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13 Querns and other hard stone tools from Geleen-Janskamperveld

Annemieke Verbaas and Annelou van Gijn

All hard stone tools from Geleen Janskamperveld, with the exception of the stone adzes, were studied for the presence of traces of production and wear. The predominant tools were quern fragments, along with some polishing stones and hammer stones. Most of the querns were used for processing cereals. The querns displayed a special biography because after use they were broken and sometimes rubbed with ochre. This, probably ritual, treatment indicates their special significance in LBK society.

13.1 Introduction

Stone tools are commonly found in excavations and represent an important part of material culture, but they are often neglected or forgotten. This lack of attention is due to their mostly uninspiring looks and lack of traces of manufacture and use. However, this attitude is changing over the last few years and stone tool analysis is no longer only directed at typology, but also focuses on raw material selection, production sequences and actual use. This information can not only contribute to our knowledge on subsistence strategies and the daily (craft) activities of prehistoric people, but occasionally sheds light on long distance social networks and, sometimes, ideological aspects as well.

The first aim of this study was to study the production, morphology and use of the stone tools found at Geleen-Janskamperveld, with the exception of the chisels. These are described elsewhere in this volume (by Bakels, in Ch. 12). By examining the stone tools from different perspectives, it was hoped to obtain information on the life history of the objects and about the various activities they were involved in. Another aim was to understand the role of stone tools in the technological system: which tasks were carried out by hard stone tools and how did this relate to associated tasks carried out by flint implements? In this way it was hoped to be able to reconstruct toolkits, sets of tools made of different materials and used for a complex activity, like woodworking or plant processing (Van Gijn 2008). A specific research question focussed on the role of cereals in the community as this is reflected in the use and treatment of querns. We also hoped to obtain information on possible bone and antler tool manufacturing in a Bandkeramik context. Even though occasionally we find bone objects in LBK contexts (De Grooth/Van de Velde 2005), use-wear traces from contact with bone and antler are largely lacking on Bandkeramik flint assemblages (Van Gijn 1990). We were interested to see whether such traces would be visible on the hard stone assemblage. Last, a specific research question was whether stone tools were used for chisel maintenance.

13.2 Methods of study and selection

13.2.1 Technology and typology

The excavation of Geleen JKV produced 781 stone artefacts, all of which were included in this study. As loess does not naturally contain stones, all stones must have been brought to the site intentionally and hence have to be considered as artefacts. A total of 436 implements show traces of manufacture and/or use on a macroscopic level and are therefore classified as tools (table 13.1). All stones found were measured and weighed, and the following variables were described[1]: primary classification, typology, raw material, modification, degree of burning, fragmentation, grain size, patination and the extent and character of the cortex. The artefacts were examined for the presence of traces of manufacture using a stereomicroscope (magnifications 10-64×). This type of microscope was also used to determine the raw material.

Stone tools are often shaped by use rather than manufacture. These traces of use are clearly visible with the naked eye and classify a piece of stone as a tool. There are many uses however that did not require any prior shaping and that might not have caused any visible use-wear traces such as for example net sinkers. Such unmodified tools are almost impossible to recognize. Although use-wear analysis may reveal such hidden tools, it is a time and money consuming method and it is often not possible to subject a large body of unmodified artefacts to use-wear analysis.

Tool types distinguished include hammer stones, whetstones, querns and flakes (table 13.1). This conforms to what is commonly found in LBK assemblages (Gaffrey 1994). No retouchoirs were found. Stones with grooves were present, some of which could be described as arrow shaft polishers, but no complete ‘sets’ were found.

type	subtype	total type	%	total subtype	%
quern		*200*	*25,6*		
	complete quern			*2*	*0,2*
	quern mano			*2*	*0,3*
	bread-shaped, fragment			*24*	*3,1*
	large and flat, fragment			*37*	*4,7*
	quern indet, fragment			*124*	*15,9*
	quern flake with quern surface			*11*	*1,4*
polishing stone		*64*	*8,2*		
	whetstone indet			*17*	*2,2*
	block shaped			*7*	*0,9*
	elongated			*1*	*0,1*
	grinding stone			*5*	*0,6*
	with regular u-shaped groove			*21*	*2,7*
	with irregular u-shaped groove			*10*	*1,3*
	polishing stone			*3*	*0,4*
hammerstone		*9*	*1,2*		
	hammerstone one sided			*1*	*0,1*
	hammerstone bipolair			*1*	*0,1*
	pounder			*7*	*0,9*
rubbing stone		*2*	*0,3*		
ornamented		*1*	*0,1*		
unknown		*1*	*0,1*		
block		*2*	*0,3*		
flake		*157*	*20,1*		
unmodified		*345*	*44,2*		
total		*781*	*100*	*273*	*35*

Table 13-1 Frequencies of the different types of artefacts distinguished

13.2.2 Use-wear analysis

Use-wear analysis has been performed on a selection of 40 tools, encompassing a representative sample of the different tool types present in the assemblage. A total of 31 stone implements exhibited traces of wear on a macroscopic level. As some tools display more than one used surface a total of 70 used zones were observed. It should be emphasized that the tools without traces of wear may have been used; absence of wear traces does not necessarily imply that these have not been used. The wear traces may have been removed by post depositional processes. Alternatively, the tools were used either very briefly or on very soft contact materials.

Use-wear analysis on stone tools is a relatively new development, in contrast to use-wear analysis on flint implements. Until recently it was limited to the so-called low power analysis, using a stereomicroscope (Dubreuil 2002; Hamon 2006; Van Gijn *et al*. 2001; Van Gijn/Houkes 2001). In the analysis of flint this low power approach is often combined with a high power approach with the use of a metallographic microscope (van Gijn 1990). Experiments have shown that the high power approach is effective on hard stone tools too (Verbaas 2005; Van Gijn/Houkes 2006; Knippenberg 2007). One of the main problems with high power analysis of stone tools is the size of the objects compared with the limited working space offered by a metallographic microscope. The solution to this problem was a microscope with a free arm, which gives the possibility to look at stones of virtually any size. This study made use of a stereomicroscope with both incident and oblique lightning and a metallographic microscope with incident light. Micrographs were made with a digital camera. Some tools were cleaned with alcohol to remove dirt and grease or were immersed in distilled water in an ultrasonic tank.

All stone artefacts from Geleen JKV have a relatively fresh appearance, displaying almost no weathering or patination. The use-wear traces are generally well preserved. Their visibility varies somewhat between different stones, depending on the hardness and grain sizes of the stone type. Traces of wear on soft stones are slow to build up and often wear away as the stone continues to be used. The traces of wear are therefore never very extensive on such stones and conclusions about the duration are precarious at best. On coarse-grained tools traces develop only slowly and concentrate on the higher points of the surface. Therefore the traces of wear are fragmented and the distribution of traces is not as clear as they are on finer grained stone tools. This variability in wear traces depending on the grain size and other physical attributes of the different stone types is a problem that is much less pertinent in the use-wear analysis of flint surfaces.

Since the reference collection of experimental use-wear traces on stone tools present in the Laboratory for Artefact Studies was relatively limited and focused on tasks relating to the Late Mesolithic, an additional seventeen experiments were carried out for the purpose of this study, focussed on possible Bandkeramik uses of stone tools (Verbaas 2005). All experimental artefacts were of the same raw material as the tools used in LBK: a quartzitic sandstone that could be collected along the Meuse River. The materials worked were, among others, cereals, linseed, bone, antler, wood, ochre and different types of stones used for the production of chisels in the LBK. The motions included crushing, grinding and polishing. All experiments were carried out for at least three hours since it was shown that traces on stone tools develop relatively slow. The results of the experiments were promising. All of the contact materials produced distinctive traces of wear although traces from contact with organic materials developed much slower than from inorganic materials.

13.3 Raw materials represented

The range of raw materials found is quite large. Different types of sedimentary, metamorphic and igneous stones were found (table 13.2). Most artefacts are made of sandstone, ranging from fine and coarse-grained sandstones to quartzitic and micaceous sandstones. All sandstone has a greyish brown colour, which is the original colour, so no patination or secondary colouring took place. The material can be found relatively near to the settlement areas, along the banks of the river Meuse. These banks consist of fluviatile gravel deposits, originating in the Quaternary, which are covered with sediment and which were eroded away by the Meuse (Berendsen 1998, 272). On these same banks the vein quartz and quartzite can be collected. In addition, a small number of metamorphic and igneous rocks were found along the Meuse. These probably originate from the Ardennes and possibly

type	*subtype*	*sedimentary*	*general*	*quartsitic sandstone*	*micaceaous sandstone*	*conglomerate*	*vein quartz*	*mehtamorphic*	*general*	*quartsite*	*shale*	*slate*	*schist*	*gneiss*	*igneous*	*general*	*basalt*	*indet*	*total*
quern																			
	complete quern		*1*	*1*	–	–	–		–	–	–	–	–	–		–	–	–	*2*
	quern mano		*2*	–	–	–	–		–	–	–	–	–	–		–	–	–	*2*
	bread-shaped, fragment		*20*	*4*	–	–	–		–	–	–	–	–	–		–	–	–	*24*
	large and flat, fragment		*32*	*4*	*1*	–	–		–	–	–	–	–	–		–	–	–	*37*
	quern indet, fragment		*102*	*19*	*3*	–	–		–	–	–	–	–	–		–	–	–	*124*
	quern flake with quern surface		*8*	*3*	–	–	–		–	–	–	–	–	–		–	–	–	*11*
polishing stone																			
	whetstone indet		*11*	–	*6*	–	–		–	–	–	–	–	–		–	–	–	*17*
	block shaped		*5*	*1*	*1*	–	–		–	–	–	–	–	–		–	–	–	*7*
	elongated		–	*1*	–	–	–		–	–	–	–	–	–		–	–	–	*1*
	grinding stone		*3*	*2*	–	–	–		–	–	–	–	–	–		–	–	–	*5*
	with regular u-shaped groove		*15*	*5*	*1*	–	–		–	–	–	–	–	–		–	–	–	*21*
	with irregular u-shaped groove		*8*	–	*2*	–	–		–	–	–	–	–	–		–	–	–	*10*
	polishing stone		*2*	–	*1*	–	–		–	–	–	–	–	–		–	–	–	*3*
hammerstone																			
	hammerstone one sided		*1*	–	–	–	–		–	–	–	–	–	–		–	–	–	*1*
	hammerstone bipolair		*1*	–	–	–	–		–	–	–	–	–	–		–	–	–	*1*
	pounder		*5*	*2*	–	–	–		–	–	–	–	–	–		–	–	–	*7*
rubbing stone			*2*	–	–	–	–		–	–	–	–	–	–		–	–	–	*2*
ornamented			*1*	–	–	–	–		–	–	–	–	–	–		–	–	–	*1*
unknown			–	*1*	–	–	–		–	–	–	–	–	–		–	–	–	*1*
block			*1*	*1*	–	–	–		–	–	–	–	–	–		–	–	–	*2*
flake			*78*	*73*	*1*	–	*1*		–	*2*	–	–	*1*	*1*		–	–	–	*157*
unmodified			*171*	*77*	*12*	*1*	*41*		*1*	*20*	*4*	*9*	*1*	–		*2*	*1*	*5*	*345*
total			*469*	*194*	*28*	*1*	*42*		*1*	*22*	*4*	*9*	*2*	*1*		*2*	*1*	*5*	*781*

Table 13-2 The different raw materials represented per tool type

even from the Vosges, because the Moselle used to be a tributary of the Meuse river (Bosch 1982). One piece of basalt was encountered, this artefact may be related to the production of chisels, but displayed no traces of modification or use. Also a lot of iron concretions (N=22) were found that often resemble polishing stones with grooves (N=6). These iron concretions can very well have been used as polishing stones, but since the grooves found in the stones are mainly irregular it seems that we are dealing with locally found and unmodified concretions of natural origin.

13.4 The querns

13.4.1 General features

The querns are easily recognizable by their regularized shape and flat and smooth grinding surface. The surface lacks the characteristic linear traces of grinding stones. The main raw material used for querns is sandstone of an average grain size, but some quartzitic sandstone and occasionally micaceous sandstone was also used (table 13.2). Traces of manufacture are often encountered. The sides of the querns were flaked into shape and the top surface was picked to create a roughened surface to facilitate the grinding. The grinding surface of the querns may initially have been flaked too, but the subsequent picking, long use life and rejuvenation of the quern top may have removed traces thereof. Different types of querns can be distinguished (Zimmerman 1988) and often traces of colorants as for example ochre are found on the tools (De Beaune 1988). Querns consist of an active, dynamic component (the *mano*) and a stationary one (the *metate*). The term quern often refers to the stationary component, the *metate,* a practice also used in this article. During grinding only the central part of the surface of quern is actually used, gradually causing the development of one or two raised borders (Hamon 2006). This process is accelerated by the recurrent roughening of the grinding surface for rejuvenation purposes.

13.4.2 Typology and technology

Querns and quern fragments form 25% (N=200) of the total assemblage and 46% of the number of modified tools. Only two complete querns were encountered (table 13.1). These two complete querns show no resemblance to the quern fragments found and seem to be of another type altogether. The quern fragments can be subdivided in two types: large and flat (N=37) and bread shaped (N=24) (fig 13.1).
The remaining 124 fragments are fragmented to such an extent that they can no longer be assigned to one of these categories. Only two *manos* were recognized, but more can possibly be found among the fragments, albeit not recognizable as such. Also eleven flakes with remnants of a quern surface on the platform were found (fig 13.1). These flakes originate from the rejuvenation of the quern surface; in order to keep the grinding possible, the top surface of a quern needs to be rejuvenated on a regular basis by pounding the surface (Gaffrey 1994). The flakes with quern surface remnants seem to have accidentally come off during rejuvenation or by intentional breakage after discard.

The querns show obvious traces of manufacture: not only is the top surface picked to create a roughened surface which is regularly rejuvenated, the quern sides also display traces of flaking in order to create a standardized quern shape. A total of 157 flakes without any further traces of modification were found, many (N=152) of these of the same raw material as the querns. It is thus very likely that the production of the querns took place on the site. The bottom sides of the querns do not show any traces of modification other than rounding due to the long use life of a quern. We have no clues as to the original size of the querns. The two complete querns show no typological resemblance to the fragments and thus cannot be used as evidence for the original quern size.
We can however extrapolate the original quern size from the size of the quern fragments: upon discard the querns seem to haven been roughly 25-30 centimetres in length and around 12 centimetres in width.

13.4.3 Use

Of the 200 querns and quern fragments found 20 were selected for use-wear analysis. All of these showed traces of use on a microscopic level, with a total of 44 used zones (table 13.3). Most of the traces could be attributed to the milling of cereals. This high incidence of use is not surprising since querns already display extensive wear traces on a macroscopic level (in fact these traces form the basis for their typological designation as querns). All querns but one had only one active zone of use, with their bottom sides displaying wear traces from lying on a surface with ground flour and seeds. One fragment classified as a polishing stone turned out to be a quern fragment, deriving from the concave part of an implement (fig 13.1). On three querns traces were present, but it was not possible to determine the use, because the traces were not developed well enough to determine the contact material involved. Two querns displayed traces of a combination of cereals and stone. The traces from contact with stone did not resemble any of the traces obtained experimentally by polishing materials used for chisels, so chisel production or maintenance can be ruled out. Rather, the traces seem to be result of stone on stone contact between *mano* and *metate*.

Milling cereals result in a granular, domed polish that is spread over the surface in small linked spots. The gloss is matt and is mainly formed on the higher parts of the stone. Often short striations can be observed with a clear directionality parallel to the longer axis of the quern. Under a stereomicroscope fresh and sharp fractures are visible. Although

Fig. 13-1 (scale 1:3)
a: fragment of a bread-shaped quern
b: fragment of a large and flat quern
c: quern flake with quern surface
d: quern fragment re-used as a polish stone
e: quern fragment re-used as a *metate*.

	non - silicious plant	*cereals*	*cereals / stone*	*'quern bottom' polish*	*wood*	*stone*	*holding*	*hard organic material*	*not specified / well defined*	*unknown*	*total*
quern	–	–	–	–	–	–	–	–	–	–	–
complete quern	–	*2*	–	–	–	–	–	–	–	–	*2*
breadshaped fragment	–	*6*	*1*	*3*	–	–	–	–	*1*	–	*11*
large and flat fragment	–	*15*	*1*	*9*	–	–	–	–	–	–	*25*
fragment	–	*2*		*1*	–	–	–	–	*2*	*1*	*6*
polishing stone	–	–	–	–	–	–	–	–	–	–	–
general	*4*	*2*	–	–	–	–	–	–	*5*	*1*	*12*
with U shaped groove	*3*	*1*	–	–	*1*	*1*	–	–	*1*	–	*7*
with irregular U shaped groove	–	–	–	–	–	–	–	*3*	–	–	*3*
hammerstone	–	–	–	–	–	–	*1*		*2*	*1*	*4*
total	*7*	*28*	*2*	*13*	*1*	*1*	*1*	*3*	*11*	*3*	*70*

Table 13-3 The relationship between tool type and contact material

the traces from milling cereals are very distinctive, they are not spread evenly over the quern surface. The polish is more developed at the original edges of the quern where rejuvenation was probably less intense than on the central part of the stone. On querns with a raised border the polish is most pronounced on the concave part of the stone (fig 13.2). Due to rejuvenation of the grinding surface use-wear traces are removed during the use life of a quern so no extensive gloss can build up. This rejuvenation can be accomplished by pounding the sandstone quern surface with a hammer stone. Considerable force is needed to do so. The flint blade cores frequently encountered in LBK context often display pounding marks (Van Gijn 1990). Experiments with replicas of these cores show these exhausted cores to be eminently suitable for this purpose. Because of their pointed butt ends and the fact that flint is much harder than sandstone, it is possible to roughen a smooth sandstone quern surface (Verbaas 2005).

The querns are predominantly used for milling, executed in a longitudinal direction, parallel to the long axis of the implement (table 13.4). On two querns traces of pounding were found, indicating a secondary use of the quern as hammer stone. The bottom sides of the querns also show traces of wear. These traces resemble those resulting from contact with cereals, but have a slightly different character, sometimes almost resembling polish from hide (fig 13.2). The gloss visible on the bottom side of the querns seems to be caused by friction with the seeds and flour that get underneath the quern while grinding and from the surface the quern is placed on to catch the cereals and flour that fall off the quern, most likely a hide. The bottoms of the querns are highly worn and rounded. Since this side of the querns is not rejuvenated during use, they give a good indication of the long use life of the querns.

13.4.4 Discard

Almost all the querns found were fragmented. This is a common practice not only in the LBK (Gaffrey 1994), but also in other periods and regions (Bakker 1979; Chapman 2000). Fragmentation is often referred to as accidental, but ground stone tools are not easy to break. They are very tough and substantial force has to be applied to fracture them.
It can of course be proposed that these tools were broken during rejuvenation of the work surface. However this would result in the snapping in half of the original quern at the centre of the tool where it was rejuvenated most intensively and was therefore the thinnest. Such breaks do occur but in addition we see fragmentation of much thicker parts of the original quern, where breaking could not have been accidental. In order to quantify the degree of fragmentation,

	longitudinal	*transverse*	*pounding*	*grinding*	*polishing*	*crushing*	*holding*	*unknown*	*total*
quern	–	–	–	–	–	–	–	–	–
complete quern	–	–	–	*2*	–	–	–	–	*2*
breadshaped fragment	*1*	–		*5*	–	–	–	*5*	*11*
large and flat fragment	*1*	–		*16*	–	–	–	*8*	*25*
fragment	–	–	*2*	*2*	–	–	–	*2*	*6*
polishing stone	–	–	–	-	–	–	–	–	–
general	*3*	–	*1*	*1*	–	*2*	–	*5*	*12*
with U shaped groove	*3*	*1*	–	–	*1*	–	–	*2*	*7*
with irregular U shaped groove	–	–	–	–	–	–	–	*3*	*3*
hammerstone	–	–	*3*	–	–	–	*1*	–	*4*
total	*8*	*1*	*6*	*26*	*1*	*2*	*1*	*25*	*70*

Table 13-4 The relationship between tool type and executed motion

the number of fractured surfaces was counted for a selection of 102 quern fragments. A total of 63 quern fragments display more than one fractured surface, with a maximum of four. If this high degree of fragmentation is not accidental, there has to be another explanation. Querns could be fragmented in order to reuse the fragments for other purposes. However, only three quern fragments were reused, two as *manos* and one as a polishing stone. Fragmentation in order to obtain stone fragments for the production of other types of tools can thus be ruled out as well.

We propose that the fragmentation is due to the intentional destruction of the querns after their use life is finished. This intentional fragmentation is a feature that we frequently see in so-called ritual context (see for examples Chapman 2000). Agriculture, the practice querns are of course intimately associated with, is of old surrounded with taboos and magical practices to ensure the fertility of the land and the abundance of the crops. Offerings are made to the gods and the ancestors to ask for favourable conditions. We propose that the fragmentation of the querns can be seen from this perspective: the querns had to be destroyed, had to die so to speak.

This proposition is supported by another striking feature seen on the quern fragments: they frequently display remnants of ochre. Again, this is a common feature in other LBK sites (Zimmerman 1988) and has also occasionally been noted for other agricultural tools (De Beaune 1987; Van Gijn *et al.* 2006; Van Gijn *et al.* in prep). Most researchers assume that the ochre traces on the LBK querns are due to the use of these querns for grinding ochre. However, the ochre on the quern fragments of Geleen JKV is not only present on the top of the querns (their actual grinding surface), but also on the bottom, the sides and, most noteworthy, on the fractured surfaces. There are no signs of use-wear polish and striations on the stone surfaces that can be linked to the grinding and crushing of ochre, so the ochre must have been intentionally applied after the fracturing of the stone. Ochre is frequently seen as a symbol of blood and thus life and used in ritual context. In LBK society it is occasionally applied in graves (Modderman 1970; De Grooth 2005) where ochre is given as a grave gift in the form of nodules or powdered ochre is spread under or over the body of the dead. The combination of intentional fracturing of the quern and the application of ochre thus seems to have a symbolic and ritual significance, marking the final death of this agricultural implement and the last step in its biography.

13.4.5 Quern biography

The querns therefore have a distinct life cycle. The sandstone cobbles from which they were produced were obtained in the gravel deposits of the river Meuse and transported to the settlement. The presence of production flakes of sandstone indicates that the querns were manufactured locally. The querns were shaped by percussion, probably with a hard hammer. We find manufacturing flakes throughout the settlement. The querns were subsequently used for grinding cereals. The quern was most likely placed on a piece of hide or leather. The tool was regularly rejuvenated during its use life. At some point, its use life ended. Because several querns

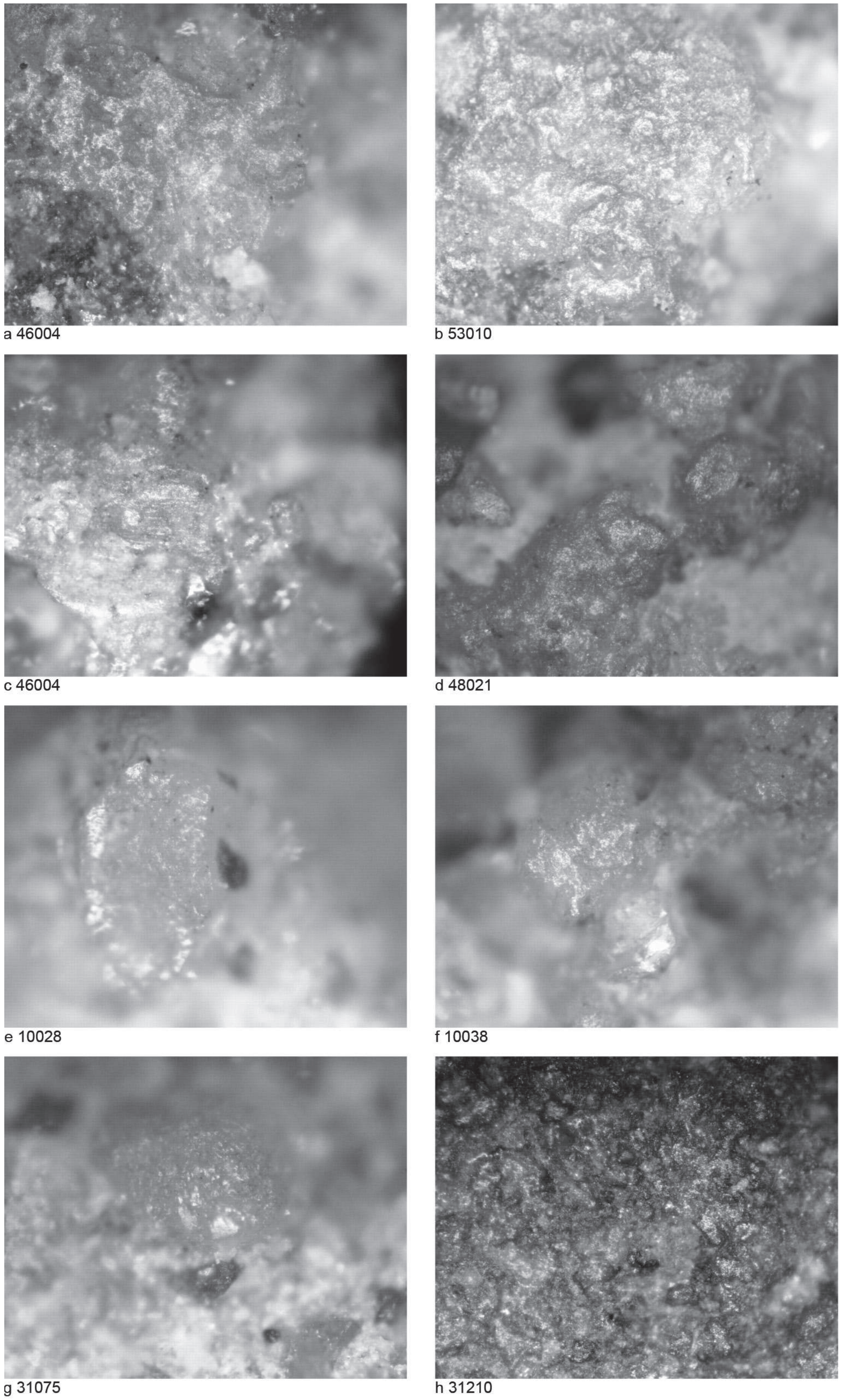

Fig. 13-2 (original magnification 100 ×)
a: traces from grinding cereals
b: traces from grinding cereals
c: traces seen on the bottom of quern
d: traces seen on the bottom of quern
e: traces from contact with both cereals and stone
f: traces from contact with non-silicious plant
g: traces from contact with wood
h: handling traces on pounder

were not exhausted when they were discarded, it is not clear why their use life was ended. All fragments differ substantially in terms of their thickness, indicating that exhaustion cannot have been the sole reason to end the use life of the querns. It is more likely that we will have to seek the explanation in the cultural sphere. We suggest that this fragmentation was intentional and had to do with the ending the life of the quern. At the end of its use-life the quern is thus fragmented and the fractures and other surfaces rubbed with ochre. After this the fragments are discarded. The fact that these querns were not just discarded after their use life but made unusable by breaking them and were covered in ochre indicates their special significance in society. Although the majority of the quern fragments was found in the features, there is no evidence that querns were deposited in pits as special depositions such as has been observed in LBK and Blicquy context in Belgium (Jadin *et al*. 2003, 457) and in the Paris basin (Hamon 2006, 148).

13.5 Other stone tools

13.5.1 Polishing stones

Polishing stones form a total of 8.2% of the assemblage (N=64) and can be further subdivided into stones with and without grooves (table 13.1). The raw material used for polishing stones varies from very fine- to very coarse-grained sandstones (table 13.2). Occasionally quartzitic or micaceous sandstone was used for the production of the polishing stones. Especially the micaceous sandstone is very fine-grained and eminently suitable for polishing, whereas the stones with grooves are mainly made of coarser-grained stones.

Polishing stones without grooves (N=33) display polished or otherwise ground surfaces. They vary from two to fourteen centimetres in length and range from 1.6 to 393 grams in weight with an average of 69 grams. They are mainly made of sandstone and micaceous sandstone but in one case a quartzitic sandstone was used. The appearance of these tools is mainly shaped by the natural surface of the raw material used. Since stones of many different shapes and sizes were employed, polishing stones display different characteristics; also they often have more than one polished facet (fig 13.3).

Stones with grooves (N=31) are commonly referred to as arrow shaft polishers. However, since this term is directly indicating an assumed use and because no corresponding ‘sets’ were found, the term will not be used here. Stones with grooves are found with U-shaped grooves (N=21) and with irregular grooves (N=10). These irregular grooves are either not straight or they have an irregular bottom, suggesting these grooves may not have been due to use but rather have a natural origin. In fact we have several such naturally grooved stones in our possession, found in southern Limburg, that further support their dismissal as human artefacts. Stones with regular grooves often also display flat polished surfaces (fig 13.3). They vary from 2.6 to 8.3 centimetres in length and have an average weight of 39.8 grams

The variability in polishing stones is probably larger than the two categories differentiated here as they display numerous different shapes and sizes and often have multiple used areas (fig 13.3). Even the strict distinction between polishing stones with and without grooves is not as strict as presented here. Polishing stones with groove often also display flat polishing surfaces. In this study however, grooves were seen as the distinctive attribute, so they were described as stones with grooves.

An alternative subdivision of the polishing stones can be made on the basis of grain size of the parent material. Such a distinction is related to the presumed use of the polishing stones: the finer-grained tools would be used for polishing, whereas the coarse-grained tools would be more suitable for the rougher, grinding work. When tools are subdivided this way we distinguish fine-grained (N=19), medium coarse-grained (N=17) and coarse-grained (N=28 of which 8 with irregular grooves) polishing and grinding stones.

A total of 18 polishing stones were selected for use-wear analysis, half with and half without grooves. Nine polishing stones show traces of wear, producing a total of 22 used zones (table 13.3). The main contact material is plant (fig 13.2), but the kind of plants and/or the part of the plant that was processed, could not be further specified. Detailed phytolith analysis would have to be performed to establish this (e.g. Van Gijn/Houkes 2006). Also traces from milling cereals were found on one of the polishing stones, an inference that seems to contradict with the tool type. This implement, however, was originally a quern fragment, that was subsequently re-used as a polishing stone (fig 13.1). On one polishing tool traces of working stone were found. This is significant since chisels were commonly used at Geleen JKV and these chisels had to be maintained and re-sharpened. One polishing stone for this purpose seems very little but it may well be that the polishing and maintenance of the stone chisels was done near a stream outside the actual settlement area. Such locations are the most appropriate areas for this task: water and sand are at hand (Pétrequin/Pétrequin 1993; Hampton 1999).

No traces of bone or antler have been found, this is consistent with the use-wear analysis of the flint tools (Verbaas/Van Gijn this volume, Ch. 11). Bone and antler tools are not found in Geleen JKV due to conservation circumstances. It is therefore impossible to determine whether these raw materials were used for tool production. It seems relatively certain however that flint and other stones did not play a role in their production.

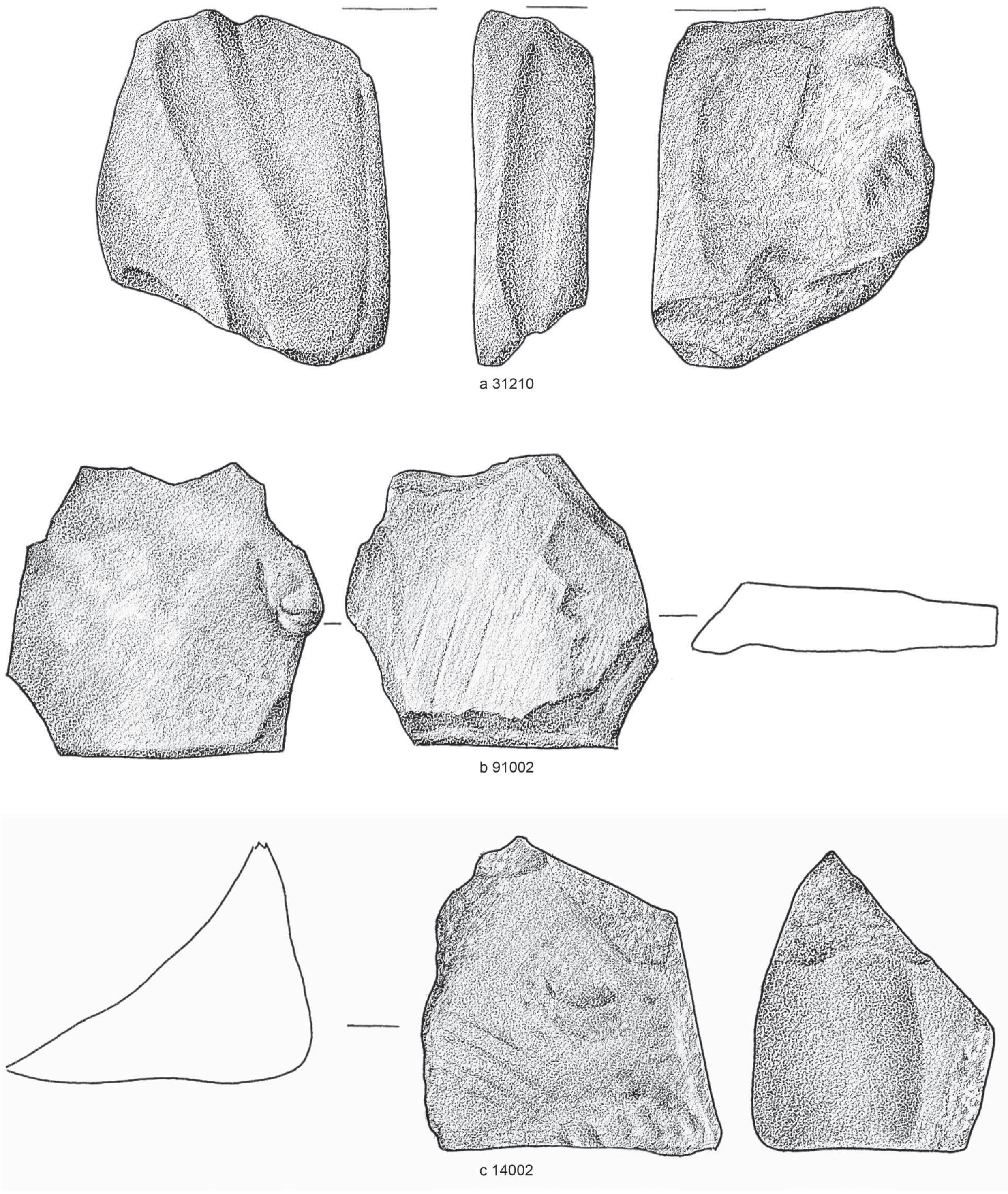

Fig. 13-3 (scale 1:1)
a: polishing stone with multiple grooves
b: polishing stone with two polished facets
c: polish stone with multiple facets

In some cases wear traces were observed on the polishing stones, but no further indication for the worked material could be given because distinctive features of wear were lacking. These wear traces were described as hard organic material, not specified/well defined and unknown materials.

13.5.2 Hammer stones

Only nine pounding- or hammer stones were found in Geleen JKV (2.1% of the tools found). In LBK context however, exhausted flint cores were reused as pounding stone (Van Gijn 1990; De Grooth, Ch. 10 this volume) making hammer stones of other raw materials largely superfluous. The hammer stones are made of sandstone (N=7) and quartzitic sandstone (N=2) (table 13.2). Two of the hammer stones found were round pebbles with impact traces on a protrusion. One was used one sided, the other two sided (table 13.1). The other hammer stones can be described as pounders, oblong in shape with pounding marks on one or both ends. One pounder showed traces of pounding a red residue on both ends (fig 13.4). It was probably used to crush and finely grind hematite nodules into powder.

Two pounding stones were selected for functional analysis (table 13.3). Both showed traces of pounding but the contact material involved could not be determined. One of the pounders showed traces of sustained holding. Holding traces are characterized by the presence of a greasy, domed and highly linked polish, located on both the lower and higher parts of the surface. These traces are also found on experimental tools that are used for a long time. The pounding traces on the tool were not very extensive; probably either a very soft material was pounded with the tool or it was used very gently.

13.6 Spatial and diachronic patterns

Both on the basis of the pottery (Van de Velde, Ch. 7 this volume) and flint (De Grooth, Ch. 10 this volume) two wards could be distinguished within the settlement, a northern and a southern one. In order to see whether this distinction would also be visible in the distribution of the hard stone tools, all artefacts found in features were plotted, both the modified and unmodified ones. Distribution plots were also made of the different subtypes (bread-shaped versus large and flat querns and polishing stones with and without grooves). Last, the distribution of the querns with ochre was examined.

It can be seen that the majority of the hard stone finds is found in the southern part of the settlement (fig 13.5). This was also observed for pottery and flint. No technological or typological differences could be seen between the northern

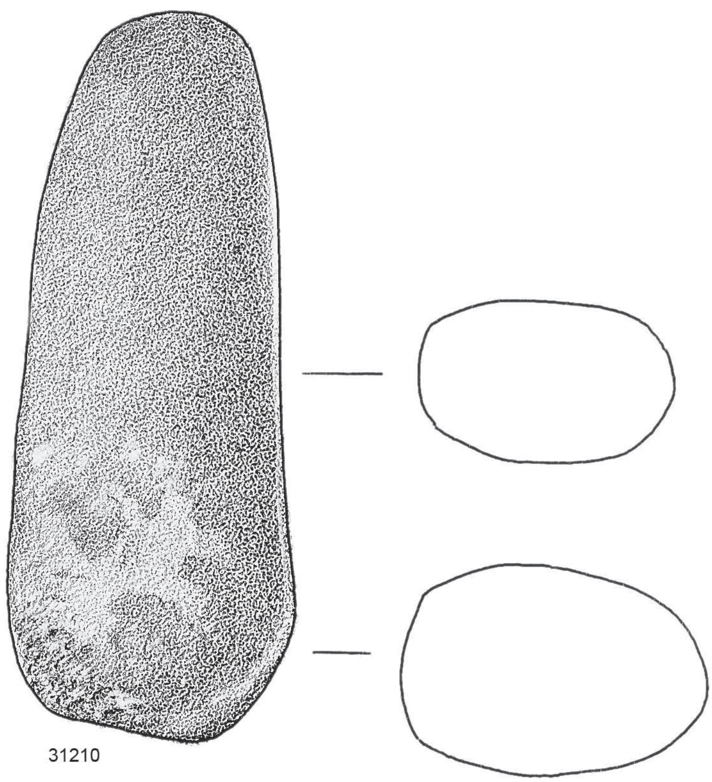

Fig. 13-4 Pounding stone used on both ends and with traces of ochre (scale 1:1)

Fig. 13-5 Distribution map of all stone tools found at Geleen JKV.

and southern ward of the settlement. The flakes with quern surfaces are all located in the southern part of the settlement. For the other tool types and the querns with ochre no spatial patterns can be observed. Diachronic patterns could not be distinguished as there was no difference in number of quern fragments between the different house generations that were distinguished. This pertained both to the fragments with ochre, as to those without.

13.7 Conclusion

The predominant hard stone implement is the quern.
A considerable number of quern fragments were found, indicating the importance of cereal processing for the LBK people. Considering the large number of finds and the probably extensive period these tools were used, we cannot but conclude that the milling of cereals constituted an important subsistence activity. Other plant materials were

processed as well, usually on flat surfaces of polishing stones. It is not clear what kind of plants were involved but it most likely concerns a subsistence activity as well.

As far as craft activities are concerned, the hard stone tools have not produced much evidence. Bone and antler working traces are absent. This is in support of the findings from the use-wear analysis of the flint implements that also indicate that bone and antler tool manufacturing may not have been a predominant task for the LBK people and certainly did not seem to involve tools of flint and other stones. Polishing stones are somewhat of an enigmatic tool category. They include grooved stones and stones with polished surfaces. Some of the grooved stones were dismissed because they were products of nature, not of man. The stones with polished surface incidentally displayed interpretable traces of wear. One such tool was found with traces from polishing hard stone, a tool that we may associate with the maintenance of chisels. However, it is likely that chisel repair and maintenance mainly took place outside the settlement proper near a stream with running water where sand was also available. Stone hammers were involved in the crushing of ochre, considering the presence of this material on one hammer stone. The hammer stones must probably be seen as multi-purpose tools. However, this is difficult if not impossible to demonstrate as the continuous pounding removes particles of the tool, and thereby developing traces of polish.

The number of tasks the stone tools were involved in is relatively limited. It is therefore difficult to reconstruct the part of hard stone tools in relation to tools made of flint. The picture is also far from complete because no chisels were examined for traces of wear. This tool type is believed to have played a role in wood working (Dohrn-Ihmig 1979/1980). It is also postulated that chisels were used for clearing the land. Hopefully the chisels can be examined for traces of wear in the future, but the experimental programme that must lie at the basis of functional inferences, will require quite an investment of time and money. Apart from the chisels other multifunctional tools were the hammer stones and possibly the polishing stones. The latter display use-wear traces from different kinds of contact materials. The amount of information is too limited to obtain a good idea of the role of flint and hard stone tools in the technological system.

As said above the quern fragments constitute the most important category of hard stone tools in Geleen JKV. The study of their life cycle has provided essential information on the significance of this type of tool. They not only formed an essential implement in the agricultural *chaîne opératoire*, processing the seeds of various cultivated cereals, but also were attributed a special significance. They seemed to have undergone a special ritual after their actual use life came to an end. This can be inferred from the intentional destruction of the querns at the end of their use life, sometimes before they were actually exhausted, and the subsequent rubbing of the fractures and other surfaces with ochre. Obviously, we will never know what their exact significance was to these past people. However, this unusual treatment of an agricultural tool *par excellence* indicates that cropping practices were surrounded by rituals, suggesting that agriculture played an important part in the ancient belief systems.

Stone tools are frequently not studied extensively, because they are often simple and not intentionally modified. In this paper we hope to have shown that stone tools merit a more thorough study. It is especially the study of the life cycle of stone tools, from the initial selection of the raw material, through manufacture and use, to the actual discard and the treatment the tool undergoes upon deposition that promises to provide not only essential but foremost exciting information on the significance of stone objects for past societies.

	longitudinal	*transverse*	*pounding*	*grinding*	*polishing*	*crushing*	*holding*	*unknown*	*total*
non - silicious plant	*4*	–	–	–	*1*	–	–	*2*	*7*
cereal	*1*	*1*	–	*24*	–	–	–	*2*	*28*
cereal / stone	–	–	–	*2*	–	–	–	–	*2*
'quern bottom' polish	*2*	–	–	–	–	–	–	*11*	*13*
wood	*1*	–	–	–	–	–	–	–	*1*
stone	*1*	–	–	–	–	–	–	–	*1*
holding	–	–	–	–	–	–	*1*	–	*1*
hard organic material	–	–	–	–	–	–	–	*3*	*3*
not specified / well defined	–	–	*5*	–	–	*2*	–	*4*	*11*
unknown	–	–	*1*	–	–	–	–	*2*	*3*
total	*9*	*1*	*6*	*26*	*1*	*2*	*1*	*24*	*70*

Table 13-5 Activities inferred: contact material versus motion

Notes

1 Typology and raw material were described according to the specifications of Archis, the digital national reference collection set up by the Archaeological State Service, Amersfoort, The Netherlands.

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