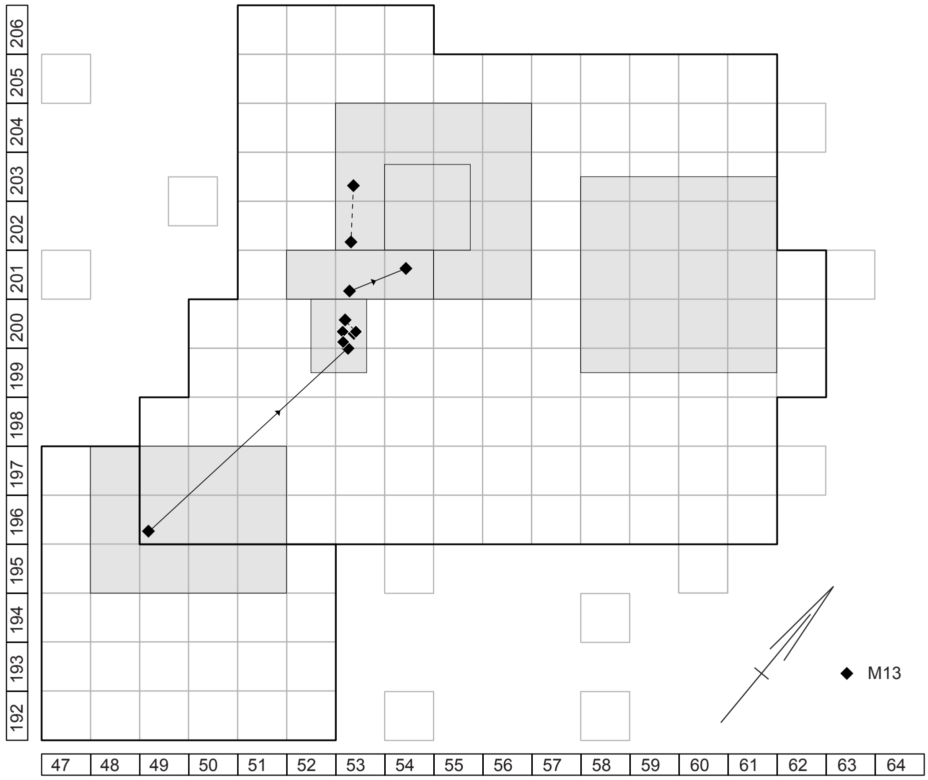


Figure 6.37 RMU M13, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

As RMU M18 only consists of one small refit group of three refitted flakes, very little can be said about the location(s) of the working of the core (which was not found). The location of the three-dimensionally recored artefacts points to a connection between RMU M18 and the central and eastern parts of the excavation, that is the area in which clusters A and C are located.

RMU M19 (fig. 6.41):
On the basis of the colour of the flint, blue-grey patina and eluvial cortex, several artefacts have been described as Rijckholt flint. They have been attributed to one RMU (M19) but are presumably the knapping products of two or more cores. Large compositions of refitted artefacts do not occur. In all cases we are dealing with small refit groups (M19.01 to M19.08) which mainly consist of flakes or fragments of blades. Of the in total 26 refitted artefacts, as many as 20 pieces were collected from the plough zone or from the surface. This number demonstrates that the ‘original’ distribution of artefacts of RMU M19 was affected to a large extent as a result of ploughing. Among the surface finds are two refitted fragments of a core (refit group M19.00).

Five refitted artefacts were recorded three-dimensionally in cluster A (flake and medial part of a blade), cluster D (flake and fragment of crested blade), and the zone between clusters A and B (fragment of burin). The distribution of artefacts which could not be refitted largely coincides with the central part of the excavated area, from the northern part of the periphery of cluster A to cluster D. South of the latter cluster, no artefacts of RMU M19 have been found. In cluster C, only one flake came to light.

Because of the large number of plough zone and surface finds and the small number of refits, it is not possible to determine specific locations of working. Probably two (or more?) cores of this RMU were worked in clusters A, B and D.

RMU M21 (fig. 6.42):
Of the three artefacts which together form RMU M21 (refit group M21.01), one specimen was found beneath the plough zone. It is a fragment of a retouched blade in cluster B. This

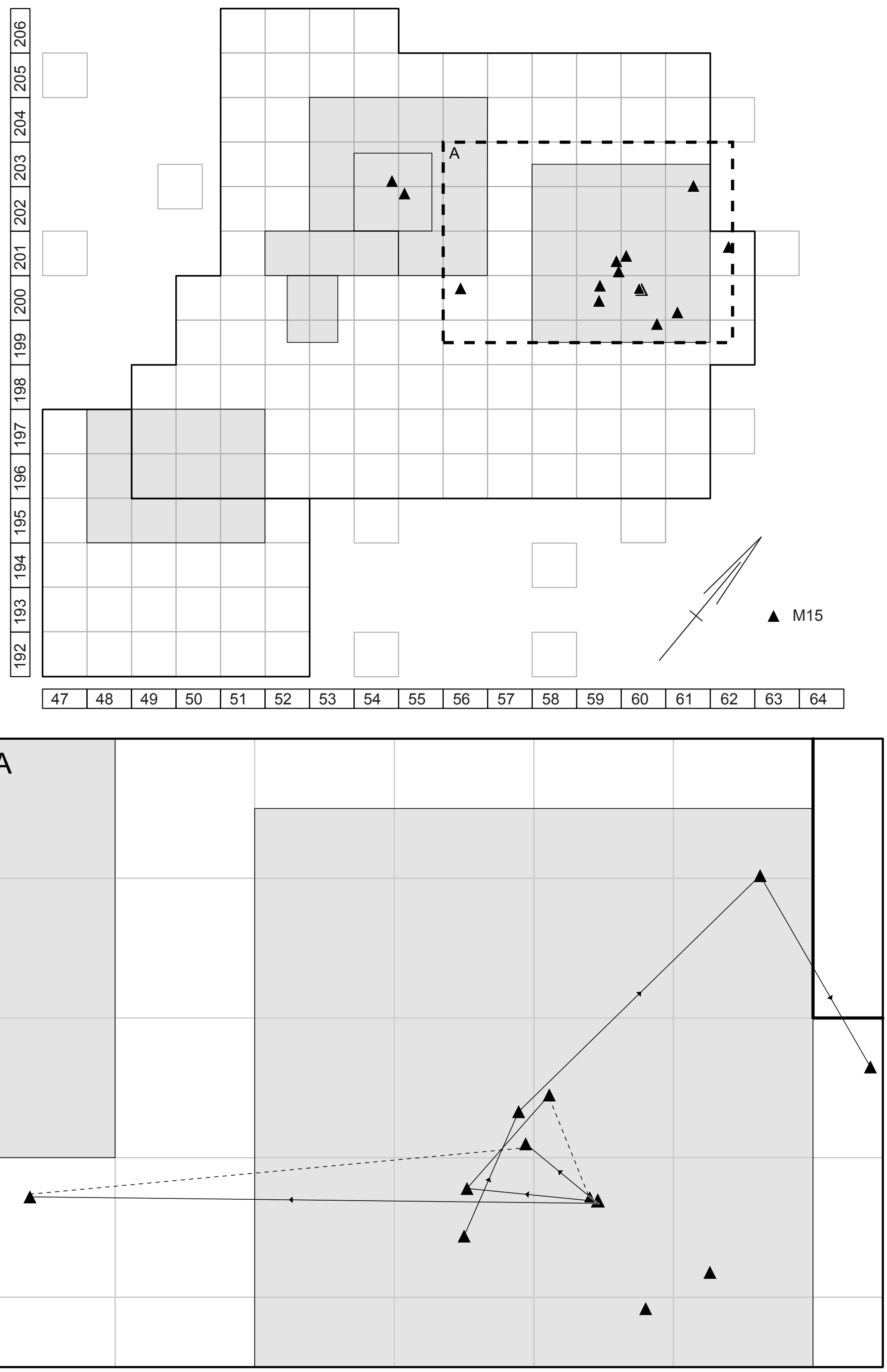


Figure 6.38 RMU M15, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

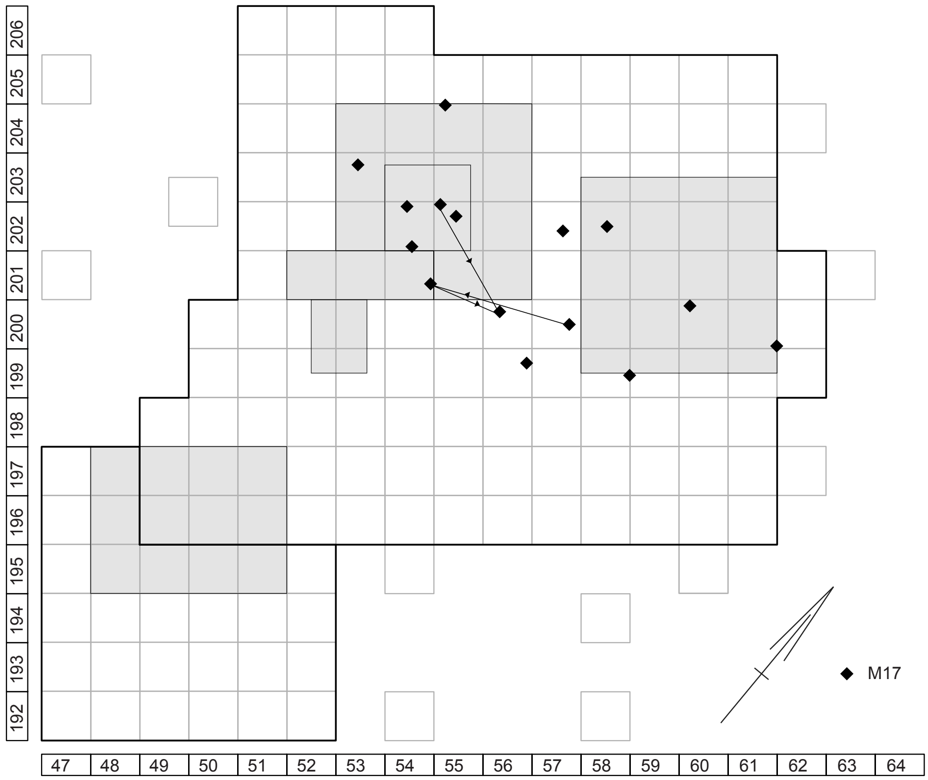


Figure 6.39 RMU M17, horizontal distribution of refitted and assigned artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal. Grid co-ordinates are at metre intervals.

fragment refits onto a complete borer which consists of two conjoined broken pieces. Both broken pieces are surface finds.

6.6.5 *Orsbach flint*

RMU O1 to O16 (fig. 6.43; table 6.22):
The distribution of refitted artefacts of Orsbach flint (RMUs O1 to O16, refit groups O1.00 to O16.00) makes the importance clear of cluster A and the periphery for the working of Orsbach flint. Of dorsally/ventrally refitted artefacts, several pieces were recovered from this part of the excavation. The number of refitted artefacts, however, is small: in most cases only one or two artefacts could be refitted onto cores. In square 53/199 in the southern part of cluster B, two artefacts of Orsbach flint were found that could be refitted onto artefacts collected in cluster A and/or its periphery. One of these artefacts refits onto a core consisting of five frost-cracked fragments (RMU O3), of which four pieces were found in the area of cluster A. A small core fragment from cluster B forms part of RMU O4, of which a blade and a core rejuvenation flake were measured in three dimensions in cluster A. A distal fragment of a blade and the core onto which this fragment could be refitted, both originate from the periphery of cluster A (RMU O6). Figure 6.43 further shows the position of conjoined fragments of cores of Orsbach flint split along frost cracks, and by means of dotted lines, the relatively large distances between locations of conjoined fragments. The most prominent example of this are two core fragments belonging to RMU O10, of which one fragment was found in square 53/200 (cluster B) and one fragment in square 49/196 (cluster D). Both fragments were lying more than 5.5 metres from each other. Another example are two core fragments in square 57/199, a few metres east of cluster A. They could be refitted onto fragments recovered from cluster A and the peripheral zone. In view of the depth of these fragments, at more than 15 cm beneath the base of the plough zone, it is not likely that the relatively large distances between conjoined fragments were the result of ploughing, whereby cores ‘were pulled apart’ by the ploughshare.

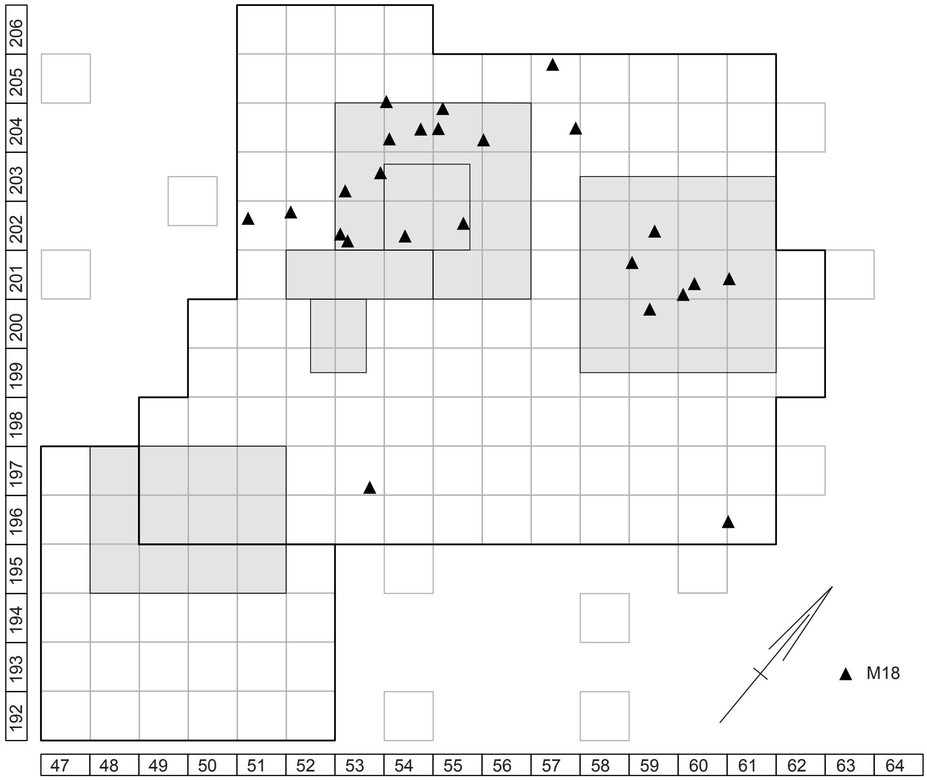


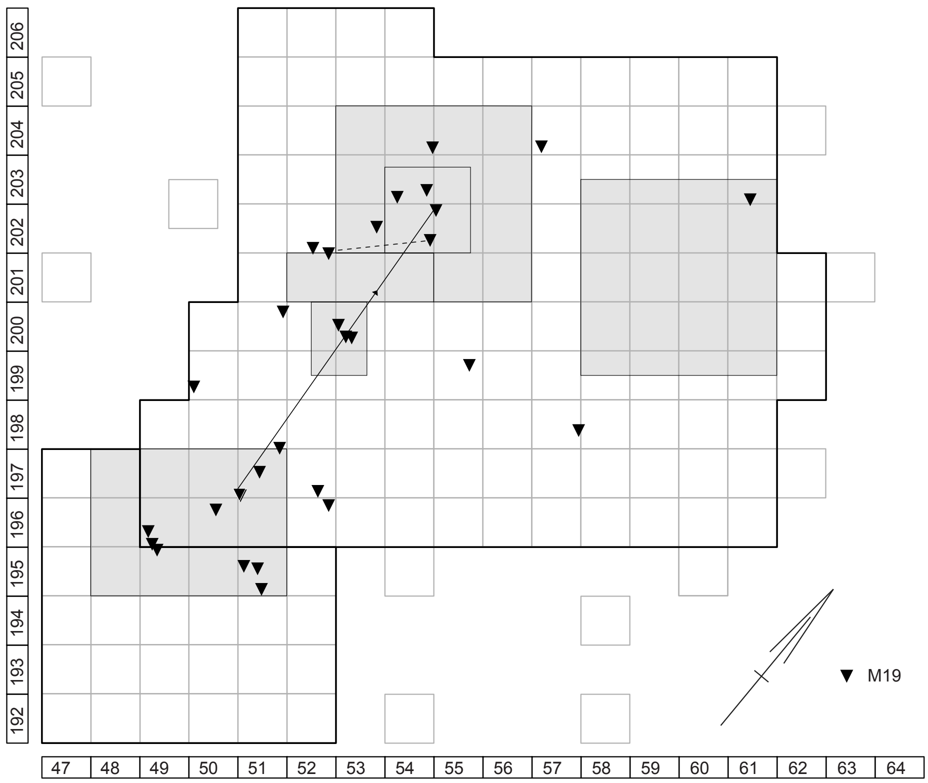
Figure 6.40 RMU M18, horizontal distribution of refitted and assigned artefacts plotted in three dimensions beneath the plough zone. Grid co-ordinates are at metre intervals.

The distribution of refitted artefacts of Orsbach flint in refit groups without a core (O601 – O643) fits in with that of the refit groups with a core (fig. 6.44). The distribution emphasises the importance of cluster A, but also of cluster B for the occurrence of refitted artefacts of Orsbach flint. Clusters C and D lie almost completely outside this distribution. Two conjoined fragments of a blade and the medial part of a crested blade were found in cluster D. The distal part of this crested blade came to light in cluster B. Close to the eastern margin of the excavation, a core rejuvenation flake was found that could be refitted onto a flake recovered from the western part.

6.6.6 Conclusions distribution RMUs
(fig. 6.45; tables 6.20 to 6.22)

In tables 6.20 to 6.22, data on the distribution of refitted artefacts of RMUs within the groups of Simpelveld flint, South-Limburg flint and Orsbach flint have been listed. Several RMUs (S1, S3, S308, S309, M1, M5, M7, M8 and M9) are represented by four or more three-dimensionally recorded artefacts in cluster A. Here 35 artefacts of Simpelveld flint and 39 artefacts of Meuse terrace flint (larger than 2 cm) were found that form part of the RMUs mentioned. If we add to these the number of refitted artefacts recovered from the periphery of cluster A it then becomes clear that the peak of the distribution of these RMUs lies in this part of the excavation. We are dealing with a find-rich location where several cores of different types of flint were prepared and where blades were produced. The importance of cluster A for the debitage of Meuse terrace flint is underlined by the occurrence of six refitted artefacts of RMU M3 in the periphery of cluster A. Of other RMUs in the group of South-Limburg flint (M2, M4, M11, M12, M15, M17 and M19), only one or two artefacts were encountered in cluster A and/or the peripheral zone.

Although the number of refitted artefacts is smaller, RMUs O1 to O4 also show a relationship with cluster A. Looking at the results of refitting, it is assumed that these RMUs have also undergone modification in cluster A and/or its immediate surroundings. Outside this area, small numbers of the RMUs mentioned have been found, among which two artefacts in cluster B.



Figiure 6.41 RMU M19, horizontal distribution of refitted and assigned artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

Small cluster B consists of 27 artefacts of RMU S5. Mostly these are flakes larger than 3 cm which form part of refit groups S5.01 to S5.04 (table 6.20). Of RMU S1, only a medial fragment of a crested blade and a flake are represented in cluster B, while knapping products of RMUs S2, S3, S308 and S309 are completely lacking in cluster B. This observation points to cluster B as location of debitage or deposition of artefacts of RMU S5. A relationship with cluster B has not been demonstrated for the other RMUs within the group of Simpelveld flint.

Apart from in cluster A, artefacts of Meuse terrace flint are well represented in cluster B. Four artefacts of both RMU M6 and RMU M7 were found in this cluster, as well as six artefacts of RMU M13. When we look at the spatial position of other artefacts, then RMU M6 has no relationship whatsoever with (the periphery of) cluster A, but does with cluster D. There four refitted artefacts (> 2 cm) of RMU M6 were found. RMU M7 does show a relationship with the area of cluster A though. Of this RMU, eight refitted artefacts were found in this cluster. Of other RMUs within the group of South-Limburg flint, the number of artefacts in cluster B amounts to only one or two. The picture emerges of cluster B consisting of (isolated) flakes and blades of RMUs of which the highest densities of finds occur in cluster A and the periphery (M3, M7, M9) and in cluster D (M6). Remarkable is the high amount of blades (n=16) and the presence of blades with edge damage (‘use retouch’) (n=3) of South-Limburg flint in cluster B. They point to blade production in cluster B and/or transport of selected end products to this area.

RMUs of which the peak of the distribution *does not* lie in (the periphery of) cluster A or cluster B are S2, M11 and M15. Of RMU S2, five refitted artefacts originate from cluster D and one artefact from the periphery of cluster A, namely a proximal fragment of a blade with a length of 9.1 cm. Products of RMUs M11 and M15 were recovered in particular from cluster C, but also cluster A yielded some artefacts of both RMUs.

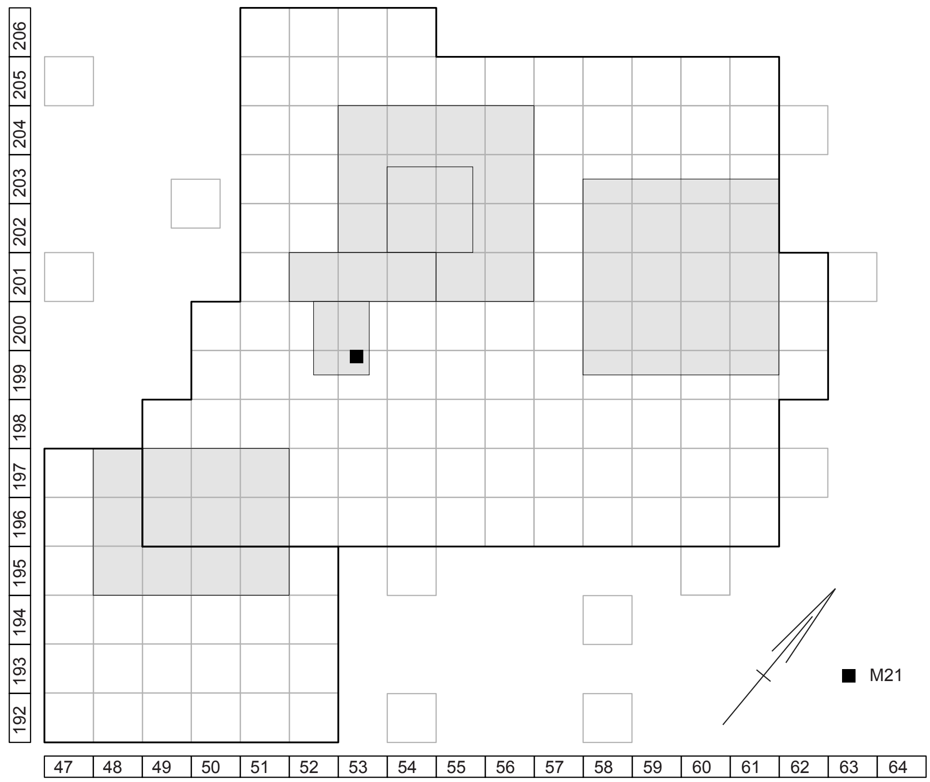


Figure 6.42 RMU M21, position of fragment of retouched blade plotted in three dimensions beneath the plough zone. Two refitted fragments of a borer were collected from the surface. Grid co-ordinates are at metre intervals.

The most important conclusions of the investigation into the spatial distribution of refitted and non-refitted artefacts belonging to RMUs can be summarised as follows (fig. 6.45):

1. Artefacts of Simpelveld flint, South-Limburg flint and Orsbach flint were found in all four clusters. With the exception of one flake, Valkenburg flint is lacking in the main concentration of the Eyserheide site, i.e. cluster A and its periphery;
2. The peak of the distribution of RMUs S1, S3, S308, S309, M1, M3, M5, M7, M8 and M9 lies in cluster A and/or its periphery. Other RMUs show a spatial association with cluster B (S5, M13), cluster C (M11, M15), and cluster D (M6, M10, S2);
3. Of RMUs of which the peak of the distribution lies in cluster A or cluster B, artefacts were also found in other parts of the excavation, both in other clusters and beyond;
4. Taking into consideration the data of refitting and the horizontal distribution of (refitted) artefacts belonging to one and the same RMU, there is no relationship between clusters B and C, and neither between clusters C and D.

6.7 Tools (fig. 6.46; table 6.23)

Among the finds of Eyserheide are 95 artefacts which have been described as retouched tools. Of this number, 52 specimens originate from the surface or from the plough zone. These artefacts form part of the ploughed-up part of the archaeological layer and can have been displaced over several metres as a result of repeated ploughing of the plot of land. For that reason they will not be considered in this paragraph.

The distribution of the retouched tools found underneath the plough zone shows similarities with those of the waste products of South-Limburg flint and Orsbach flint. Most tools were recovered from cluster A, from the periphery of cluster A, from zone A/B and from cluster B (fig. 6.46). In these parts, a total of 26 retouched tools came to light, i.e. 60% of the total number of three-dimensionally recorded tools (n=43). The number of retouched tools in cluster A and the peripheral zone is 19. The tools were made of South-Limburg flint (n=8) and Orsbach flint (n=8). Of Simpelveld flint only few blades and flakes with edge damage (‘use retouch’) were found in this area. Among the tools there are borers, dihedral burins, end scrapers, and a fragment of an steeply

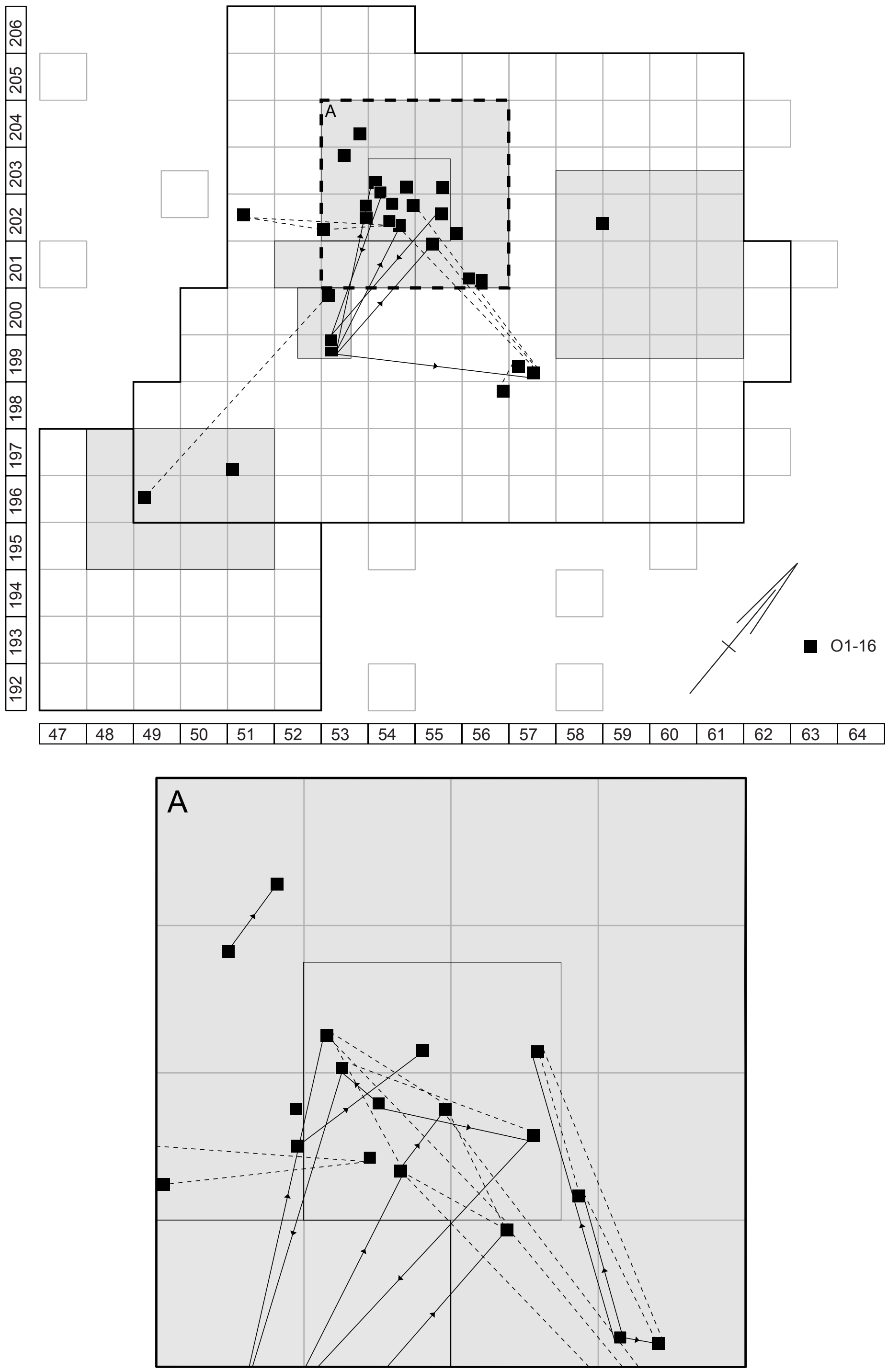


Figure 6.43 RMU O1 to RMU O16, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

			Three-dimensionally recorded and refitted artefacts in loess soil							
RMU	Surface	Plough zone	Cluster A	Periphery cluster A	Cluster A/B	Cluster B	Cluster C	Cluster D	Other sections	N
O1	.	5	1	3	.	.	.	.	.	9
O2	2	1	1	1	.	.	.	.	.	5
O3	.	1	3	1	.	1	.	.	1	7
O4	2	3	3	.	.	1	.	.	.	9
O5	1	2	.	.	.	.	.	.	2	5
O6	.	.	.	2	.	.	.	.	.	2
O7	2	2	.	.	.	.	.	.	.	4
O8	1	.	.	1	.	.	1	.	.	3
O9	1	2	.	.	.	.	.	.	.	3
O10	.	.	.	.	.	1	.	1	.	2
O12	.	.	1	1	.	.	.	.	1	3
O13	.	3	.	.	.	.	.	.	.	3
O14	1	2	.	.	.	.	.	.	.	3
O16	2	.	.	.	.	.	.	1	.	3
Totaal	12	21	9	9	0	3	1	2	4	61

Table 6.22 Spatial distribution of three-dimensionally recorded, refitted artefacts >2 cm of Orsbach flint (RMUs O1-O10, O12-O14, and O16). The first two columns indicate the numbers of artefacts collected from the surface and plough zone.

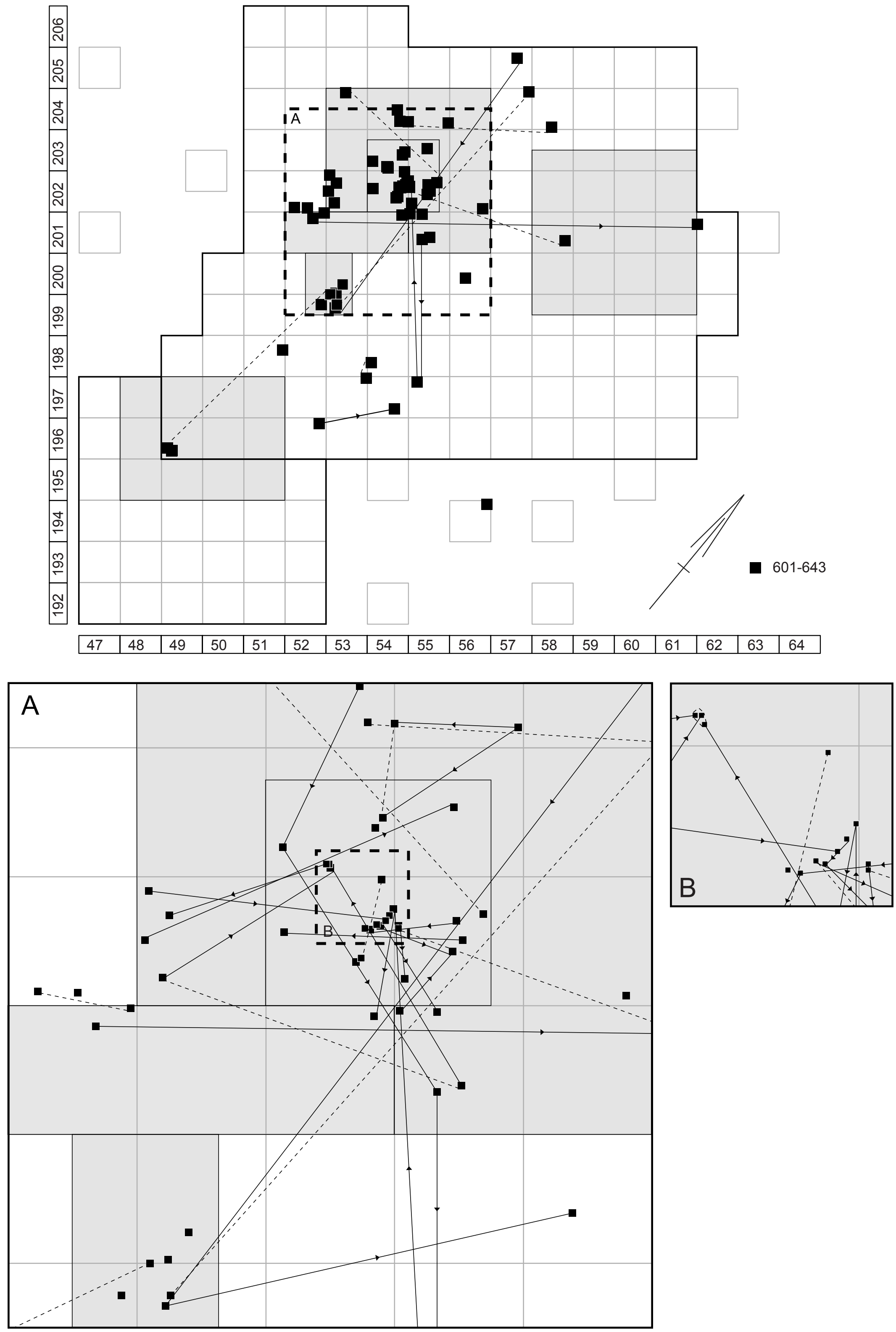


Figure 6.44 O601 – O643, horizontal distribution of refitted artefacts plotted in three dimensions beneath the plough zone. Solid line = ventral/dorsal, broken line = broken pieces. Grid co-ordinates are at metre intervals.

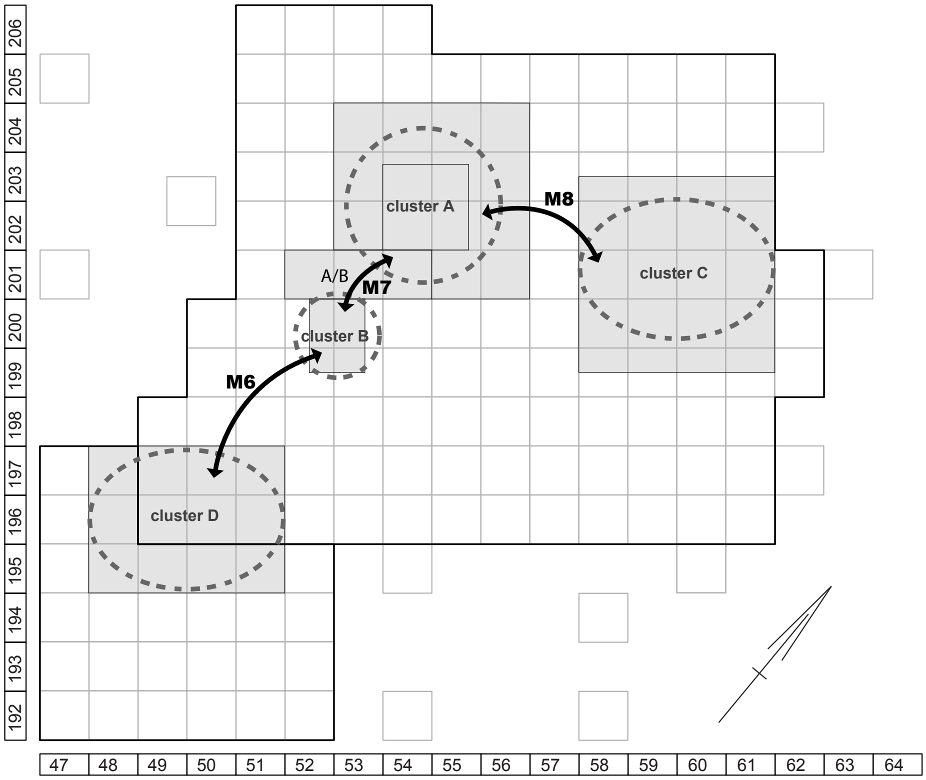


Figure 6.45 Relationships between clusters on the basis of refitted artefacts. Transport of artefacts and contemporaneous use of clusters is indicated by refitting of knapping products especially of RMU M8 (clusters A and C), RMU M7 (clusters A and B) and RMU M6 (clusters B and D).

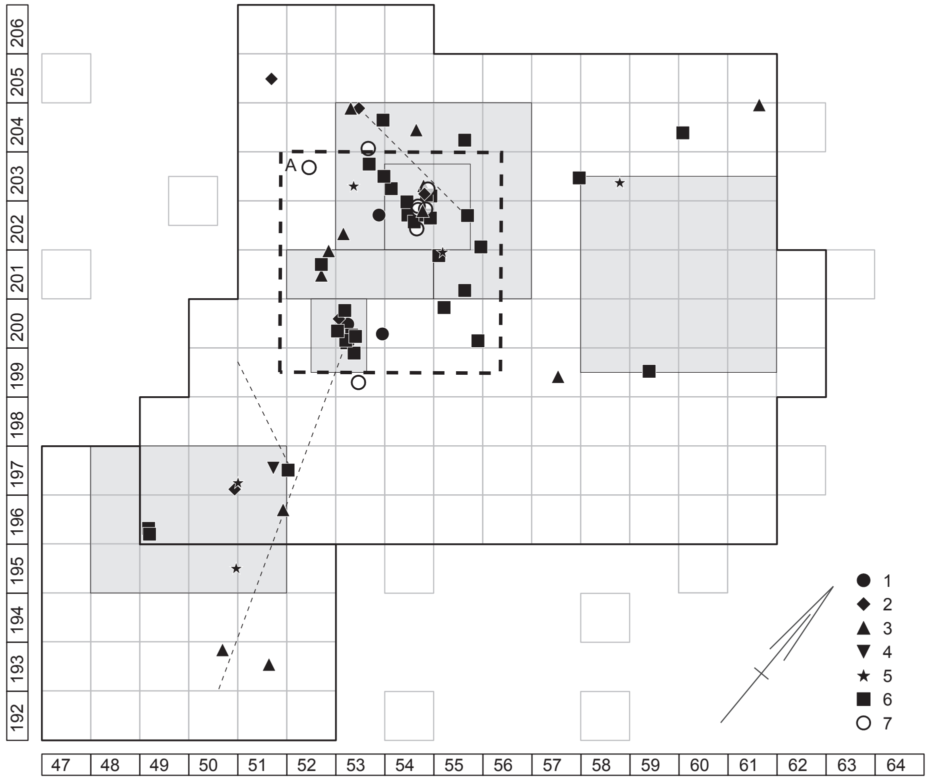
retouched artefact. Later in this chapter (6.8.4) we will go further into the position of these artefacts when discussing the ring and sector method of D. Stapert (1989). This method was applied to cluster A and surroundings in the central part of the excavation.

The number of retouched tools measured in three dimensions in cluster B is only four, including a borer fragment and a complete burin. The borer fragment is made of Simpelveld flint and the complete dihedral burin of Orsbach flint. One fragment of a retouched blade has been assigned to RMU M21. The other tool is also a fragment of a retouched blade manufactured of Orsbach flint.

Outside clusters A and B, significantly fewer artefacts were found (fig. 6.46 and table 6.23). This does not mean that also in other parts of the excavated area tools could have been used and discarded, for instance in cluster D. Here, compared to the number of waste products of flint working, relatively many retouched tools have been found, among which two end scrapers of Meuse terrace flint (M6 and M13), an end of a Lacan-burin of Orsbach flint, and a fragment of a bec of Valkenburg flint. Furthermore, cluster D yielded a retouched blade of South-Limburg flint. A few metres south of cluster D two burins came to light, at a distance of over eight metres from cluster A. These are a small, broken dihedral burin of Meuse terrace flint (M10) and a burin on a break of Simpelveld flint.

And finally, we should draw attention to an area with some dispersed retouched tools in the eastern part of the excavation, immediately north and south of cluster C. Among these are a broken dihedral burin and a broken-off working edge of a dihedral burin of Orsbach flint. Of the same flint, and just inside the area of cluster C, a fragment of a blade end scraper was found. Cluster C yielded further one truncated blade, and compared to cluster A, the number of retouched artefacts is significantly lower.

An important observation is that in cluster A and in its periphery only some blades displaying edge damage ('use retouch') of Simpelveld flint were found, but no retouched tools of this flint. As highlighted in paragraph 6.2.2., in this



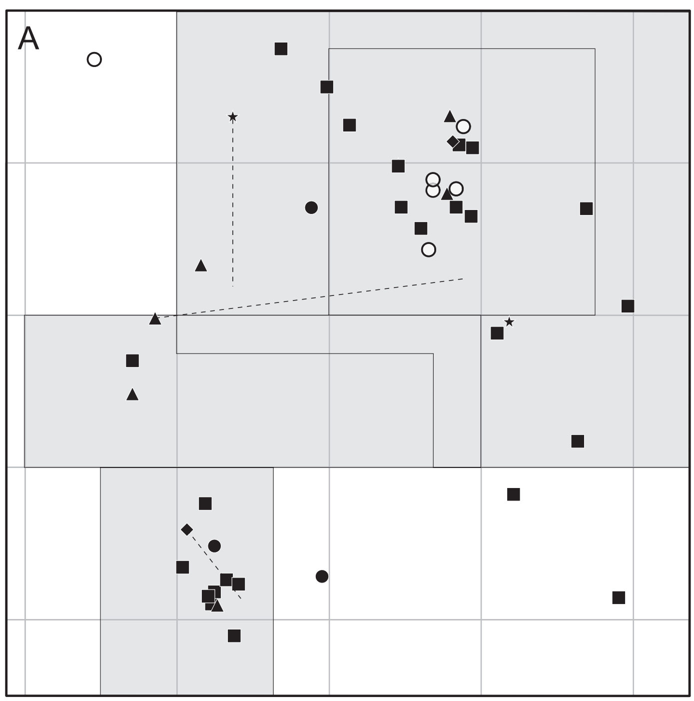


Figure 6.46 Horizontal distribution of three-dimensionally recorded tools. Broken line = conjoined broken pieces of tools. 1 backed bladelet, 2 borer/bec, 3 burin, 4 composite tool, 5 end scraper, 6 retouched blade, blade with edge damage ('use retouch'), 7 retouched flake, flake with edge damage ('use retouch').

			Tools recorded three-dimensionally in loess soil							
Tool type	Surface	Plough zone	Cluster A	Periphery cluster A	Zone A/B	Cluster B	Cluster C	Cluster D	Other sections	N
Backed bladelets	1	3	.	.	.	.	.	.	1	5
Steeply retouched blade	.	.	.	1	.	.	.	.	.	1
Borers on blade	1	1	1			1				4
Booruiteinde	.	.	.	1	.	.	.	.	1	2
Becs on blade	.	.	.	.	.	.	.	1	.	1
Burins on a break	.	1	.	.	1	.	.	.	1	3
Dihedral burins	5	7	2	3	.	1	.	.	3	21
Burins on truncation	.	2	.	.	.	.	.	.	.	2
Bec-steker	.	.	.	.	1	.	.	.	.	1
Broken burins	1	1	.	.	.	.	.	.	.	2
Lacan burins	1	.	.	.	.	.	.	1	.	2
Combination tools	.	.	.	.	.	.	.	1	.	1
End scraper on blade	4	1	1	1	.	.	1	2	.	10
Broken end scraper	.	1	.	1	.	.	.	.	.	2
Scraper on flake	1	.	.	.	.	.	.	.	.	1
Retouched blade	8	3	2	.	.	2	.	1	2	18
Notched blade	.	.	.	.	1	.	.	.	.	1
Truncated blade	4	2	.	2	.	.	1	.	.	9
Piece esquilee	.	1	.	.	.	.	.	.	.	1
Retouched flake	1	2	2	.	.	.	.	.	1	6
Notched flake	.	.	1	1	.	.	.	.	.	2
Total	27	25	9	10	3	4	2	6	9	95
Blades with edge-damage	5	4	8	4	.	6	.	1	4	32
Flakes with edge-damage	.	1	.	1	.	.	.	.	2	4
Total	32	30	17	15	3	10	2	7	15	131

Table 6.23 Spatial distribution of three-dimensionally recorded retouched tools (per type) and flakes/blades displaying edge damage ('use retouch'). The first two columns indicate the numbers of tools collected from the surface and plough zone. Counts before refitting of broken pieces.

area both debitage waste and many (fragments of) long and regular blades of Simpelveld flint were found. It underlines the notion that blades of Simpelveld flint may have been produced on the spot for use in other camp sites in the Meuse-Rhine loess area.

6.8 Clusters A and B: interpretation

6.8.1 Introduction

With a view to intra-site spatial analysis and, also based on the results thereof, to a functional interpretation of the site of Eyserheide, (the periphery of) cluster A and nearby cluster B take up an important position. This part of the excavation with a surface of c. 20 m^2 is characterised by a high density of retouched tools, flint debitage, and fragments of unworked, partially heated natural stone (see 6.8.2). With regard to the slightly circular cluster A, the question seems justified whether the archaeological material found there represents the residue of activities around a central hearth, and if so whether these activities took place inside or outside a tent or hut structure. To what extent does the horizontal distribution of the finds indicate the presence of one or more habitation structures? And which activity areas, whether or not connected to a hearth, could possibly be recognised in this distribution?

Before we will address these questions, we shall examine in the next paragraph whether we are possibly dealing with a central hearth in cluster A (6.8.2). Subsequently, the distribution of flint artefacts in the area of clusters A and B will be confronted with the hearth seating model of L. Binford (6.8.3) and with the ring and sector method of D. Stapert (6.8.4). Data that can be inferred from this model and this method will in their turn be evaluated based on data on cultural and natural (post-depositional) formation processes in this part of the excavation (6.8.5). At the end of this chapter (6.9) a general conclusion regarding the use and organisation of the camp site of Eyserheide is presented.

6.8.2 A central hearth or not?

A frequently occurring phenomenon in well-preserved Magdalenian open-air sites in Northwest Europe are hearths constructed with stones (see for instance Olive 1989, Plumettaz 2007). Also based on ethnographical research, they are generally regarded as focal points of domestic activities, such as the preparation of food, working of stone, and manufacturing and repairing of hunting gear. The fire places not only provided heat, but also light and were thus a central component from the perspective of communication between group members and social activities of the group (also) in the evenings. Starting from this role as focal point, much importance should be attached to the occurrence of hearths in prehistoric hunter-gatherer sites. They form a suitable point of departure for spatial analysis and the application of methods aimed at determining the way in which camp sites were used and organised. As Leesch et al. (2010, 53) observe:

> "Detailed studies of well-preserved sites have demonstrated that most of the domestic and technological activities performed in Magdalenian camp sites took place in the immediate vicinity of hearths. Consequently, as many authors have already underlined, fireplaces present the major site-structuring features crucial for the understanding of Upper Palaeolithic human behavior."

The presence of a hearth manifests itself in different ways in the archaeological record of the Magdalenian. Clearly visible are hearths constructed with stones, of which the hearth stones bear traces of heating and the spatial lay-out is still intact, as part of well-preserved living floors in open-air sites such as Verberie, Etiolles and Champréveyres. But also locations with heat-altered sediment and concentrations of charcoal, burnt bone and ash can indicate a fire place during the occupation of a camp site. In cases where direct evidence is lacking, the distribution of burnt stone artefacts and of backed bladelets can be an indirect means for determining and locating hearths. In the Swiss open-air sites of Champréveyres and Monruz, backed bladelets have been found in close spatial association with remnants of hearths. These tools are generally regarded as part of hunting gear, as "small lithic elements that probably formed the lateral inserts of the antler projectile points" (Leesch et al. 2010, 65). The position of backed bladelets in the immediate vicinity of hearths is the result of performing activities connected with the manufacture and maintenance of hunting gear. For this fire was required "to soften the adhesive in order to remove the used pieces and to haft new ones onto the points".

In Eyserheide, an intact hearth constructed with stones has not been found in cluster A, nor in any other part of the excavation. Moreover, possible other traces (charcoal, burnt bone and/or ash) of a hearth probably were destroyed completely as a result of (Holocene) soil formation, already a long time before the disturbance of the archaeological layer by modern human land use. Looking at the position of unworked stone, we observe that fragments of these were found in particular in the centre of cluster A, in the eastern part of square 54/202 and the western part of square 55/202 (fig. 6.47). The majority of these has been described as a very fine siltstone (code 15), including two fragments bearing traces of hematite which must have been formed after heating of the stones (see 6.2.6). No red-coloured surfaces, cracks or other traces were observed on other fragments of siltstone that could point to contact with fire. In contrast, fragments of other types of stone, recorded three-dimensionally in the same area, do display traces of

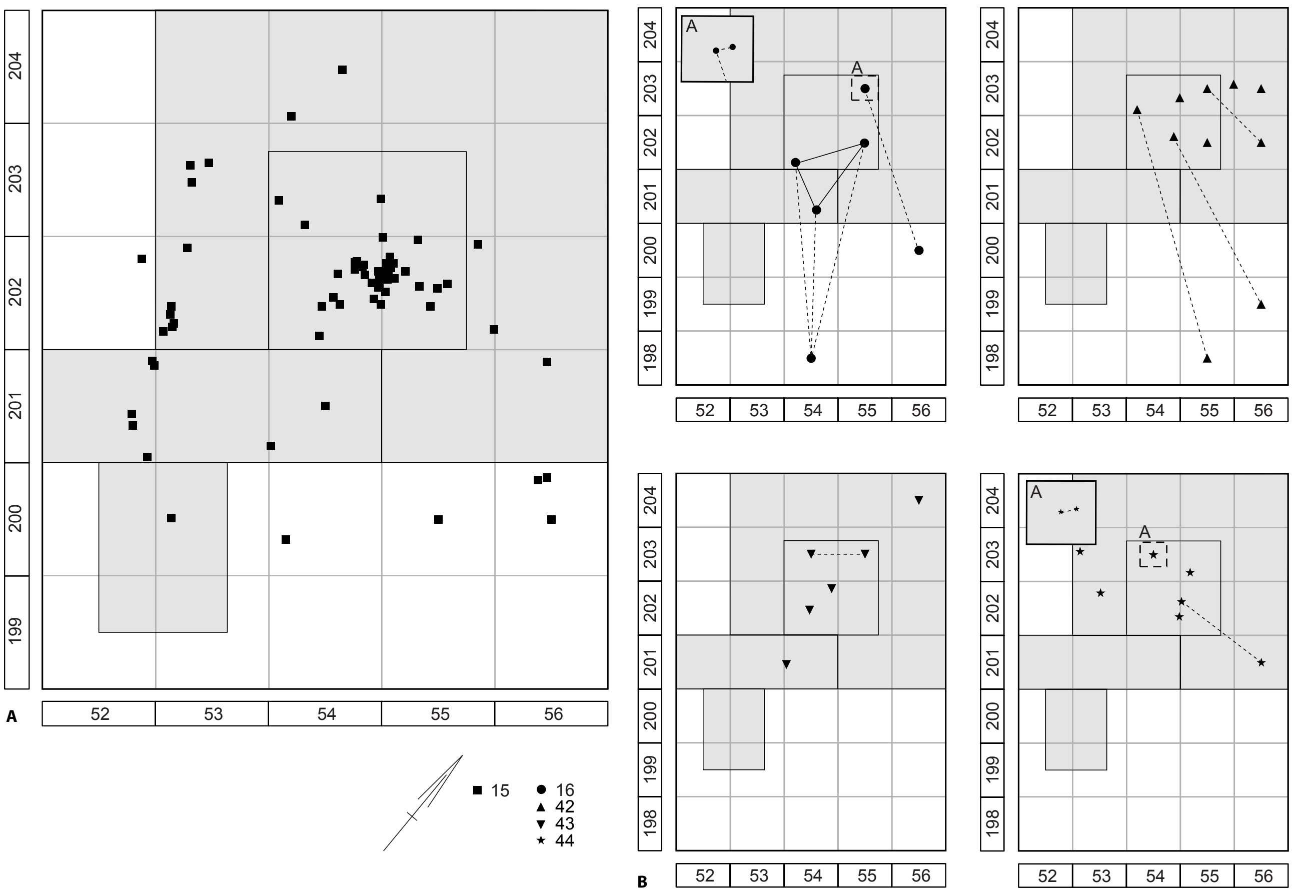


Figure 6.47 a: Clusters A and B and surroundings. Distribution of fragments of fine siltstone (code 15) plotted in three dimensions beneath the plough zone; b: Clusters A and B and surroundings. Distribution of fragments of quartzitic sandstone from the Devonian (code 16), fine-grained sandstone from Meuse gravel (code 42), quartzitic sandstone (code 43) and coarse-grained quartzite (code 44). Solid lines represent refits between fragments plotted beneath the plough zone. In cases of a broken line, refits include stone fragments collected from the plough zone.

heating (figs. 4.37 and 4.38). They were lying close together in an area of 2 × 1.5 m, with two fragments on the boundary of squares 54/202 and 55/202. Some of these could be refitted onto larger fragments, also bearing traces of heating and originating from the plough zone. During trowelling of the plough zone, refitted conjoined fragments were found in particular east and southeast of cluster A, dispersed over an area of c. 6 × 3 m. These stones were ploughed up from the archaeological layer and, after incorporation into the plough zone, could have been displaced over a few metres as a result of ploughing. These are both fragments of quartzitic sandstone from the Devonian (code 16), fine-grained sandstone from Meuse gravel (code 42), quartzitic sandstone (code 43), and coarse-grained quartzite (code 44). In view of the position of the three-dimensionally recorded pieces in cluster A, it is plausible that these fragments are connected with the occupation of Magdalenian hunters and gatherers of the camp site of Eyserheide. An interpretation of these stones as remnants of a small hearth structure is evident. The exact size and shape cannot be further specified as a result of the high degree of disturbance.

Other indications of a hearth in the site of Eyserheide are very rare. From the central part of the excavation with a surface area of 42 m^2, including clusters A and B, originate only 24 (fragments of) burnt artefacts. Their distribution is very random: there is no clear clustering in the centre of cluster A. Hence, they do not form an indication of the location of a hearth. The rare occurrence of burnt artefacts is a general feature of open-air sites from the Magdalenian. Leesch et al. (2010, 64) give the following explanation:

"The particularly low proportion of burned flints in Late Upper Paleolithic context is a characteristic feature of this period and is probably related to the mode of functioning hearths … The stone-covered structures functioning with brushwood would indeed largely prevent the flakes and chips produced in the immediate vicinity of the hearth to drop among the embers."

Another method which may enable us to locate hearths, namely based on the position of backed bladelets, cannot be applied to the site of Eyserheide. Of this type of tool, only one implement has been found underneath the plough zone, in square 53/200 close to cluster B. Although we should bear in mind the possibility that backed bladelets were not observed during the trowelling of the sediment of the non-ploughed part of the loess soil, this is not the case for cluster A and the periphery. During the sieving of the sediment of squares in this area, no (fragments of) backed bladelets were found in the sieve residue.

Based on the above data, the following can be concluded. The position of conjoined fragments of heated stone in the find-rich area of cluster A (both measured in three dimensions and plough zone finds) makes us presume that we are dealing with the remnants of a hearth constructed with stones. In view of the position of the heated stone fragments and the clustering of numerous fragments of very fine siltstone (including two fragments which display traces of heating) in the same area, a position of the presumed hearth in the centre of cluster A, near co-ordinates 55.00 / 202.60, is considered likely. It should be emphasised here that this is a rough determination of the location. As a result of bioturbation and the disturbing actions of the plough, stones have become dispersed, as can be inferred from the distances between conjoined broken pieces (partially with fresh breaks!). For this reason the exact location of the (presumed) hearth cannot be determined with certainty. Also activities related to the use and possible maintenance of the hearth, such as the clearing-out of burnt and broken stones, can no longer be determined. If we view the presence of heat-altered stones in the area of cluster A, then we can assume a small structure with few furnishings (compare *foyers cuvettes* and *foyers plats* from Pincevent).

6.8.3 Binford's hearth seating model

Ethnographical and ethnoarchaeological investigations of camp sites of historically documented hunters and gatherers have been of great value for the analysis of spatial patterns in Late Upper and Late Palaeolithic sites (see for instance Gamble and Boismier 1991). In this respect, the work of L. Binford deserves a special mention. Binford describes the way in which Nunamiut Eskimo deal with waste in the Mask site, an observation stand with five hearths in North Alaska (Binford 1978, 1983). Point of departure is a small group of people who on one side of a central hearth and in a sitting position are performing activities in the open air. The material residue of these activities is expressed in fixed spatial patterns, namely drop zones, forward toss zones, backward toss zones, and dumps (fig. 6.1b). The drop zone corresponds with the area where the persons are seated and consists of small objects and waste which fall to the ground during the carrying-out of activities. As people are seated on one side of the hearth, the shape of the drop zone is semi-circular. Larger objects and larger waste are for practical reasons thrown backward (backward toss area) or forward (forward toss area) and end up in the toss zones. The backward toss zone is located behind the positions of the seated persons, while the forward toss zone extends to the other side of the hearth. The toss zone is not only distinguished from the drop zone by its position in relation to the hearth. There are also differences in the sizes of the objects and the waste that are found there: small objects and small waste in the drop zone versus larger, thrown-away objects and waste in the toss zone. Binford considers the handling of waste described here as typical of activities around a central hearth in the open air. In covered areas, where the hearth forms the centre of a tent or hut, a toss zone is lacking or this zone stands out less clearly. The reason for this is that food remains and stone debitage are not left lying about inside but that they are collected and carried away outside in a concentrated form. At some distance from the tent or hut, they are deposited in the form of dumps (Binford 1983).

With the aid of his hearth seating model, Binford subjected the tent model of Leroi-Gourhan (1966) for Pincevent Habitation no. 1 to a further investigation (see 6.1). For this unit, Binford concludes that only the southeastern hearth I was possibly lying inside a habitation structure. The other hearths II and III meet his criteria for outdoor hearths: there are drop zones and toss zones in the distribution of finds around both hearths. According to Binford, both hearths were not in use simultaneously. Change of wind direction was for the inhabitants reason to construct and utilise a new hearth. They thereby took up a different position in relation to the hearth in order to avoid the smoke (Binford 1983, 157).

Application of the hearth seating model to the spatial distribution of stone artefacts in cluster A and surroundings in the Eyserheide site yields the following picture. Figure 6.48a shows an overview of the distribution of all flint artefacts in units of 50 × 50 cm in and around cluster A. The units with the highest number of artefacts are immediately west and south and at maximally two metres from the supposed location of the hearth (= LH with co-ordinates 55.00/202.60). If we divide the artefacts into three size categories (< 2 cm, 2-5 cm, and > 5 cm) and we

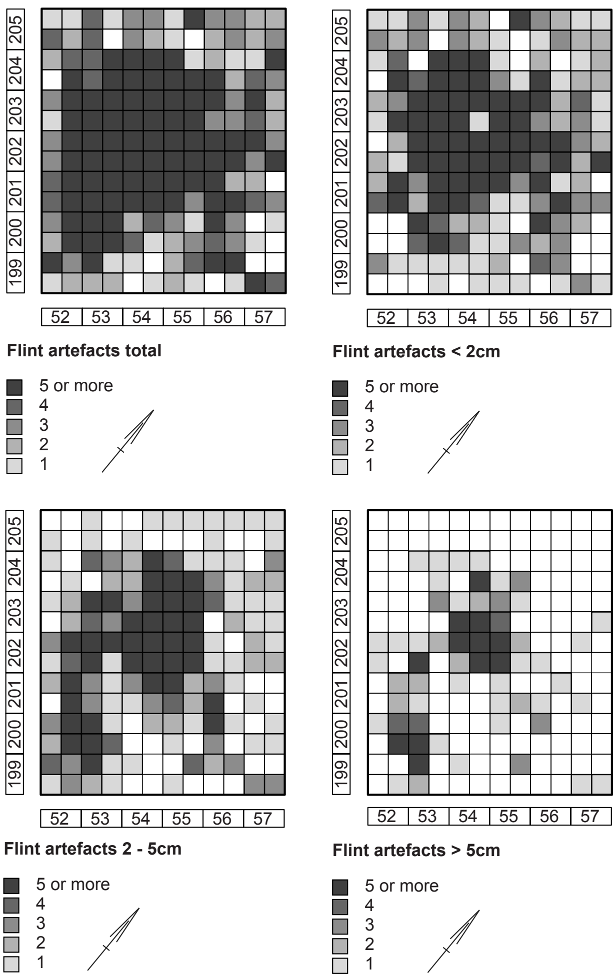


Figure 6.48 Clusters A and B and surroundings. Densities of flint artefacts in units of 50 x 50 cm (total of artefacts) and according to size (<2 cm, 2-5 cm, and >5 cm).

look at the spatial distribution of artefacts according to size category, then the following points are noticeable (fig. 6.48 b-d):

- the units with the highest numbers of artefacts are located in particular close to LH. This observation also applies to artefacts larger than 5 cm, of which we can presume that all pieces have been found beneath the ploug zone during the excavation. But also the distribution of artefacts between 2 and 5 cm corresponds with this picture, though units with relatively high numbers of artefacts also occur at larger distances from LH. Artefacts smaller than 2 cm have been found over a larger area and more dispersed, but also in this case are the units with high densities lying nearby and mainly (south)west of LH. From this observation can be concluded that we cannot speak of a clear difference in the spatial distribution of small, medium and large artefacts, as can be expected when assuming Binford's hearth seating model.
- east of LH, the number of units of 50 × 50 cm with large numbers of artefacts between 2 and 5 cm and larger than 5 cm is lower than west of LH. This observation argues against the presence of a forward toss zone. Nonetheless, it cannot be excluded that artefacts have ended up on the east side of LH as a result of throwing away of objects or larger pieces of stone waste.
- if we look at the distribution of the medium artefacts (between 2 and 5 cm) then two narrow zones with larger numbers of artefacts are visible south of LH. They are separated from each other by a relatively find-poor area. One of these zones borders directly onto LH, while the second zone lies about 3 m south of LH. Also in this second zone there is one unit in which relatively many (n=5) artefacts larger than 5 cm were found. Although these numbers are small, this spatial picture could be seen as an indication (though a weak one) of the presence of a backward toss zone.

6.8.4 *Stapert's ring and sector method* (fig. 6.49a-b; table 6.24)

The distinction described in the previous paragraph between drop zones and toss zones underlies the ring and sector method of D. Stapert (1989, 1990). The method consists of dividing the distributions of finds ('mobilia') around central hearths (domestic hearths) in Palaeolithic sites into rings and sectors. By counting the number of tools, cores and burin spalls per ring of 50 cm and per sector of 60 degrees, it can be determined whether and if so in which parts of a concentration, the mentioned categories of finds are present in small or large numbers. Stapert has applied the ring and sector method to several Late Upper and Late Palaeolithic sites, such as Oldeholtwolde (Hamburg culture), several habitation units in Niveau IV-2 of Pincevent, and in Gönnersdorf CI and CIII (Magdalenian). From this analysis, two types of distributions emerged. In the first distribution (unimodal), most tools occur near the hearth (often between 0.5 and 1.5 m), and the number of tools decreases as the distance to the hearth increases. Stapert considers this distribution as characteristic of activities around hearths in the open air (open-air hearths). In the second distribution (bimodal), there is a first peak between 0.5 and 1.5 m, and a second peak between 2 and 3 m from the hearth. Stapert gives as explanation for this second peak the throwing away backward of objects and the landing and accumulation of these objects against an obstacle, that is to say the

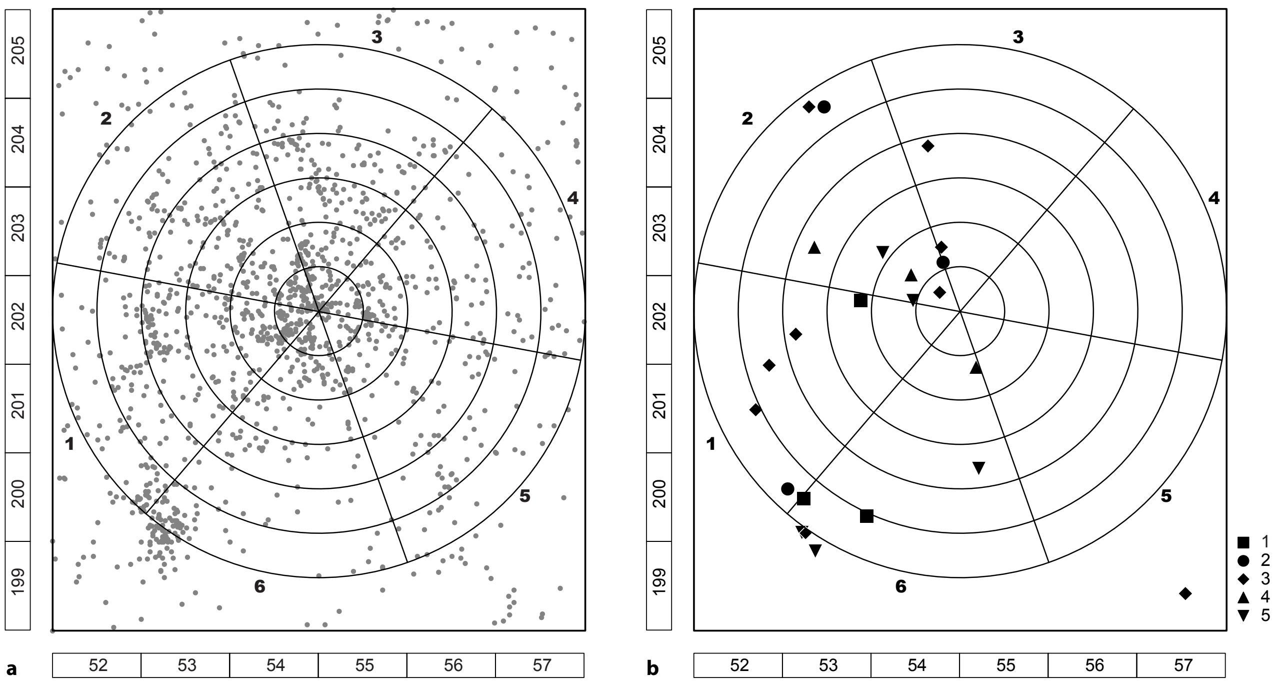


Figure 6.49 Clusters A and B and surroundings. Division of the central part of the excavation into rings and sectors (1-6) according to Stapert's ring and sector method, and distribution of all artefacts (a) and retouched tools (b) plotted in three-dimensions. 1 backed bladelet or blade, 2 borer/bec, 3 burin, 4 end scraper, 5 retouched blade.

wall of a tent or hut. This is called the barrier effect. Stapert regards a bimodal distribution as indication of activities carried out around a central hearth located in a tent or hut. Based on the results of the ring and sector method, Stapert assumes for Pincevent hearths in the open air. All analysed habitation units are characterised by unimodal ring distributions.

The fact that in Eyserheide all flint artefacts found underneath the plough zone were measured in three dimensions, makes it possible to apply the ring and sector method of intra-site spatial analysis to cluster A and surroundings. The area was thereto divided into six rings with a width of 0.5 m, and into six sectors. Two important assumptions were thereby made, namely 1) artefacts in cluster A reflect activities carried out in the immediate vicinity of a hearth, and 2) the hearth was located in the central part of cluster A, approximately level with co-ordinates 55.00 and 202.60.

Earlier in this paragraph (6.8.2), we discussed the issue and problems related to the determination of the presence and the exact location of a hearth in cluster A. When reading the text below and in the evaluation of the results of the ring and sector method, this issue should be borne in mind.

The supposed location of the hearth (LH) acts as centre of the division of cluster A and surroundings into rings and sectors, based on the coordinates 55.00 and 202.60. Using six sectors Stapert regards as a sufficient number for sites with low densities of finds within 3 metres from the centre of the hearth. In order to be able to compare the results in a proper way with other sites analysed by Stapert, we have opted for not letting the sectors coincide with x or y co-ordinate lines which form part of the grid system used in Eyserheide. For the sake of analysis, cluster A was divided into two halves based on a dividing line, the orientation of which is exactly north-south. This line was used as point of departure for determining the boundaries of the six sectors by means of marking off angles of 60 degrees. Subsequently, numbers of the following categories of retouched tools were counted per ring and per sector: backed bladelets, burins, end scrapers, borers/becs, and retouched blades. Because of the small number of complete cores, it was not meaningful to include this category of finds in the analysis. In several sites, cores have been found in particular in the periphery at a larger distance from the hearth, which is probably related to the forward and backward throwing of these artefacts into the toss zones. Whether this pattern also applied to the site of

Distance to supposed location of hearth (in cm)						
Ring	Backed blade	Borer/bec	Burin	End scraper	Retouched blade	N
0-49	.	.	1	.	.	1
50-99	.	1	1	2	1	5
100-149	1	.	.	.	1	2
150-199	.	.	2	1	1	4
200-249	.	.	1	.	.	1
250-299	2	2	2	.	.	6
Total	3	3	7	3	3	19
Sector	Backed blade	Borer/bec	Burin	End scraper	Retouched blade	N
1	1	1	3	.	.	5
2	.	2	2	2	2	8
3	.	.	2	.	.	2
4	.	.	.	.	.	0
5	.	.	.	.	.	0
6	2	.	.	1	1	4
Total	3	3	7	3	3	19

Table 6.24 Results of counting the retouched tools according to Stapert's ring and sector method.

Eyserheide could unfortunately not be determined due to the small number of complete cores found beneath the ploughzone.

The results of the ring and sector method are summarised in figure 6.49 and table 6.24. From the table it is clear that the distribution of the retouched tools over the six rings of 0.5 m is very random. Tools have been measured in three dimensions both near to the central point of LH and at a greater distance from this point. Thus, (fragments of) burins were found in five out of six rings. Relatively many tools were found between 0.5 and 1 m (n=5); 1.5 and 2 m (n=4), and 2.5 and 3 m (n=6). The observed spatial distribution consisting of three 'peaks' cannot be called either unimodal or bimodal, as is common in Late Palaeolithic sites (Stapert 1989, 37). The distribution in Eyserheide is such that there is no question of a meaningful pattern.

The distribution of retouched tools over sectors clearly shows a different picture (fig. 6.49b). In sectors 4 and 5, east of LH, retouched tools are lacking completely (!). On the other side of LH, 15 out of 19 retouched implements were found in sectors 1, 2 and 3. These sectors form the western half of cluster A. Such a distribution with large numbers of tools in the western part of a concentration is a general feature of Magdalenian sites with a central, domestic hearth. Examples are several habitation units in Pincevent. Stapert (1989) supposes that this distribution is related to the wind direction at the time of occupation of the camp sites. Not to be inconvenienced by the smoke, the inhabitants were seated on one side of the hearth with the wind coming from the back. The pattern is regarded as an indication of the position of the hearths and the performing of activities in its immediate vicinity in the open air. In the case of a tent of hut structure, the wind direction would probably not have played an important role in the choice of seats around the hearth. In that case, the distribution of retouched tools would have had a different character. Another argument in favour of activities in the open air is the lack of accumulations of tools/artefacts at greater distance from the hearth. No indications are visible in the distribution of artefacts of the barrier effect, in the form of an enrichment of finds in the outer ring 6 of sectors 1, 2 and 3 (distance to centre of 'hearth' is 2.5 to 3 m) or possibly at a greater distance from there.

Because of the small number of tools, it is not meaningful to compare different types of retouched tools with each other with regard to their distance to the supposed location of the hearth. Thus, only one backed blade was recorded three-dimensionally in the analysed area of cluster A. The spatial pattern that has been established for habitation units in Pincevent, namely backed bladelets near the hearth, borers and burins at a slightly large distance, and scrapers even further from the hearth (Stapert 1989), can for this reason not be established in a meaningful way for Eyserheide.

6.8.5 Evaluation

In the preceding two paragraphs, we discussed the distribution of the archaeological finds (flint artefacts) in the central, find-rich part of the excavation at Eyserheide, confronting this distribution with the hearth seating model of Binford (6.8.3) and the ring and sector method of Stapert (6.8.4). In this analysis, we assumed an ideal situation of intra-site spatial analysis, i.e 1) cluster A represents the remains of one activity area or one habitation unit with a central hearth, and 2) the archaeological materials of this cluster were found in primary archaeological context. In this paragraph, we will examine both points in more detail using additional data on cultural and natural site formation processes for the central part of the excavated area (clusters A and B).

1) Stapert (1989) points to two factors that should be taken into account when using his ring and sector method and determining the number of rings and thus the maximum distance between the centre of the domestic hearth and the outer ring. Within the area to be analysed, there should not be two or more overlapping habitation units. And the area to be analysed is characterised also by the absence of dumps. In the case of Eyserheide, a distance of three metres was chosen between the centre of the supposed location of the hearth and the outer ring. By using this distance, the northern part of cluster B falls within ring 6 of the analysed area. The cluster is located c. three metres south of the centre of cluster A. Not only its small size, but also the composition of artefacts is noticeable in this cluster. The cluster consists of 35, mostly refitted flakes belonging to RMU S5. They are to a large extent responsible for the designation and defining of the location as cluster B. But even if we leave these artefacts aside, this is a small but important area. In contrast to cluster A, artefacts of Valkenburg flint have been found here. In addition, 16 flakes and 16 (fragments of) blades of Meuse terrace flint occur. They partly originate from RMUs of which knapping products have also been found in cluster A (M3, M7, M9) and cluster D (M6, M10).
The chance that cluster B represents a second habitation unit at a short distance from cluster A, is considered small. The very small size of the cluster (1.8 × 0.7 m) and the relatively small quantity of flint artefacts are indications of this. The possibility of cluster B reflecting a small dump cannot be excluded though. With a view to an interpretation of cluster B, it is important to note that almost no knapping products of RMU S5 were found outside cluster B, with the exception of a few pieces in the southern part of the excavation (fig. 6.20). In cluster B itself, no flake or chip smaller than 2 cm of RMU S5 was found, which would have been expected had this RMU (also) been worked at this location. For this reason cluster B is not seen as the location of debitage of RMU S5. An interpretation as dump of preparation flakes of this RMU which represent an early stage of core reduction, completed with a few (used?) blades and flakes of other RMUs, is more likely. Besides, it should be borne in mind that artefacts could have ended up in cluster B as a result of post-depositional processes.

Taking into consideration the position of the northern part of cluster B within the analysed area, we should bear in mind that the retouched tools in ring 6 and in sectors 1 and 6 (see fig. 6.49b) possibly do not relate to activities carried out in cluster A around a central hearth (hearth-related activities). But even if we exclude these implements from the analysis, the general picture of retouched tools clustering in the western part of cluster A (sectors 1, 2 and 3) remains intact.

2) To gain further insight into natural site formation processes and the extent to which parts of the analysed area of clusters A and B have been disturbed, an overview was made of the depth of three-dimensionally measured artefacts in the non-ploughed part of the loess soil. Per square of 1 × 1 m, the number of artefacts was counted recovered from the base of the plough zone to a depth of maximally 30 cm (layers 1 to 6), and the number of artefacts that occurred at a deeper level (layers 7, 8 etc.) If almost all or all artefacts were recovered from the upper 30 cm, it is considered an indication of a relatively small extent of disturbance of the archaeological layer as a result of bioturbation and specifically of tree falls. For squares with high numbers of artefacts at a deeper level (more than 30 cm) beneath the plough zone, a larger extent of disturbance of the archaeological layer is assumed. In these squares more artefacts were found at a deeper level than could be expected exclusively based on homogenisation (bioturbation).

The result of this counting of artefacts is represented in figure 6.50. From this figure can be inferred that within the area of 30 m^2, large differences exist at short distance in the vertical distribution of artefacts and thus in the degree of disturbance of the archaeological layer. There is a relatively high degree of disturbance in the western part (squares 53/201, 52/202, 53/202 and 53/203). The majority of these squares corresponds with the area of the tree fall which shows up as a discoloration in the loess soil immediately west of cluster A. In nine out of twelve squares in the central part of the analysed area (squares with x co-ordinates 54 and 55), the vertical distribution of the artefacts is limited largely or completely (80 to 100%) to the upper 30 cm of the non-ploughed area of the archaeological layer. This part corresponds with cluster A and some adjacent squares that form part of the periphery of cluster A. Compared to the adjacent squares, only square 55/201 shows a large vertical

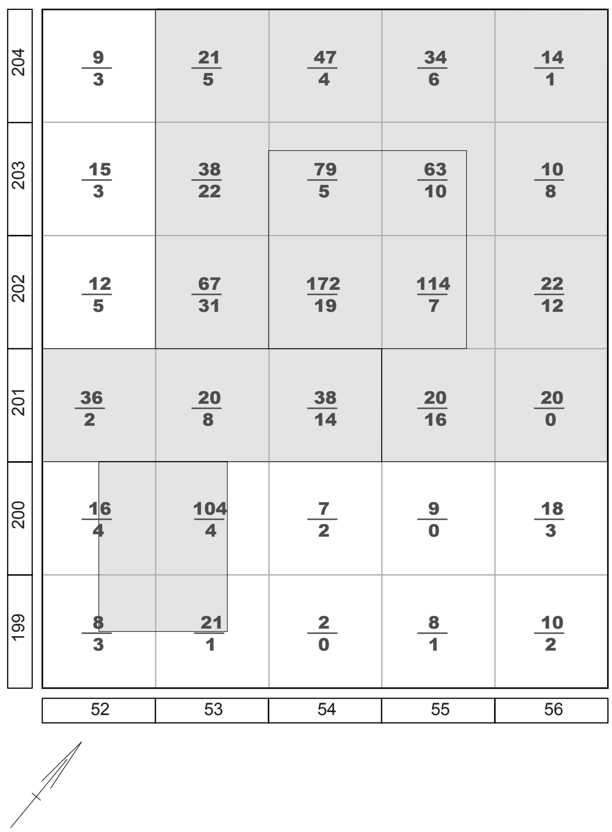


Figure 6.50 Clusters A and B and surroundings. Ratio of the number of artefacts plotted in three dimensions in the upper 30 cm (above dash) and at a deeper level (below dash) of the non-ploughed part of the loess soil, per square of 1 x 1 m.

distribution: in this square 45% of the artefacts were found at a depth of more than 30 cm beneath the base of the plough zone. And finally, the eastern part (squares with x co-ordinate 56) shows a relatively uniform picture regarding the vertical distribution of artefacts. In four out of six squares, more than 80% of the artefacts originate from the upper 30 cm of the non-ploughed part of the archaeological layer.

Data on horizontal displacements of artefacts in cluster A and surroundings were obtained through refitting and the distances between refitted artefacts of RMUs in this part of the excavation (S1, S3, S5, S308, S309, M1, M3, M5, M7, M8 and M9; see table 6.25). The overview shows that distances between refitted artefacts within RMUs are very variable and, with the exception of RMU S5, in many cases (n=44) they amount to two or more metres. This underlines the idea that artefacts can have been moved over considerable distances also in a horizontal direction as a result of post-depositional processes. We should also mention the relatively

	RMUs											
Distances (in cm)	S1	S3	S5	S308	S309	M1	M3	M5	M7	M8	M9	N
0-49	7	1	17	1	3	.	1	2	1	.	4	37
50-99	3	.	3	.	.	2	1	1	2	1	5	18
100-149	5	1	1	.	2	.	2	.	1	2	2	16
150-199	1	.	1	.	.	.	4	2	1	1	3	13
200-249	4	1	.	2	1	1	.	.	.	.	.	9
250-299	2	.	.	.	.	.	2	1	2	.	.	7
300-349	.	1	1	.	.	.	.	.	1	.	1	4
350-399	1	.	1	.	.	1	1	.	1	.	2	7
400-449	.	.	.	.	.	1	1	1	.	.	.	3
450-499	1	1	.	.	.	.	1	.	.	.	.	3
500-549	1	.	3	.	.	.	.	.	.	.	.	4
550-599	.	1	.	.	.	.	1	.	1	.	.	3
600-	1	1	.	.	.	.	.	.	.	2	.	4
Total	26	7	27	3	6	5	14	7	10	6	17	128

Table 6.25 Horizontal distances between find locations of three-dimensionally recorded and refitted artefacts using distance classes of 50 cm. The refitted artefacts belong to RMUs of Simpelveld flint and Meuse terrace flint which were worked in cluster A and surroundings.

large number of refitted fragments of artefacts with non-patinated breaks. Several specimens of these were found in the analysed area of cluster A, *underneath* the base of the plough zone and thus apparently outside the reach of the ploughshare. This observation indicates that fragmentation of artefacts after the period of the Late Glacial and presumably in ‘recent’ times was not restricted to the ploughed top soil. Possibly, the ploughshare disturbed the archaeological layer locally deeper than was thought likely in the first instance, based on the thickness of the plough zone.

Finally, we should in any case take into account that only a part of the tools connected with the activities in cluster A were actually found in this area underneath the plough zone. For an unknown number of tools that originally formed part of cluster A, it is very likely that they were collected from the plough zone or from the surface. Of course, these artefacts cannot be included in the analysis. Assuming a fixed direction and fixed pattern in the many years of ploughing of the plot in Eyserheide, it can moreover not be excluded that more artefacts (including tools) were ploughed up from specific areas (furrows) than from other areas. No concrete indications of this were found though during the field work. And we should bear in mind a (small) distortion of the results of the analysis because of the occurrence of tools in cluster B. The northern part of this cluster falls just inside the area analysed by rings (ring 6) and sectors (sector 6).

6.9 Discussion

In 1980 D. Cahen, C. Karlin, H. Keeley and F. Van Noten published an interesting article on the subjects of spatial patterns, technology of stone working and function of tools in two open-air sites from the end of the last ice age: Pincevent in France and Meer in Belgium. In the article, two at that moment relatively new methods of lithic analysis were discussed together, namely refitting and use-wear analysis. About 30 years later, this article is, in this author’s opinion, still a substantial source of information and inspiration for archaeologists who are involved in spatial patterns in Late Upper Palaeolithic sites. The article provides a good picture of the possibilities which both methods offer for ‘unravelling’ and interpreting prehistoric hunter and gatherer sites in which lithic concentrations are present. Also important is the observation of the authors that refitting and use-wear analysis can provide new insights into spatial aspects of sites that have been preserved less well (provided they were excavated in a proper manner):

“Les méthodes que nous allons décrire requièrent certaines conditions de gisement, de fouilles et de conservation du matériel. S’il est vrai qu’elles produiront tous leurs effets lors de l’étude de sols d’habitats non perturbés, elles s’avèrent aussi très efficaces pour l’analyse de sites moins bien conservés auxquels elles confèrent de nouvelles dimensions. Ce serait donc une erreur de les réserver à quelques stations dites exceptionnelles.” (Cahen et al. 1980, 210).

The results of the investigation of Eyserheide are a confirmation of the view of the authors as set out in the above quotation. Also in this research did the results of refitting prove to be invaluable for gaining insight into the post-depositional history of the camp site, locations of working of individual flint nodules and possible contemporaneous use of locations (see below). The processing of the Eyserheide site offered furthermore the opportunity to use the results of two other studies that became available just before and several years after the publication of Cahen et al. in 1980, namely the hearth seating model of L. Binford (1978) and the ring and sector method of D. Stapert (1989).

In paragraphs 6.8.3 and 6.8.4, the distribution of flint artefacts in clusters A and B of the site of Eyserheide was discussed in the light of the hearth seating model and the ring and sector method. Two important assumptions were thereby used, namely 1) a hearth constructed with stones was present in or near the centre of cluster A, on a level with co-ordinate 55.00 / 202.60, and 2) locations where artefacts were plotted in three dimensions underneath the plough zone correspond with the locations where the occupants of the camp site deposited these artefacts, dropped them on the ground or tossed them to. From the discussion on the post-depositional processes (see 6.4 and 6.8.5), we know that this situation, i.e. a position of the find material in *primary archaeological context*, does not apply to the site of Eyserheide. After the Magdalenian hunters and gatherers abandoned the camp site, various processes influenced the archaeological layer and the position of the finds themselves. We can mention in chronological order from the end of the Pleniglacial to modern times:

- wind and water surface erosion, whereby small artefacts in particular will have been displaced, partly to (far) beyond the excavated area (end of the Pleniglacial);
- sedimentation of loess, with the result that remains of the camp site became embedded in a preserving layer of fine-grained sediments (end of the Pleniglacial);
- the lifting up through frost of large artefacts and large-sized fragments of unworked stone (end of the Pleniglacial);
- the splitting of artefacts and large-sized fragments of unworked stone by repeated alternation of frost and thawing (end of the Pleniglacial);
- the sinking of (mainly) small artefacts into frost cracks and/or drought fissures (end of the Pleniglacial, Late Glacial, Holocene);

– eluviation of chalk and soil formation as a result of chemical weathering, complete decomposition and eluviation of organic remains (Holocene);
– homogenisation of the upper part of the loess soil by biotic processes and displacement of stone artefacts in root channels and burrowing tunnels (Holocene);
– the toppling over of trees and accumulation of artefacts in the pits that were thus created (Holocene);
– land use, including ploughing of the plot of land, and incorporation of the upper part of the loess soil into the plough zone (historical and modern times).

In Eyserheide, about one third of the archaeological material was collected from the surface or the plough zone, an amount that is comparable with the site of Sweikhuizen-GP, where 36.5% of the material consists of surface or plough zone finds (Arts and Deeben 1987b, 130). The original position of these finds in the settlement area can no longer or, in the case of finds from the plough zone, can only be determined in outline. By ploughing the surface, traces of post-depositional processes that had earlier taken place in the upper part of the loess soil can no longer be recognised as such. Underneath the plough zone are locally natural disturbances (= remains of tree fall pits) in which artefacts have become incorporated that were displaced horizontally or vertically. As a result of the working of trees, plants (bioturbation) and animals, the vertical distribution of the archaeological material underneath the plough zone amounted in many squares to 30 cm or more. In cluster A, artefacts were even collected up to a depth of one metre below the present surface. In addition, the western limit of this cluster could not be determined properly because of the presence of a large, tree fall pit. If we take these data into consideration, it is clear that in Eyserheide no well-preserved and stratigraphically well-defined living floor (in French: *sol d'habitation*) was exposed. Despite the embedding of the archaeological material in fine-grained loess, presumably already shortly after the occupation of the location at the end of the Pleniglacial, the archaeological layer was affected to a large extent. The vertical distribution of the flint artefacts but also the lack of a hearth or habitation structure *in situ*, hampers the determination of the exact stratigraphical position of the living floor at the time of occupation of the site in the Magdalenian. This applies for instance to cluster A, where in square 54/202 172 out of 191 artefacts were recovered from the upper 30 cm of the non-ploughed part of the loess soil (table 6.13). Together with fragments of unworked stone, these artefacts, including many pieces that could be refitted, were distributed regularly in this part of the loess soil. Thus, they are of little value in determining the exact position or depth of the Magdalenian living floor in the Holocene loess soil. The relatively large numbers of artefacts that were measured in three dimensions in cluster B at a depth of 15-30 cm beneath the plough zone (for instance 85 out of 108 artefacts in square 53/200) could indicate that in this part of the excavation a small part of the original living floor was actually preserved. A comparable, very limited vertical distribution of (mostly refitted) flint artefacts has not been documented in cluster A nor in other parts. Assuming the depth position of these artefacts in cluster B, the living floor at that time was at this location between 40 and 55 cm beneath the present-day surface.

In view of the above processes, the possibilities of intra-site spatial analysis are relatively limited in Eyserheide, certainly compared to well-preserved habitation units known from Magdalenian open-air sites abroad: Pincevent, Verberie, Marolles, Etiolles, Monruz, Champréveyres, etc. As in Eyserheide, the archaeological material of these sites became gradually embedded in fine-grained sediments shortly after the period(s) of occupation. We are not dealing here, as in Eyserheide, with aeolian deposits (loess) but with sediments of large rivers (Seine, Yonne, and Oise in the Paris Basin) and lacustrine deposits (Lac du Neuchâtel in Switzerland). In terms of potential of sites for spatial analysis, the differences in post-depositional history between Eyserheide and the mentioned sites are however of more importance. Due to the relatively large depth of the archaeological finds compared to the present-day surface, settlement features and concentrations of stone artefacts have remained largely intact in the French and Swiss sites, in particular the deeper lying archaeological levels. For these levels we can speak of 'high resolution archaeology' (Audouze and Enloe 1997) and well-preserved living floors. That aside, the deciphering of the 'depositional puzzle' is also for this category of site no easy task. The critical considerations of the spatial model that Leroi-Gourhan formulated for Pincevent section 36 is an example that shows this. As we discussed earlier, data on use-wear analysis and refitting, but also for instance of experimental archaeology, can be an important tool (Cahen et al. 1980). Results of ethnographical and ethnoarchaeological research have been important, according to the author, in particular for gaining insight into the *complexity* of cultural, dynamic formation processes that form the basis of the static archaeological processes.

Insight into the extent of disturbance of the archaeological layer in Eyserheide was mostly obtained thanks to the results of refitting and differences in the find context (surface, plough zone, non-ploughed part of the loess soil) of the artefacts. For instance, artefacts associated with tree fall pits could be refitted into artefacts that were also collected underneath the plough zone but outside natural pits. Despite this evidence of disturbances of the archaeological layer, spatial analysis has yielded information on the organisation and use of the camp site of Eyserheide. Two clear clusters (A and B), two less find-rich clusters (C and D) and an adjoining area with a dispersed position of Magdalenian artefacts were recognised. As far as can be said on the basis of the data of the excavation, cluster A reflects the main activity area or 'core' of the camp site. In favour of this argue the high density of knapping products of various RMUs, the number and diversity of retouched tools and the presence of fragments of non-worked stone with traces of heating in the centre of cluster A. The stones have been interpreted as remnants of a small hearth that was completely disturbed by ploughing and other processes. In addition, a rough insight was obtained into the locations where individual flint nodules have been worked and where tools have been used and/or discarded. The distribution of knapping products belonging to RMUs and the results of refitting demonstrate that various flint nodules were worked in cluster A and its periphery. Good examples of these are RMU S1 of Simpelveld flint and RMUs M3 and M8 of Meuse terrace flint. The cores forming part of these RMUs were worked according to *le débitage magdalénien classique* and point to the presence of at least one experienced flint worker in the camp site of Eyserheide. This person (these persons) presumably was (were) seated immediately west of the supposed location of the hearth, in a zone from where also retouched tools and blades with use-wear traces were retrieved. The fact that no retouched tools have been recovered of RMUs S1 and M8, indicates that blades were struck for future use in other camp sites. For RMUs of Simpelveld flint in particular, we should allow for transport of blade products to other locations. Retouched tools made of this flint are (almost) completely lacking in the site of Eyserheide, despite the large number of long and regular blades that have been producted at the site.

With reference to the spatial use of cluster A, the configuration of finds should be mentioned in the southern part of square 54/203. This square forms the western part of cluster A and was one of the trial squares that were excavated in April 1990. Artefacts with small dimensions are almost completely lacking in this square and the amount of retouched tools and blades measured in three dimensions is large. Among the finds are a complete blade end scraper (length 10.7 cm), complete borer (length 11.3 cm), and a complete dihedral burin (length 7.9 cm) (see fig. 3.3). This part of cluster A lies at less than one metre from but beyond the reach of the more westerly situated, tree fall pit (fig. 6.13). In the square 54/203, 94% of the artefacts were measured in three dimensions from the base of the plough zone to maximally 30 cm beneath this base. If we look at the southern part of square 54/203, it is noticeable that the distribution of large artefacts is more or less U-shaped surrounding a space with almost no finds (fig. 6.13). As we are dealing here with a relatively undisturbed part of the Holocene soil, this distribution *possibly* (!) reflects a location for working of flint and/or use of retouched tools by one person.

The central character of cluster A and the peripheral zone, and an interpretation as multi-functional activity area is emphasised by the number and, especially also, the diversity of retouched tools. Among the retouched tools are a steeply retouched blade and (fragments of) borers, burins, end scrapers and retouched blades. Broken ends of working edges mainly originate from burins made of Orsbach flint. They were probably broken by accident as a result of resharpening of the working edge or during use, for instance during the working of bone and antler. Judging from the results of the ring and sector method, tools were especially used and discarded in the western part of cluster A. The results point to the performance of domestic activities in the open air and in the vicinity (west) of a small hearth structure. The fact that cluster A is the remnant of an originally richer concentration and that (many) artefacts were not found in a primary archaeological context, makes it difficult however to evaluate correctly the outcomes of the ring and sector method. Thus, the distribution of the artefacts does not offer indications of accumulation of artefacts against a tent wall. Also the distinction, that Binford makes between drop and toss zones, a spatial characteristic of performing activities around a central hearth and in the open air, cannot be determined with certainty for the same reason.

Artefacts from the Magdalenian have also been recovered from outside the central area of clusters A and B. In view of the smaller numbers of waste products and tools, and less diversity in RMUs, these zones, at only a few metres from clusters A and B, were less intensively used and/or the archaeological layer had been subjected more to the disturbing action of the plough. The distribution of RMUs and data of refitting point to a relationship between clusters A and B, clusters A and C, and clusters B and D. Cluster D has no spatial relationship with cluster A, but does have one with cluster B. The fact that clusters could be linked to each other by refits may indicate that different locations were used simultaneously. In this notion, the clusters contain the archaeological residue of activities (including flint knapping and tool use) that were carried out during one and the same phase of occupation. Because a well-preserved living floor has not been preserved, we should be cautious with statements about which locations exactly were used simultaneously. For instance, the possibility that cores, flakes and blades discarded in the first instance were (re-)used in a later occupation phase cannot be excluded. Whether the location has been reused or whether we are dealing with one single occupation event can not be determined on the basis of differences in the stratigraphical position of the finds.

An indirect indication of a relatively short occupation is the mixing up of retouched tools and waste products of flint working in cluster A, and the lack of small concentrations of knapping products removed from one and the same flint nodule, that could be interpreted as dumps (with the exception of possibly cluster B). With a longer stay, there is the expectation that more would have been invested in site maintenance activities, among which the dumping of waste, and in a spatially more differentiated use of the camp site. In this regard we could also point out the lack of small clusters of certain types of tools, burin spalls and/or retouch waste which point to selective use of locations for bone and antler working, cleaning of hides etc. In the distribution of three-dimensionally recorded artefacts, it was also not possible to determine locations where blades were produced exclusively. Blades were produced at spots where also other activities were carried out, among which preparation and maintenance of cores and use and discard of tools (see also Pincevent, Cahen et al. 1980, 218).

The investigations of Magdalenian open-air sites in the Paris Basin have shown that (waste) products of carefully worked cores were often lying close to a hearth and the knapping products of badly executed debitages further away from the hearth (see for instance Audouze et al. 1988). Earlier in this paragraph, we mentioned that products of *le débitage magdalénien classique* were recovered in the centre of cluster A, close to the location where a hearth was possibly present. Whether this careful method of core preparation also occurred in other parts of the excavation, cannot be stated with certainty. An important reason for this is that no clear picture has been obtained of the activities carried out in cluster C and cluster D. Possibly both clusters reflect (strongly) thinned-out remains of larger find concentrations, whereby – in the case of cluster D – it cannot be excluded that a hearth formed part of the cluster. As the southern part of the excavation was heavily disturbed by bioturbation, it is not known whether the working of flint nodules (for instance M6) and the use of tools has taken place there in the proximity of a hearth, as is supposed for cluster A. RMU M6 is regarded as a good example of the application of a *débitage simplifié*. From the core, with a *dos cortical*, blades were removed that were probably meant exclusively for use in the camp site of Eyserheide itself. Two blade end scrapers that could be refitted onto the core underline this notion.

With the results of the spatial analysis of the site of Eyserheide, it has been demonstrated, in the opinion of the author, that open-air sites from the Late Upper Palaeolithic located at the surface and disturbed by ploughing and/or bioturbation should not be excluded from analysis in advance. Not only are they important for a better understanding of the effects of post-depositional processes on find distributions in Palaeolithic surface sites. They are also important for further insight into the use and organisation of camp sites, though information on the spatial organisation will usually be less detailed than with well-preserved living floors. The potential of ploughed open-air surface sites from the Magdalenian for obtaining spatial information is further shown in the results of analyses in Alsdorf (Löhr 1979), Kanne and Orp-le-Grand (Vermeersch et al. 1985, 1987), and Sweikhuizen-GP (Arts and Deeben 1987b).

When processing the site of Eyserheide we have opted, with the aid of the hearth seating model of L. Binford and the ring and sector method of D. Stapert, to first analyse and interpret the spatial distribution of artefacts in the find-rich, central part of the excavation, assuming a position of the artefacts in primary archaeological context. Subsequently, the results were critically examined and possibilities of interpretation were differentiated, taking into account the (locally heavily) disturbance of original spatial patterns by post-depositional processes. In view of the results achieved for the site of Eyserheide, we would recommend this procedure also to other prehistoric hunter-gatherer open-air sites with a heavily disturbed archaeological layer.