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The Kaaraneskoski Site in Pello, South-Western Lapland – at the Interface between the "East" and the "West"

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ABSTRACT **The paper discusses the Late Mesolithic Kaaraneskoski site in Pello, southern Finnish Lapland, focusing on its quartz assemblage. A variety of analysis methods (e.g., technological analysis, fragment recognition, fracture pattern analysis, tool identification, low-power use wear analysis, and spatial analysis) are employed to study the structure of the site, the formation of the quartz assemblage, and the processes of quartz reduction and tool blank selection. The studied assemblages from two separate excavation areas display unusually high tool percentages. The *chaînes opératoires* display five separate production concepts. It is concluded that the site consist of a number of small, consecutive living floors produced by mobile hunter-fisher-gatherers, reflecting intermittent use of a productive locality, and that the quartz assemblages are to a large degree selected from material knapped outside the excavated areas. The assemblages include elements that speak for contacts between the Late Mesolithic south-western (Swedish) handle core area and the eastern (Finnish) oblique point area.**

KEYWORDS
Late Mesolithic, Lapland, quartz, lithic analysis, *chaîne opératoire*, fracture patterns, spatial analysis

Introduction

The Stone Age Kaaraneskoski site in south-western Finnish Lapland (**Fig. 1**) was excavated in 1997–98. The site was named after the neighbouring Kaaraneskoski Rapids, though these themselves no longer exist, having been partly drowned and partly diverted by the building of a small hydroelectric dam in the early 1950s. The earliest stray find from the environs of the rapids, a slate knife, was found as early as 1884, but the existence of a site at the location was first confirmed in 1956 when archaeologist Aarni Erä-Esko found several quartz artefacts near the dam area. Erä-Esko visited the site again in 1964, picking up more quartz and shards of slate from the edges of a small sand quarry. Markku Korteniemi also included it in his survey of the prehistoric sites in Pello Borough (Korteniemi 1984). By the time an excavation was launched in 1997, the expanding sand quarry had destroyed most of the probable central parts of the site and it remained for the archaeologists to work around the surviving edges (**Fig. 2**).

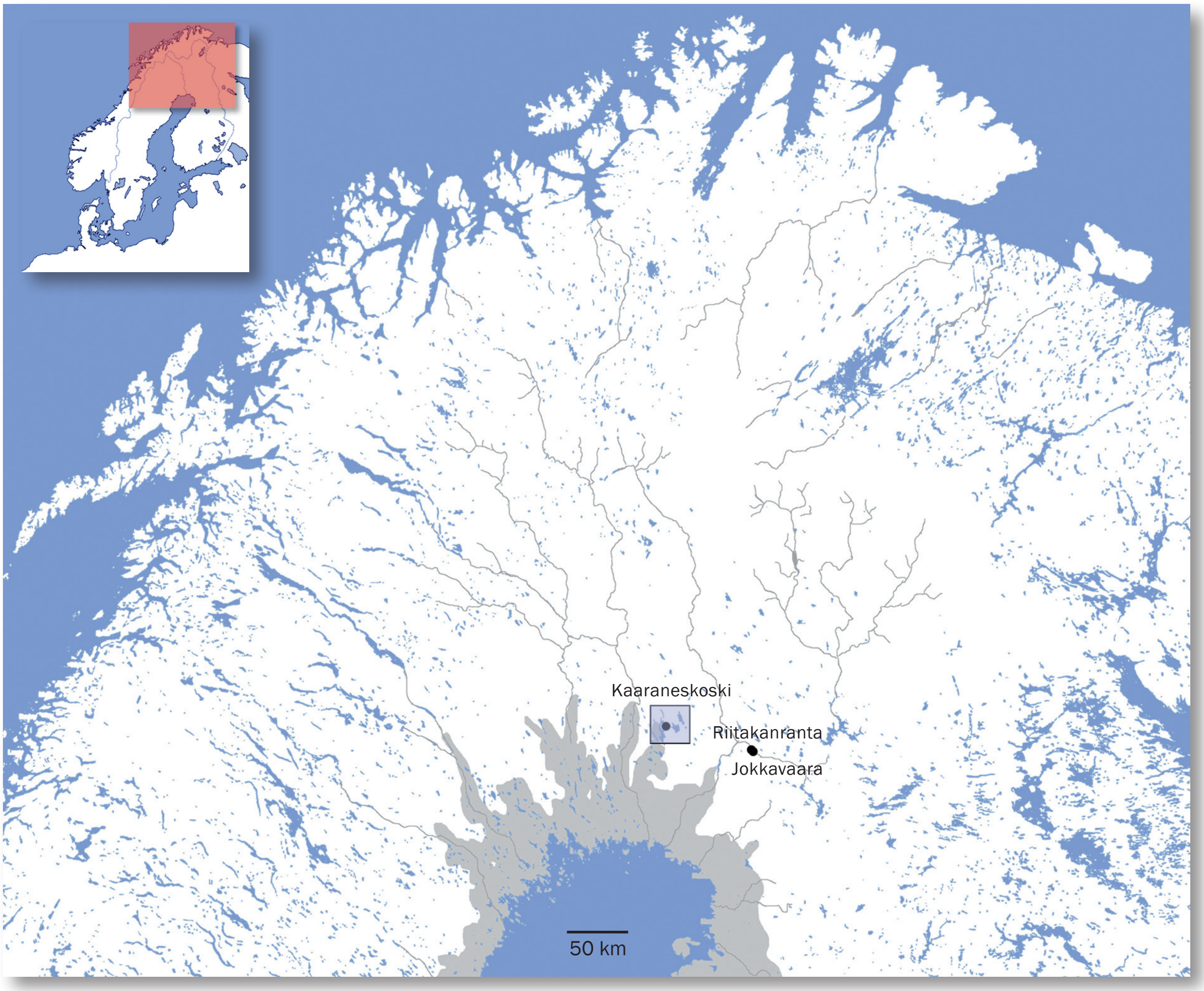


Figure 1. The location of the Kaaraneskoski site in Pello and the Riitakanranta and Jokkavaara sites in Rovaniemi. The grey colour indicates the shoreline of the Litorina Sea at 7100 BP, i.e., slightly before the beginning of the occupation of the site. The box indicates the area covered by **Figures 3** and **4**. Map by M. A. Manninen and J. Kankaanpää.

This paper discusses the locality, the excavations, and the finds, focusing on the quartz assemblage that includes some unusual features. The site is dated to very late Mesolithic, around 5500 calBC (see below). It is located at the interface between the eastern oblique point area and the south-western handle core area (see Manninen & Knutsson *this volume*:Fig. 11). This position is reflected in the assemblage. The aim of the analyses presented in this paper has been to study the structure of the site and the character of the occupation, as well as the character of the lithic assemblage and what it can tell us about the activities that took place at the site. An important objective has also been to show the research potential in quartz assemblages and to provide comparative material for future research. Because of this, the technological characteristics of the assemblage are described in some detail.

The view taken by the authors of this paper is that, instead of concentrating on typologically diagnostic tool forms, lithic analysis should always include all of the various components of the lithic assemblage. While recognisable retouched tools can tell us a variety of things about the activities performed at a site, it is the debitage assemblage that informs us about the *processes* involved in lithic manufacture and use (see, for example, Rankama 2002:80). These processes help us understand the human decision making involved in making and using stone tools. They allow us a unique glimpse of prehistoric human mental processes that are difficult to reconstruct by any other means. They are also a key

Figure 2. The Kaaraneskoski site area from the south-west in 1997. Photograph by J. Kankaanpää.

to understanding the learned, cultural aspects of technology that help us find regional similarities and differences and reconstruct complexes that can be understood as having had a common basis, and thus, perhaps, also sharing other aspects of (material) culture.

Lithic technology is the most reliable key to these reconstructions. Although tool types are often used to identify cultural ties between assemblages and areas, they can be deceptive: individual tools, especially spectacular ones, or ones made of exotic raw materials, can be transferred from area to area as gifts and may not be usable as cultural indicators, even though they may inform us about contacts between groups of people. When studying quartz assemblages, tool types tend to be even less useful. The general pattern in Finnish quartz assemblages is not one of formalised tool types or even of a struggle towards similarities in shape (cf., Rankama 2003b:205). Instead, the emphasis has been on finding or preparing a suitable working edge for each purpose, with less regard on the shape of the piece otherwise. Identified tools display a minimal amount of modification, and the strategy of the quartz user seems to have been to select tools and tool preforms from among the natural fragments produced by quartz reduction. Retouched quartz tools, thus, seldom work as chronological indicators in Stone Age Finland, and the few examples that exist are usually borrowed from outside current Finnish borders. The oblique points discussed by Manninen and Knutsson and Manninen and Tallavaara in this volume may be an exception (but see Manninen & Tallavaara *this volume*). Another exception might be thumb-nail scrapers, which appear, based on experience with several quartz assemblages, to be a Mesolithic tool form. This hypothesis, however, has never been properly studied. Both tool types, in any case, are present in the Kaaraneskoski assemblage (see below).

This study utilises the *chaîne opératoire* concept when interpreting the results of the analyses. Based on Marcel Mauss' anthropology of gestures and body techniques, according to which they are culture-specific (e.g., Mauss 2009:77–95; originally "Les techniques du corps", *Journal de psychologie* 32, 1935), and developed within French archaeology (Leroi-Gourhan 1964), the *chaîne opératoire* approach looks at lithic production as a process of culturally transmitted gestures. A study of *chaîne opératoire* means reconstructing "the organisation of a technological system at a given archaeological site" (Sellet 1993:106) and involves studying lithic manufacture as a process that proceeds from raw material procurement through all the stages of production and use until discard. The *chaîne opératoire,* thus, covers the life cycle of the lithic products and can be used to describe the approach of the prehistoric knapper to the raw material (see, e.g., Sellet 1993 and Sørensen 2006 for an explanation of the meaning of the *chaîne opératoire* concept, its history, and applications).

The intentions of the lithic producer are formulated in his/her mind as conceptual operational schemes, "road maps" to the desired end products, where the process is divided into stages that gradually lead to the goal (Pelegrin 1990:117). According to Pelegrin (1990:118), elaborate knapping activity involves two key concepts: knowledge (*connaissances*) and know-how (*les savoir-faire*). Knowledge means the mental aspect of the process of lithic production: knowing the raw material and the possible modes of dealing with it, knowing the geometry necessary for production, knowing the modalities of production and the required tools on a mental level, and having the mental templates of the desired products. Know-how, on the other hand, involves both the ability to analyse, reflect, and decide on suitable actions in each situation, and the ability to execute the actions successfully (Pelegrin 1990:118–119; see also Sørensen 2006:33, Fig.1).

In the context of quartz reduction, knowledge would, then, involve knowing, for example, the limitations posed by the raw material: which techniques and methods are the most successful, which kinds of quartz are best suited for reduction and which might even be approached with more complex techniques, and which methods would *not* be worth attempting. The mental templates, on the other hand, might require an attempt at production even in a situation of limited raw material possibilities, and learning the limitations of a new raw material environment is one of the key adaptational processes of a colonisation situation. A situation of contact between different social groups, where new modes of production are observed, may also lead to attempts to emulate them in less than ideal raw materials. Evidence of this kind of behaviour can be observed in the Kaaraneskoski assemblage.

Lithic concepts are reproduced within a society through a learning process and tend to remain constant at least to some degree. They can, thus, be considered specific to particular societies (Sørensen 2005:22, Fig. 2; Sørensen 2006:34, Fig. 2) and can be used to study the differences and similarities of lithic manufacture between social groups. An archaeological assemblage can – and usually does – consist of the remains of several *chaînes opératoires*, and several operational schemes or concepts can also exist within one society. These may depend, for example, on the range and quality of available raw materials, but also on social contacts, as well as, naturally, on the desired products. It is for the archaeologists to reconstruct the *chaînes opératoires* and to try to explain the rationale behind the different lithic concepts and the choices behind their use in particular situations.

The Kaaraneskoski site and excavations

The site lies on the sandy western slope of a ridge that separates lakes Vähä-Vietonen (90–93 m above sea level, dam-regulated) and Miekojärvi (76.9 m above sea level; **Fig. 3**). The top of the ridge, down to c. 93 m above sea level, is rocky glacial till and bare bedrock. This is covered at lower elevations by a layer of sand several metres in thickness. The sandy slope terminates at c. 83 m above sea level in a level plateau of agricultural land with a substratum of moist clay, obviously a former lake or sea bottom. The area is covered with mixed forest, primarily Scots pine and birch (see **Fig. 2**). A clear-cut power line corridor passes through the sand quarry from north to south and continues towards the south-east. Most of the upper edge of the remaining sandy area above the sand quarry has been logged some decades ago and is now covered by a dense thicket of pine saplings. The understory consists mainly of heather, lingonberry, and moss.

Due to isostatic uplift, Kaaraneskoski currently lies some 90 km from the coast of the Gulf of Bothnia, but during its occupation the site was coastal and can, thus, be dated through shore displacement chronology (see, e.g., Siiriäinen 1974). The location was at the mouth of a short river draining the Lake Raanujärvi – Lake Iso-Vietonen – Lake Vähä-Vietonen system into a long fjord-like bay of the Litorina Sea (**Fig. 4**). Although some 5 kilometres wide in places, the open expanse of the fjord was broken by a number of islands, including fairly large ones directly west of the site. The site was, thus, reasonably well shel-

Figure 3. Current topography of the Kaaraneskoski area. Topographic map published with the permission of the National Land Survey of Finland.

Figure 4. Late Mesolithic extent of the Litorina Sea with the shoreline at 90 m above the current sea level, and the location of the Kaaraneskoski site. Drawing by J. Kankaanpää.

tered from all but north-western winds. Its location at the mouth of the river would have been profitable for hunting and fishing both in the sea and in the lakes and forests beyond the immediate site area. It is likely that salmon would have entered the river system and the site would have made an excellent salmon fishing location.

Archaeological investigations were carried out at the site in 1997–98 by Jarmo Kankaanpää on behalf of the National Board of Antiquities. The primary goal was to assess the extent and age of the site, since it was deemed to be progressively eroding and largely destroyed. The excavations were financed by a government make-work programme with a set budget. Due to limited funds and time, an excavation of the whole find-bearing area was not possible. The finds, catalogues, maps, photographs, and excavation reports are archived at the National Board of Antiquities in Helsinki.

Figure 5 shows the topography of the site and the excavated areas. The 1997 excavation commenced with surface collecting, during which quartz artefacts were observed in both the upper (eastern) and lower (western) edges of the sand quarry – note that north is to the left of the plan. Test pitting of the upper part of the site was followed by the opening up of two parallel, 1 metre wide test trenches (Areas 1 and 2, 14 m^2 and 12 m^2, respectively) some 10 metres apart in the upper slope between c. 90 and 89 m above sea level. The location of the trenches was decided partly on the basis of productive test pits in the area, partly by the fact that the edge of the sand quarry was eroding and on the verge of destruction. The local tree cover was also a deciding factor, as the placement of the trenches was designed so as not to excessively disturb the growing saplings.

A third trench (Area 3, 36 m^2), perpendicular to the other two, was placed in the power line corridor at approximately the same elevation. As this trench was quite productive, it was widened to three metres over its southern half. A fourth excavation area (Area 4, c. 13.5 m^2) was opened up in the northern part of the site, where a streak of red ochre had been observed in the eroding slope of the sand quarry. The lower (western) part of the quarry edge was deemed stable and left for the following year. The finds from the 1997 excavation are catalogued as KM 30721:1–524.

The 1998 excavation concentrated on two areas: extending the productive Area 3 with perpendicular test trenches and parallel extensions (total = 47.5 m^2), and opening up a new system of trenches (Area 5, 37 m^2) at the lower western edge of the site between c. 86 and 85 m above sea level. The location of Area 5 was decided

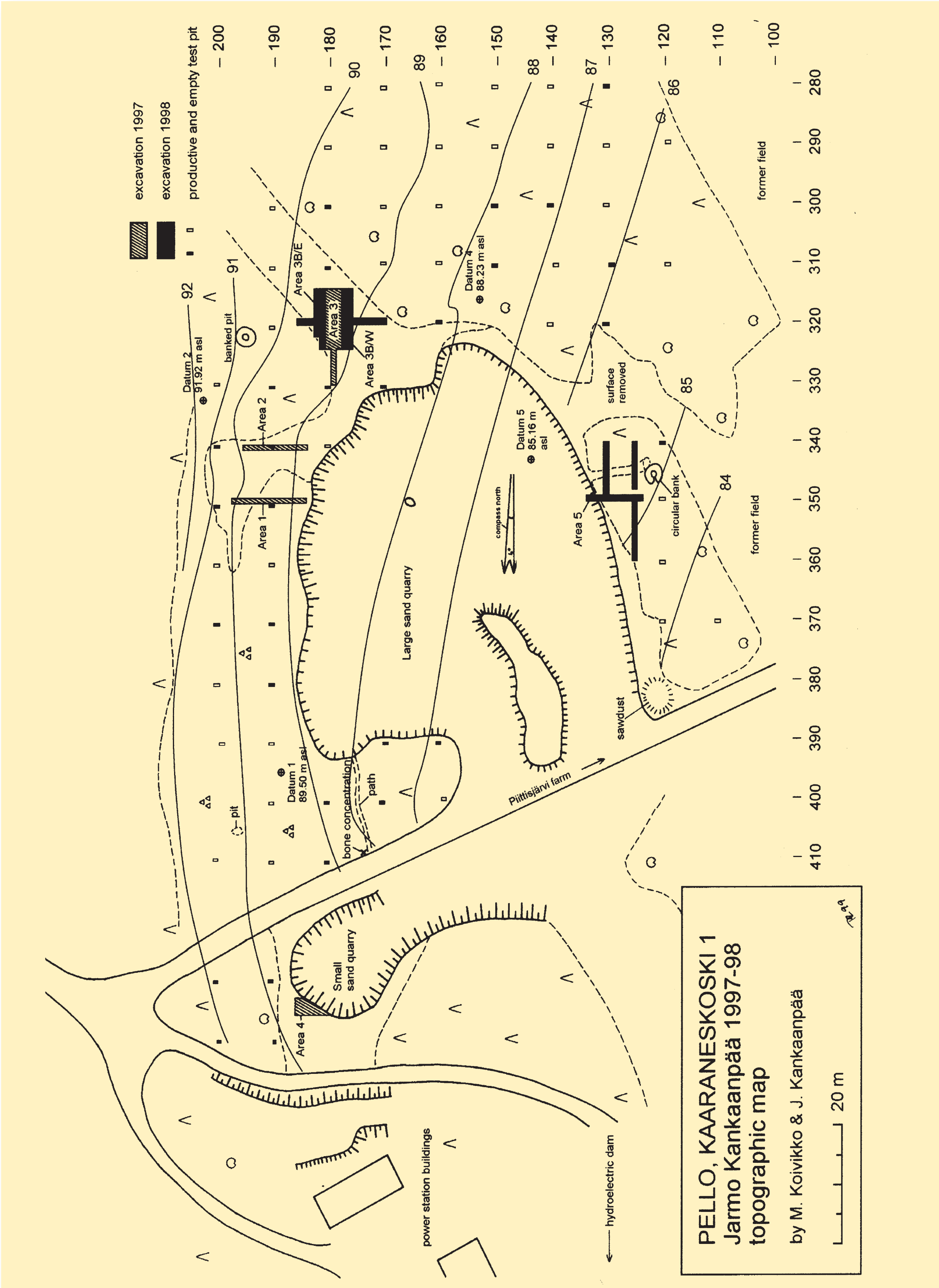


Figure 5.
General plan of the site with areas excavated in 1997 and 1998. Surveyed by M. Koivikko and J. Kankaanpää. Drawing by T. Rankama.

on the basis of abundant surface finds of quartz. Test pitting was also continued along the slope towards the south and along the lower edge. A small concentration of burnt bone eroding out of a road bank in the middle of the area at c. 88 m above sea level, known as "Paula's pit", was excavated as a separate unit and provided the only usable charcoal samples obtained during the excavation (**Fig. 5**). The finds from the 1998 excavation are catalogued as KM 31377:1–1122.

The total excavated area (excluding the test pits) was c. 160 square metres in size. Opening more excavation areas or extending the existing ones was not possible due to limited resources. It is clear from the distribution of productive test pits (**Fig. 5**) that the site area continues to the south and east of the sand quarry and that a considerable portion of the site has been quarried away. The test pits also show that archaeological remains are not contiguously distributed over the site, but occur sporadically over a large area. A substantial part of the site to the north of the quarry has also probably been destroyed by the construction of the hydroelectric power plant. The restricted sizes of the excavation areas, naturally, limit the conclusions that can be drawn from the studied assemblages. Nevertheless, we feel that due to the diffuse structure of the site (see below), we have been able to capture the character of the occupation and analyse coherent, and independent, portions of the occupation area.

The lower edge of documented archaeological remains lies at c. 85 m above sea level, while the upper edge rises to around 91 m above sea level. The elevation range of the site is at least 6 metres, which, at these altitudes, represents a period of some 400 years (see below).

The excavation proceeded in 5 cm artificial spits. Tools noticed during excavation were plotted three-dimensionally. The recovery unit for the rest of the finds was a palm-sized area within the spit, providing for a horizontal and vertical plotting accuracy of ±5 cm. This is sufficient for reliable distribution plans at the scales normally used. In addition, all excavated soil went through a 4 mm mesh sieve. As a result, the larger artefacts not noticed during trowelling were recovered, while the smallest fraction was inevitably lost. The sieve finds were plotted only to the spit and square metre.

Throughout the excavation areas the soil displayed a podsol profile on top of undisturbed sand. Small patches of anthropogenic stained sand were observed only in area 3. The thickness of the excavated layer varied generally between 15 and 30 cm, with only a few small areas reaching a depth of 40 cm or more. The majority of the finds (79 %) were in the top 10 cm, with a further 18 % in the next 10 cm. The bottom 5 excavation spits yielded only 3.3 % of the finds, emphasising the fact that the productive part of the cultural layer was only about 15–20 cm in thickness.

The finds consist primarily of quartz and "slate" (mainly chlorite schist). No pottery was found, though the lowest parts of the site could theoretically date to the Early Neolithic[1]. In Areas 1–3, excavated in the upper part of the site, a band-like concentration of finds was observed following the 89.5 metre contour. This was interpreted as reflecting an occupation phase that closely followed the beach line. Find concentrations were also observed in the Area 5 trenches at the lower edge, but their contexts were less clear. Some of these finds were clearly in a secondary context resulting from recent surface disturbances connected with sand extraction and smoothing the quarry edge. The red ochre notwithstanding, no clear evidence of a burial was observed in Area 4. The area produced a number of finds (mainly quartz and a few fragments of slate), but they did not appear to cluster specifically around the red colour streak.

The date of the site

M. Saarnisto's shore displacement curve for the Rovaniemi–Pello Area (Saarnisto 1981:Fig. 9) dates the site's 91–85 m elevation to c. 7000–6600 BP (**Fig. 6**), but the single radiocarbon date from the bone concentration in "Paula's pit" at 88 m (Hela-323) runs to 6310±85 BP (5473–5061 calBC, 2σ; IntCal09: Reimer *et al.* 2009), suggesting that at least that feature may have been located several metres above the contemporary waterline. In view of this observation, it might be prudent to date the whole site slightly younger than shore displacement would theoretically allow.

The potential occupation period of the site, in any case, covers some 400 years. Because of this, one of the questions addressed by the analyses presented below was whether the occupation was continuous or recurrent, for example within a seasonal round.

[1] In the Finnish chronological system, the beginning of the Neolithic is identified by the appearance of pottery. Agriculture is not present or implied at this stage.

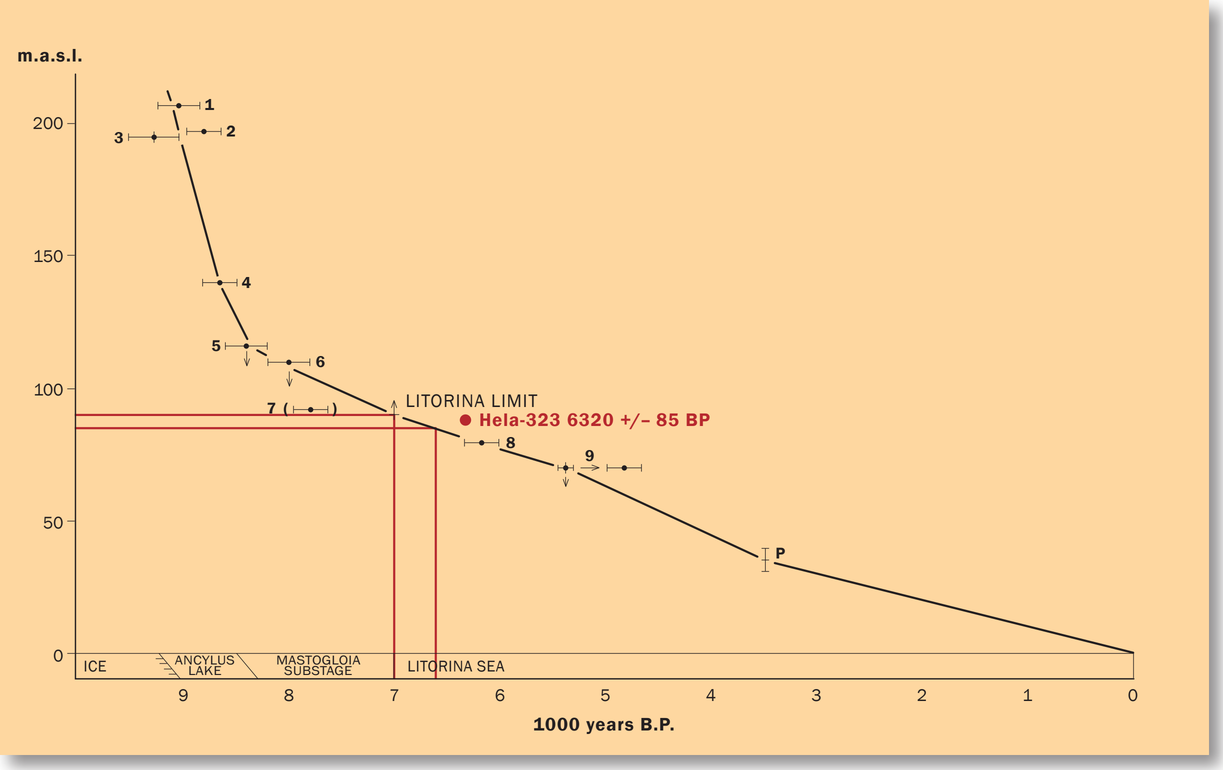


Figure 6. Shore displacement curve for the Rovaniemi–Pello area (Saarnisto 1981:Fig. 9), with the radiocarbon date from "Paula's pit". The elevation of the Kaaraneskoski site is marked with red lines. Edited by J. Kankaanpää.

The lithic assemblage and the structure of the site

The quartz assemblage from Kaaraneskoski consists of 1897 artefacts. In addition, the finds include 305 artefacts of other lithic raw materials, mainly chlorite schist, but also a few pieces of other slate-type rocks and quartzite, as well as 234.6 grams of burnt bone.

The quartz analyses presented in this paper concern the two largest excavation areas (**Fig. 5**): Area 3 to the south-east of the quarry and Area 5 to the west. The quartz assemblages from these areas put together comprise 86% of the recovered quartz artefacts. The number of analysed pieces is 795 from Area 3 and 896 from Area 5. In addition to the quartz, some of the schist implements recovered during the excavation will be commented upon.

In the following analyses, the quartz assemblage from each analysed area is dealt with separately. This is due to the fact that there is a difference of c. 5 metres in the elevation of the areas and they can, thus, be assumed to differ in age. Due to the thin find-bearing layer in each area, the finds have been treated as an undivided whole without an effort to look for vertical differences. Another reason for this is the soil formation that has taken place after the occupation: apart from two small stained patches in Area 3, any anthropogenic discolourations in the soil that might have provided clues to stratigraphy have been destroyed by the podsolisation process (cf., Rankama 2003a:58–60).

Apart from the elevation, the current topography gives few clues to the relationship of the two areas with each other, or indeed to the structure of the site as a whole. The presence of the quarry that seems to have eliminated the central part of the site makes it possible to imagine that most of the archaeology has been lost and what remains are the dregs in the periphery. A closer look at the distribution of the finds in Area 3 (**Fig. 7**) tells a different story, however: there is a distinct fall-off in the finds below the 89.2 metre contour line. The same contour line can be seen as the lower edge of finds also in Areas 1 and 2. This suggests that the occupation reflected in Areas 1–3 has been located at a particular shoreline and that, rather than one large contiguous occupation area, the Kaaraneskoski site as a whole repre-

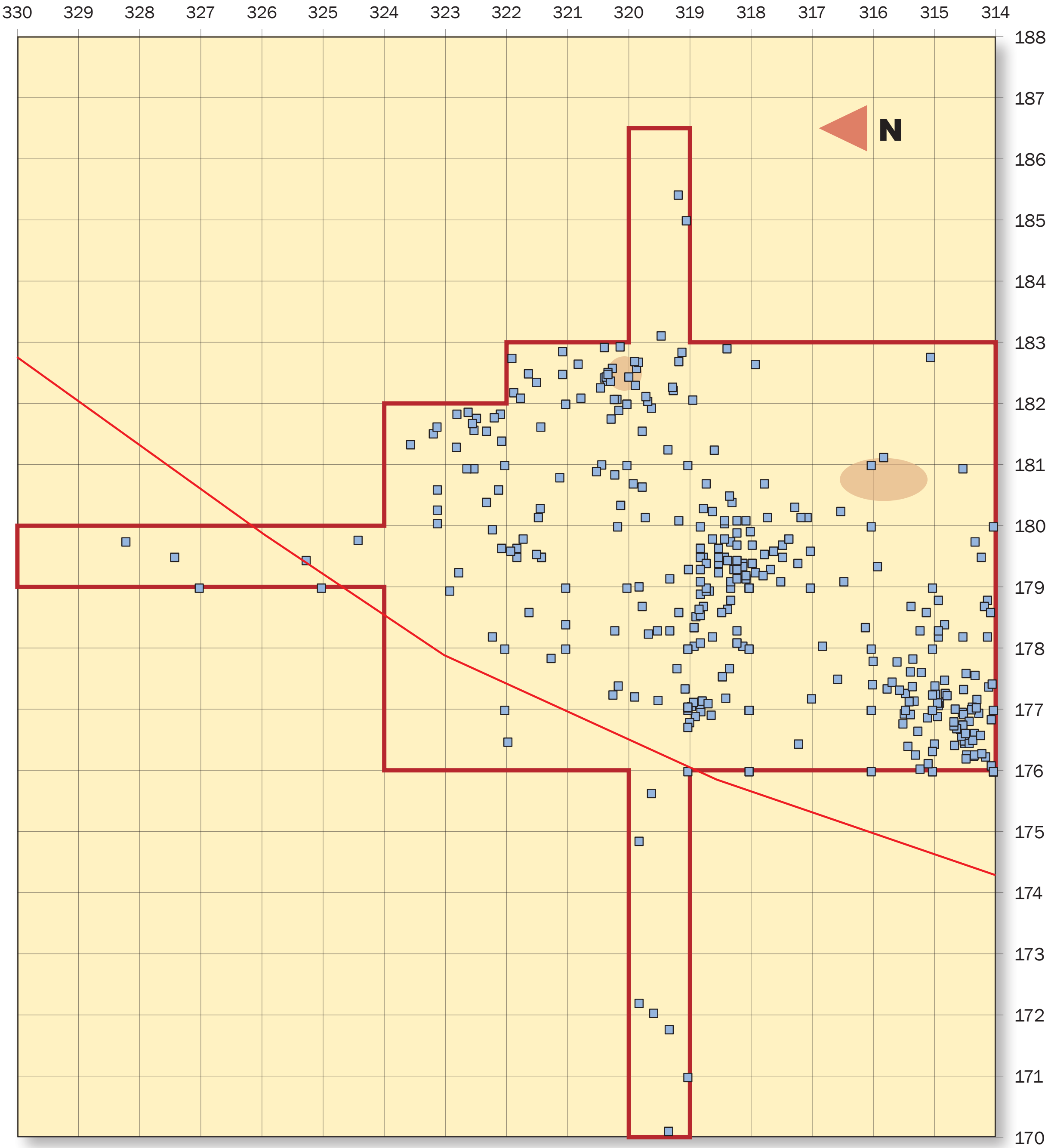


Figure 7. The distribution of all quartz finds in Area 3 at Kaaraneskoski. The ovals show the locations of the stained sand. The red line marks the 89.2 m contour.

sents the remains of a number of individual occupation episodes, each located at or close to the shoreline of their time. Because of the receding shoreline and continuously changing topography, the most profitable site location shifted with time, resulting in the formation of a fairly loose network of living floors of fairly short duration. The finds from each excavation area can, thus, be assumed to constitute samples of separate, coherent wholes.

The distribution of productive and unproductive test pits (**Fig. 5**) tells the same story: productive ones are dispersed as small clusters among unproductive ones. Although the area over which productive test pits occur is wide, the evidence does not support the idea of a large occupation site of long duration, but rather recurring visits by small groups of people over a longer period of time.

The picture that emerges is, thus, not quite as bleak as might be imagined. A large part of the site is definitely gone, but it was not necessarily *the* central part of *the* occupation. Instead, the area that has been quarried away has probably borne the remains of a number of similar separate occupation episodes as the excavated ones. This means that despite the destruction, each of the analysed areas contains clues to one episode of human presence at the site, and these clues need not be considered peripheral to the occupation of that particular episode. As a consequence, it is also safe to assume that the assemblages from excavation areas at different elevations are fairly pristine, i.e., there is no reason to postulate a high degree of mixing of materials from different occupation episodes. As regards settlement structure, the episodic nature of the occupation points towards a mobile way of life, possibly a regularly or irregularly recurring round of which a stay at Kaaraneskoski was just one part. This, of course, is the likeliest lifestyle for Mesolithic hunter-fisher-gatherers in Finland.

The methods of analysis

The classification of the Kaaraneskoski quartz artefacts was done with the help of a low magnification stereo microscope. The standard magnification was 3.6x. In addition, 6x, 12x, and 24x were used to verify the existence of wear marks and very small retouch. All quartz artefacts went through the same analytical procedure.

Several methods were used in the analysis. These included technological analysis, i.e., the identification of the reduction methods employed, the classification of the assemblage into flakes, various categories of tools, and cores, fragment identification and fracture analysis, identifying obvious use wear on the scrapers, and spatial analyses of the various artefact categories.

The technological analysis aimed at identifying the methods used in quartz reduction at Kaaraneskoski. The most common methods employed by the Stone Age quartz users in Finland were platform reduction and bipolar reduction (Hertell & Manninen 2005; Pesonen & Tallavaara 2006; Rankama 2002; Räihälä 1998; 1999; Schulz 1990). Both of these methods were identified among the cores, tools, and flakes in the studied assemblages. In addition to the basic division into bipolar and platform reduction, it was also possible to recognize two separate production concepts within the platform method: flake production and microblade production.

While core classification is usually fairly simple, the reduction method of quartz flakes is not always easy to recognise. Experiments have shown that as much as a fifth of the flakes produced by bipolar reduction may be mistakenly classified as platform flakes, while some platform flakes can also take the appearance of bipolar flakes (Driscoll 2011:739; Knutsson 1988:91–93). These trends, obviously, cancel each other out to some degree in statistical analyses of large assemblages. The "loss" of bipolar flakes to the platform category might also be partly compensated for by the observation (Driscoll 2011:739) that more platform than bipolar debitage tends to remain unclassified as to reduction method. The results of analyses also always depend on the experience of the analyst. Various sources of error, thus, exist and must be borne in mind when assessing analysis results.

The sources of error notwithstanding, technological analysis is a necessary step in the analysis of every quartz assemblage, since it throws light on the technical decisions made by the prehistoric quartz users. The choice of reduction method may be based on practical reasons. Since the bipolar method produces thin flakes with a straight profile, while platform flakes are often slightly bent (Callahan *et al*. 1992:33; Lindgren 2004:174, 176) and fairly thick at least towards the proximal end, it is conceivable that the specific needs of the quartz knapper in each situation played a role in the selection of the reduction method. The method may also be chosen on the basis of the known behaviour of the raw material during reduction. Quartz is known to be difficult to control. The bipolar method, however, produces better results than the platform method: there is, for example, a lower probability of the flakes fragmenting when the bipolar method is used (Callahan *et al.* 1992:34, 38; Driscoll 2011) and this may have played a role in the selection process (Tallavaara *et al.* 2010). It has also been suggested that the choice of reduction method may have depended on the stage of the reduction: analyses of quartz assemblages from Sweden display a *chaîne opératoire* where the reduction was initiated with the platform or platform-on-anvil method, but finished with the bipolar method (Callahan 1987:60–61; Darmark *et al.* 2005; Knutsson 1988:198; Vogel 2006a; 2006b). The same process has been seen as a possibility also for some assemblages in Finland (Pesonen & Tallavaara 2006:16).

On the other hand, the reasons behind the decisions concerning reduction methods may have been culturally or socially determined. In the quartz-using regions of Sweden, for example, analysis results suggest that the bipolar method was a typically Mesolithic mode of quartz reduction, while the proportion of the platform method increased when moving towards the Neolithic. Eventually, the bipolar method all but disappeared (Knutsson & Lindgren 2004; Lindgren 1994:81; Lindgren 2004:38–40, 249–250, 266, Fig. 2.10). This has been interpreted as reflecting a significant change in social structure (Lindgren 2004). Only by analysing a large number of quartz assemblages will it be possible to establish whether culturally or socially based preferences in quartz reduction methods existed also in Finland. According to analyses carried out so far, both the bipolar and the platform method were present in the Mesolithic and there was no notable decrease in the use of the bipolar method in the course of the Stone Age (Pesonen & Tallavaara 2006:16–17; Rankama 2002:83–86, Figs. 3, 5; Räihälä 1998:11; Räihälä 1999:123; Schulz 1990:Fig. 4). Quite the contrary, in the analysed quartz assemblage from one of the youngest published sites, Råvåsen in Kristiinankaupunki, the bipolar method is more dominant than in any of the others (Hertell & Manninen 2005:87, 89–90).

Since the natural breakup of quartz flakes during reduction produces a variety of fragments (Callahan *et al.* 1992; Rankama 2002:Fig. 2; Tallavaara *et al.* 2010) that can, in the absence of appropriate knowledge, be mistakenly interpreted as implements (see Knutsson 1998), strict criteria were employed in tool identification within the Kaaraneskoski assemblage (cf., Rankama 2002:81). These were: 1) presence of secondary modification (retouch) distinguished either with the naked eye or with the microscope, 2) presence of obvious use wear, i.e., rounding or micro-chipping of the edges, even if retouch was absent, or 3) both. The definition of accepted retouch was three consecutive retouch scars. Rounding of the edges was tested by studying the other edges of the supposed tools: if the other edges and ridges were clearly sharper than the proposed working edge, the presence of use wear was accepted. This was based on the assumption that rounding of all edges could be the result of post-depositional processes, such as water rolling, but selective rounding of only one part of the artefact, especially one fit as a working edge, could only have been produced by use.

Defining the exact function of the tools was not attempted, since funds for high-power use wear analysis were not available. Morphologically based functional categories, such as scrapers, were, however, employed in the classification.

Fragment identification was a key part of the analysis. Quartz has an idiosyncratic mode of behaviour during reduction in that the detached pieces more often than not break into smaller fragments. The fragmentation is not random but follows the laws of the behaviour of brittle materials under stress. The most common fracturing types are radial fractures emanating from the point of impact that split the flakes lengthwise, and bending fractures caused by vibrations in the material that result in perpendicular breaks. Both forces act simultaneously (Callahan *et al.* 1992:30–32, 38–38, 50, Fig. 2). The result is a range of fragments (**Fig. 8**), the recognition of which is vital for any quartz analysis. An awareness of natural fragmentation makes it possible to understand quartz assemblages better, and although fragment identification is time-consuming, it is absolutely necessary for avoiding the misclassification of natural fragments as tools (cf., Knutsson 1998).

Since the various fragments have different characteristics as regards, for example, length of thin, sharp edge or sturdiness, fragment classification can be used to study behavioural patterns and the choices made by the prehistoric quartz users, for example the selection of specific fragment types for use or modification as tools (Callahan *et al.* 1992:52–54; see also Darmark *et al.* 2005; Rankama 2002). Combined with spatial analyses, fragment classification may reveal possible activity areas or storage facilities for tool blanks (Rankama 2002:97–106).

Fragment classification was originally used as the basis of fracture analysis, in which the proportions of the various fragments were employed to infer the degree of disturbance – human or otherwise – to a prehistoric quartz assemblage. According to the original publication (Callahan *et al.* 1992), which was based on experimental work, it was possible to put forward the ideal composition of a complete fragment series from which nothing had been removed. In addition, different reduction methods produced distinctly different fracture patterns, i.e., the proportions of whole flakes, lateral fragments, distal fragments, and so on, varied predictably depending on whether the assemblage was produced by platform reduction or bipolar reduction. It was then deemed possible to compare the facture

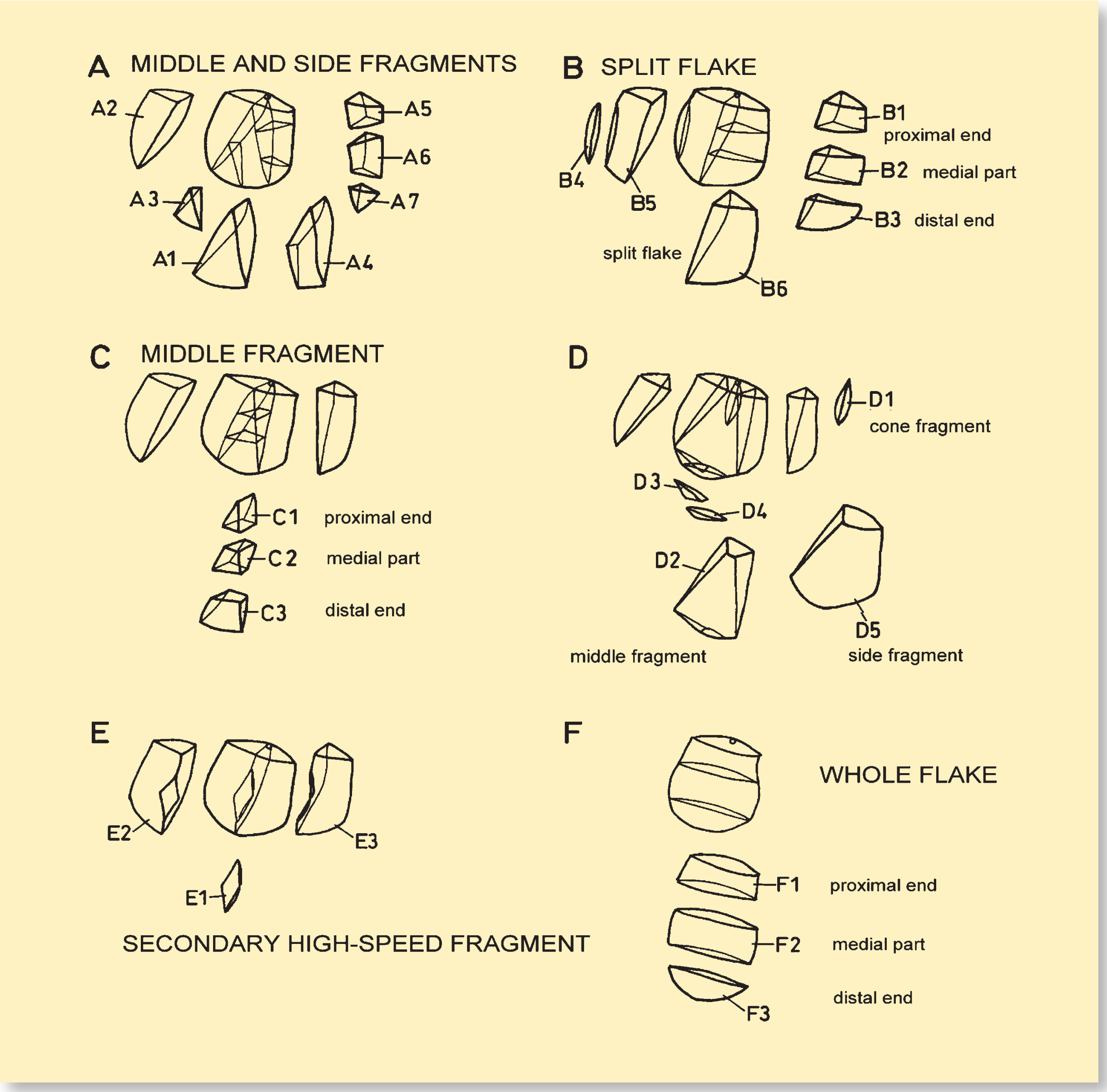


Figure 8. Schematic representation of the different fragment types. Modified from Rankama 2002:Fig. 2. Based on Callahan *et al.* 1992:Fig. 3.

patterns of archaeological assemblages with experimentally produced complete fracture patterns to see to what degree they differed from each other. This was thought to make it possible, for example, to distinguish assemblages representing knapping sites from which the usable fragments had been removed from assemblages representing selected collections of tool blanks (cf., Darmark *et al.* 2005; Rankama 2002; Räihälä 1998; 1999; Vogel 2006a; 2006b).

Recent studies (Tallavaara *et al.*, 2010) have, however, shown that the patterns of fragmentation are not quite as clear-cut as originally proposed. The fracture patterns produced by hand-held direct percussion appear to be affected by "indenter hardness, the relative thickness of the detached flake, and individual knapper-related factors", such as skill, more than allowed for by Callahan *et al.* (1992). As a consequence, comparisons between archaeological and experimental fracture patterns are not as straightforward as originally thought and should, at the very least, be used with caution. This does not, however, reduce the value of fragment identification as a tool for analysing quartz assemblages, or undermine the understanding of quartz behaviour during reduction gained through the experiments by Callahan and his co-workers.

In this study, fracture patterns are not compared with any experimental fragment distributions, but they are used as a basis of conclusions about the formation of the assemblage. The identified fragments are also utilised, for example, in studying the preferences of the fragments used as blanks for a variety of tools, and in combination with the identified tools, in distribution studies that seek to detect activity areas within the site.

Since the whole assemblage went through a low-power microscope analysis, obvious instances of use wear were recorded, and verified by increasing the magnification up to 24x. This paper discusses the patterns of use wear recorded on the scrapers, in which the wear was clearest. The identification follows the guidelines published by Broadbent and Knutsson (1975) and Broadbent (1979). Since they studied quartz deriving from similar geological contexts as in Finland, their experiments and observations were assumed to be valid for the Kaaraneskoski scrapers. The magnifications they used were, however, much higher than was possible in this study. High-power microwear analysis, which would have been necessary for identifying, for example, the exact mode of use of the artefacts, would have required sending the artefacts abroad and was not financially possible.

The wear marks were coarsely divided into "hard" and "soft" wear, "hard" being characterised by crushing and occasionally undercutting of the scraper edge, and "soft" by rounding. No finer distinction of wear types was attempted. According to Broadbent and Knutsson (1975) and Broadbent (1979), hard wear is typically produced by the use of the tool on a hard surface, such as wood, antler, or bone, while soft wear results from working soft materials, such as hide. Due to the low magnifications used, the analysis of the Kaaraneskoski scrapers is necessarily simple and the interpretation should be taken as suggestive only (but see Odell 1990 for a discussion of the potential of low power use wear analysis in interpreting site assemblages). The presence of use wear on several scrapers (and other tools) is, nevertheless, undeniable.

The purpose of the use wear analysis was to study the patterns of scraper use. According to conventional wisdom scrapers are tools that are most commonly used in hide working. Earlier analyses have shown, however, that this is not necessarily the case and that wear associated with working harder materials is more common on scrapers (Broadbent & Knutsson 1975:125–126; Rankama 2002:92–93).

The recording of the finds in small areal units and often individually made it possible to study the spatial distributions of the various artefact categories. An example of the usefulness of distribution studies has already been presented (**Fig. 7**). This paper does not, however, include a full spatial analysis – that would be the topic for a separate publication. A few patterns are, nevertheless, briefly discussed, although the small sizes of the excavation areas and the shape of Area 5 make it difficult to draw definitive conclusions on the basis of the limited distribution analyses included here.

The results of the analyses

Technological analyses

As indicated above, identifying the technique with which a quartz flake has been produced is not always straightforward. Platform reduction sometimes produces flakes that look like bipolar flakes, and vice versa (Driscoll 2011:739; Knutsson 1988:91–93), which means that every analysis will include a certain degree of uncertainty. With this *caveat* in mind, we can look at the results of the technological analyses of the Kaaraneskoski assemblages.

The reduction method was determined in about half of the quartz flakes and tools – 49.3% in Area 3 and 56.6% in Area 5 – and all of the cores. The large proportion of unclassified flakes can be explained by fragmentation: in the Area 5 assemblage, 74.6% of the flakes whose reduction method was not defined were distal or medial fragments which, in the absence of the proximal end or other diagnostic features, cannot be classified (cf., Rankama 2002:Fig. 4), and the same pattern undoubtedly applies to the Area 3 assemblage. Looking at the tools separately, the proportion of artefacts the reduction method of which it was impossible to determine is higher, 65% in both areas. This can be explained by the secondary modification that has in many cases destroyed the evidence of the primary reduction method. Scrapers are a case in point: of the 20 scrapers in the Area 3 assemblage 18, or 90%, could not be classified as to the method of producing the original flake; in Area 5, the percentage was 85, i.e., 33 out of 39.

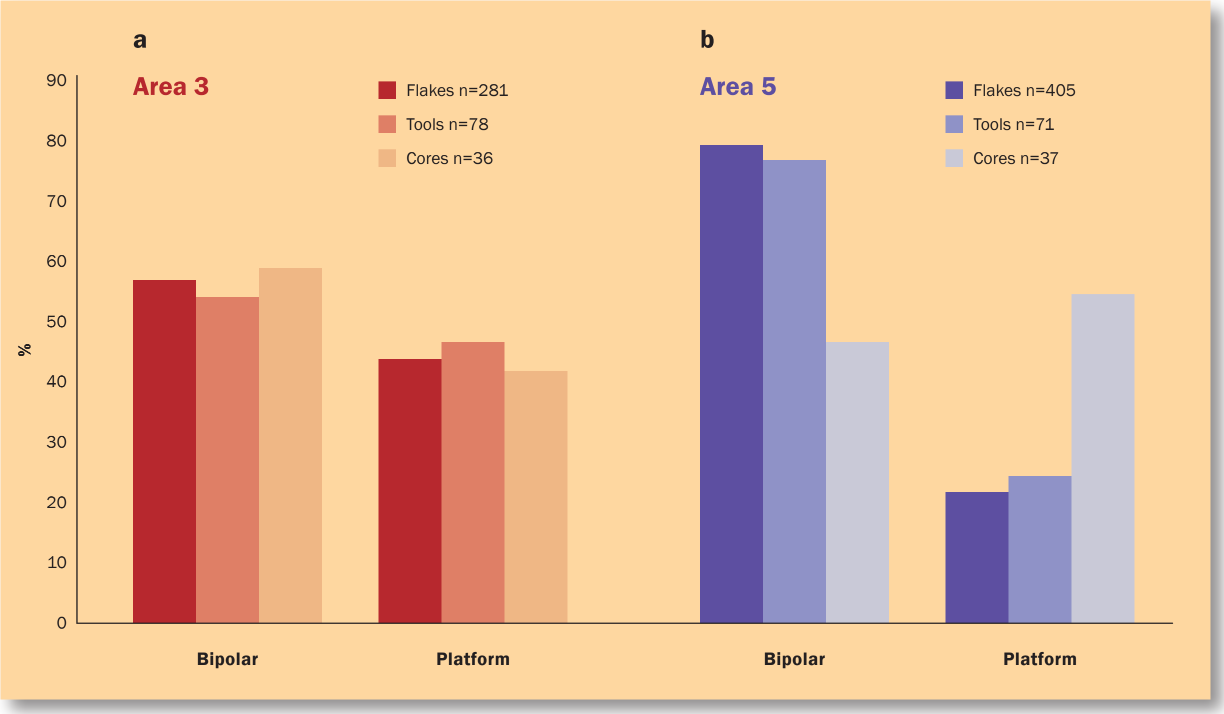


Figure 9. The identified reduction methods in Areas 3 and 5 at Kaaraneskoski.

The technological analysis shows a slight preponderance of the bipolar method in Area 3 (**Fig. 9:a; Appendix I: Table 1**): 54–58% of the flakes, tools, and cores that it has been possible to classify derive from bipolar flaking. In Area 5 (**Fig. 9:b**) the dominance of the bipolar method is more pronounced among the flakes and tools, reaching 76–79%. Among the cores, however, the platform method dominates with 54%.

The pattern in Area 3 suggests that the bipolar and platform methods have been used side by side. There is no discrepancy between the percentages of the different artefact categories, although such discrepancies have previously been observed in several analysed assemblages in Finland and Sweden (see Rankama 2002:84–86 with references for examples and a discussion of this phenomenon). In Central Sweden, it has been suggested that quartz reduction followed a sequence in which the knapper started off with the free-hand platform method, changing to the platform-on-anvil method and finally the bipolar method as the core size diminished (Callahan 1987:60–61, Fig. 97; see also, e.g., Darmark *et al.* 2005; Vogel 2006a; 2006b). This kind of sequence might, for example, result in an overabundance of bipolar cores, as well as platform flakes, as compared with the number of platform cores, since the latter would have changed type during the reduction chain. The Kaaraneskoski Area 3 pattern does not suggest a shift from one method to the other.

To study this theme further, a comparison was made between the sizes of the flakes produced with bipolar and platform reduction. If a sequence from platform through platform-on-anvil to bipolar were present, one should expect to see a pattern where the platform flakes would be systematically larger than the bipolar flakes. Since length measurements of all the flakes were not available, this study was done by comparing the mean weights of the flakes. The results (**Fig. 10; Appendix I: Table 2.**) show that among the unfragmented flakes the bipolar ones are systematically heavier than the platform ones in both excavation areas, although the difference is smaller in Area 5. The pattern is the same when all the flakes are included. This does not support the idea of a sequence from platform to bipolar.

A comparison between the weights of cores of different categories was also carried out (**Fig. 11; Appendix 1: Table 3**). In this study, a more detailed classification of core types was used. The platform cores from both analysed areas at Kaaraneskoski include a few micro-

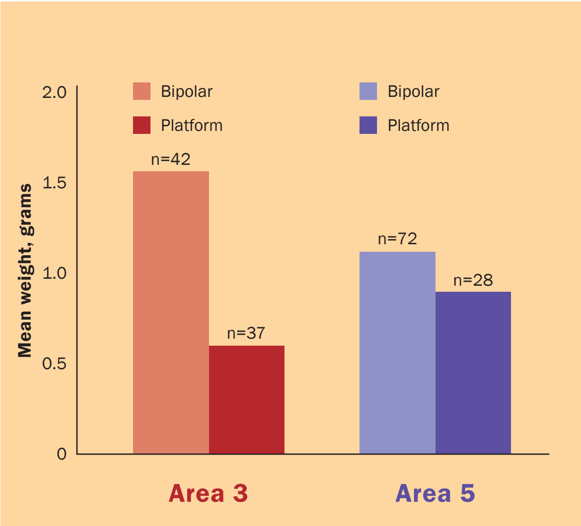


Figure 10. Mean weights of unfragmented flakes from Areas 3 and 5 at Kaaraneskoski.

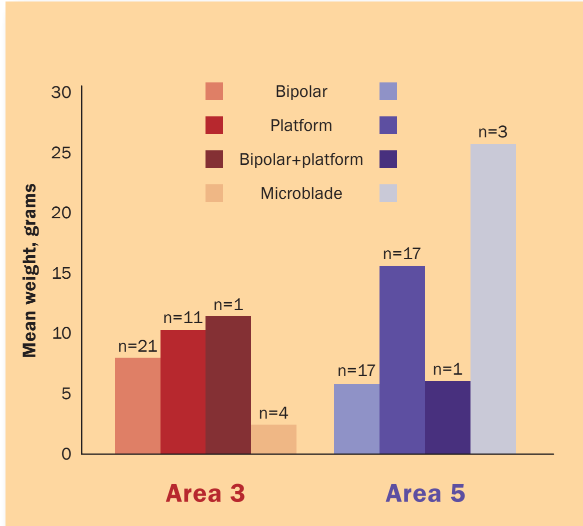


Figure 11. Mean weights of different core categories from Areas 3 and 5 at Kaaraneskoski.

blade cores. One core from each area shows evidence of having been used both in platform and in bipolar reduction. The cores from Area 3 show less variation than the cores from Area 5, but in both areas it is clear that the bipolar cores are smaller and have, thus, been worked further than the platform cores. Combined with the flake weight data this suggests that bipolar reduction started with fairly large nodules, certainly not smaller than platform reduction, and, as is common with the bipolar method, continued until the cores were clearly smaller than the discarded platform cores. The fact that bipolar+platform cores, nevertheless, exist, indicates that, although the two reduction methods as a rule represented separate *chaînes opératoires*, it was not inconceivable to occasionally shift from one method to the other as the situation demanded, or to reuse an old core. There is no evidence, however, of a regularly followed sequence from platform to bipolar in the assemblage.

To return for a moment to the identified reduction methods in Area 5 (**Fig. 9:b**), the number of platform cores seems high as compared with the number of platform flakes. This is difficult to explain, but may have to do with the character of the excavation area, which was basically a set of narrow intersecting trenches (**Fig. 5**). The finds from this area may, thus, not represent a balanced sample of the whole assemblage from this occupation episode.

Tools, cores, and flakes

The analyses revealed an exceptionally high proportion of tools in the Kaaraneskoski quartz assemblages (**Fig. 12; Appendix 1: Table 4**). Although strict criteria were employed in tool identification, in Area 3 as much as 29% of the quartz artefacts were classified as tools, while in Area 5 the percentage reached 23. These percentages are much higher than in other analysed quartz assemblages in Finland. At most analysed sites the percentage is well below 10 (e.g., Pesonen 2001:45; Schulz 1990:10, Fig. 4). Percentages approaching 10 have been recorded at Hossanmäki in Lohja (9.5%; Pesonen & Tallavaara 2006:15, Table 2) and at Kauvonkangas in Tervola (9.8%). In one of the semi-subterranean houses at Kauvonkangas the tool percentage was as high as 13.4 (Rankama 2002:86–88, Fig. 6, Table 1). It is probable that the high tool percentages at Hossanmäki and Kauvonkangas can be explained at least in part through the use of a microscope in the analysis process. This makes it possible to employ use wear to identify tools that have no secondary modification. The existence of tiny retouch can also be verified better with the use of a microscope.

The high proportion of tools in the Kaaraneskoski assemblages may also be associated with the character of the occupation. It has already been observed that the site most probably consists of the remains of a number

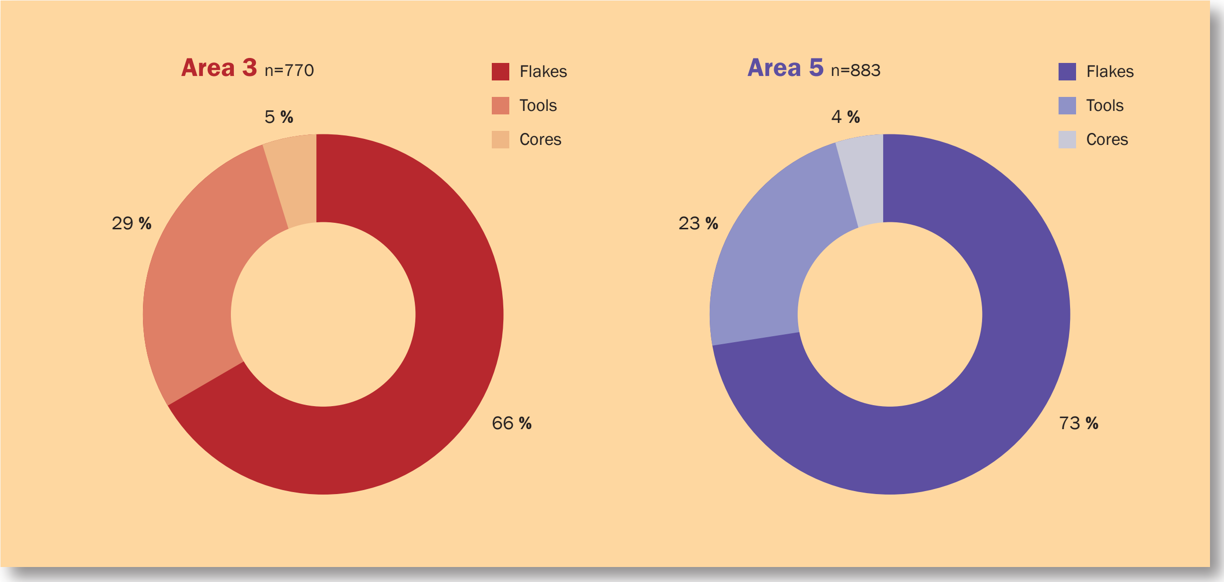


Figure 12. Major artefact classes in the analysed Kaaraneskoski assemblages. The category "Flakes" includes flake fragments.

of individual occupation episodes that took place over a period of some four hundred years. This implies a mobile lifestyle. The groups visiting Kaaraneskoski were using several campsites and transporting lithic material from one site to another within their regular mobility pattern. In this kind of a situation the assemblage of each campsite is hardly pristine, but consists of both artefacts manufactured *in situ* and artefacts brought in from the previous campsite. Since the material brought in is likely to consist mainly of tools, tool blanks, and cores, this will add to the tool percentage, even if some tools will again be taken along to the next site.

The high tool percentage may also be associated with the spatial distribution of activities at the site. Although both analysed assemblages include a large amount of debitage, most of the primary reduction may have taken place away from the actual residential area. The assemblages would, thus, represent highly selected collections of artefacts, which would mean that the artefacts classified as debitage should also show evidence of selection, since they could be expected to consist to a large degree of blanks for tools rather than debitage from primary reduction.

Figure 12 shows also the proportions of cores and flakes in Areas 3 and 5 at Kaaraneskoski. The core percentages – 5% in Area 3 and 4% in Area 5 – are not unusual in Finland. Similar percentages have been published from Hossanmäki in Lohja (3.7%; Pesonen & Tallavaara 2006:15, Table 2) and Kauvonkangas in Tervola (2.6% and 4.5%; Rankama 2002:86–87, Fig. 6). The range of core percentages at archaeological sites appears wide and is subject to a variety of sources of error (see Rankama 2002:86–88 for a further discussion of core and tool percentages in Sweden and Finland). Since there is no standard number of detachments that one core can be expected to produce, it is difficult to know what core percentages as such might reflect. Extremely high or low percentages might evoke arguments about transportation, caching or other special treatment of cores, but with average percentages such discussion is not possible.

Tool categories

Since the various, and numerous, tools are one of the most distinctive features of the Kaaraneskoski assemblage, this chapter discusses implements not only from Areas 3 and 5 but in part also from the other excavation areas, test pits, and surface finds. The quartz tool categories identified can be seen in **Figure 13** (also **Appendix 1: Table 5**), which lists the tools from Areas 3 and 5. Only the most abundant categories will be discussed below in more detail.

As can be seen, both areas have yielded a great variety of tools, indicating that numerous different activities took place in each area. This means that we are

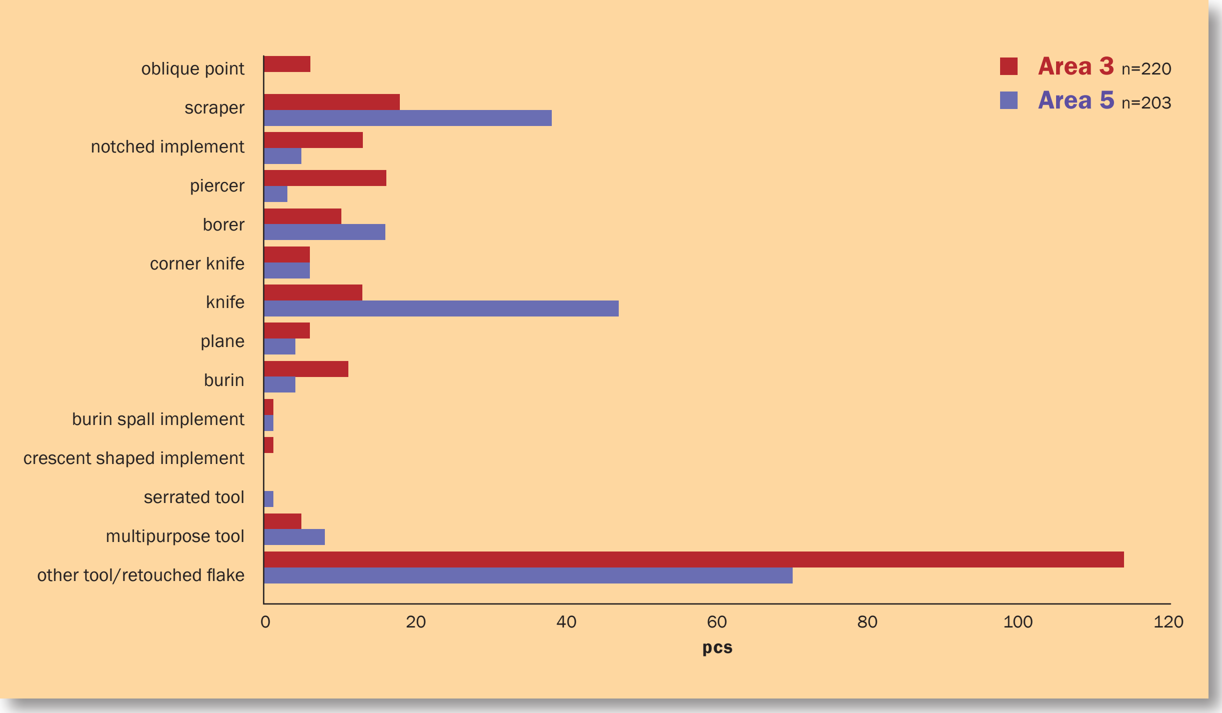


Figure 13. Quartz tool categories from Areas 3 and 5 at Kaaraneskoski.

not dealing with single purpose sites, such as hunting stations.

The most abundant tools are retouched flakes, the exact function of which cannot be determined without microwear analysis. There may be a discrepancy in classification as regards the classes "knife" and "retouched flake". Since Area 5 was excavated in 1998, while Area 3 was excavated partly in 1997 and partly in 1998, the assemblages were analysed at different times. This may be reflected in the number of pieces classified as "knives": in the Area 5 assemblage, analysed later and with more experience, more of the retouched pieces were perhaps classified as "knives", while in the earlier analysis the more general category "retouched flake" was considered safer.

As became evident already in the discussion about tool percentages, tools of almost all categories are more numerous in Area 3 than in Area 5. The most notable exception to this is the scrapers. Borers and multipurpose tools are also slightly more numerous in Area 5. The total numbers are, however, so small that the differences cannot be given statistical significance. The shape of Area 5 also renders it difficult to judge what these discrepancies might mean.

Oblique points

This tool category has been extensively discussed by Manninen and Knutsson (*this volume*) and Manninen and Tallavaara (*this volume*). The oblique quartz point is a Late Mesolithic artefact form that has an eastern and northern distribution in Fennoscandia, i.e., it is found mostly in Finland and northern Norway. Its distribution complements that of the contemporaneous handle cores, which have a more western and southern distribution, but these artefacts seldom occur at the same sites. There is a region in northern Sweden where oblique points, although rare, are found side by side with handle cores (Manninen & Knutsson *this volume*:e.g., Fig. 5, Fig. 11.). The Kaaraneskoski assemblage includes both artefact types and seems, thus, to be the easternmost extension of this region.

Oblique quartz points are characterised by an almost triangular shape, where the narrow base widens towards the tip that is formed by a feathered edge of the flake. The cutting edge is oblique, or sometimes transverse. The base is shaped by backing, usually on both edges (Manninen & Knutsson *this volume*:Fig. 2.). The classification of oblique points is often difficult, since most of

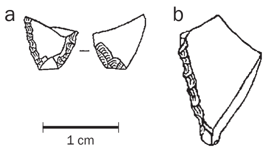


Figure 14. Oblique point fragments of quartz from Area 3 at Kaaraneskoski. Scale in centimetres. Drawings by T. Rankama[2].

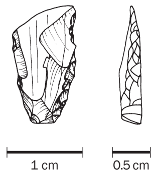


Figure 15. Oblique slate point from Area 2 at Kaaraneskoski. Scales in centimetres. Drawings by T. Rankama.

them are fragmentary. The best identification criterion is the backing, but even this can be at times difficult to ascertain. The presence of backing is, however, essential, since without it, natural fragments can easily be included in the category (Knutsson 1998). The Kaaraneskoski assemblage includes six artefacts classified as oblique point fragments of quartz, all from Area 3. The most compelling fragments are illustrated in **Figure 14**.

In addition to the quartz points, the assemblage includes a unique slate point shaped in the oblique point style (**Fig. 15**). Its edges and base have been shaped first by invasive retouch and then by backing, and the rest of the dorsal surface is polished. It may have been a flake detached from a polished slate adze that was recycled as an oblique point. The implement was found in Area 2, one of the test trenches in the eastern part of the site (**Fig. 5**). Area 2 lies at the same elevation as Area 3 and is probably roughly contemporaneous with it. If most of the quartz oblique points from the site are to some degree suspect, this slate point makes it clear that the oblique point concept was alive among the group(s) that visited Kaaraneskoski.

Scrapers and planes

The assemblage includes 86 artefacts classified as scrapers and 15 artefacts classified as planes. Scrapers and planes are tools that are usually associated with wood, bone, antler, or hide working. In the classification used here, planes differ from scrapers in that they are larger and the working edge is nearly straight and very sturdy. The edge angle is close to 90˚, although precise angle measurements have not been made. Without a microwear analysis the justification of these tools being classified as planes can, of course, be questioned.

The shapes of the scrapers are fairly heterogeneous. As is most often the case in Finnish Stone Age assemblages, the most important feature of the tool seems to have been the working edge, which is usually convex and has been modified with semi-abrupt retouch. The shape of the rest of the implement has apparently been considered less important. **Figure 16** shows a selection of scrapers from the various excavation areas at Kaaraneskoski. Their sizes vary. Some of the scrapers are represented by only a short fragment, barely more than the working edge (**Fig. 16:k, l**). These "slugs" may have been broken – intentionally or unintentionally (cf., Knutsson 1988:150) – or, alternatively, resharpened until only a short piece has remained (cf., Gould 1977:83). In the latter case, they must have been hafted. Some scrapers have two opposing working edges, one with normal, the other with inverse retouch (**Fig. 16:a**). This kind of "propeller" retouch suggests that the pieces were not hafted, or that the hafting method allowed for easy detachment and re-attachment. The recovered pieces are not long enough to have been placed in a hole in the middle of a long shaft with the edges showing from the opposite sides of the shaft, as recorded in some ethnographic examples (e.g.,. Itkonen 1948:313, Fig. 126.)

Despite the generally varied morphology of the scrapers, a couple of more specific scraper types can be distinguished. One is high and almost rectangular, such as the ones shown in **Figure 17**. The other is the circular, or thumb-nail, scraper, which is fairly common in the assemblage (n=12). Scrapers of this type have been found all over the site (**Fig. 18**). Thumb-nail scrapers are often included in Mesolithic assemblages in Finland, but since no quantification of their occurrence at sites of different ages has ever been made, positive statements about their chronological position cannot be made. The implement type would, in any case, be worth a proper study.

As indicated above, only a small proportion – 13 out of 73, or 15% – of the scrapers could be classified as to the method of producing the blank. Five scrapers were made from bipolar flakes, another five from plat-

[2] For the catalogue numbers of this and the subsequent artefact illustrations, see **Appendix II**.

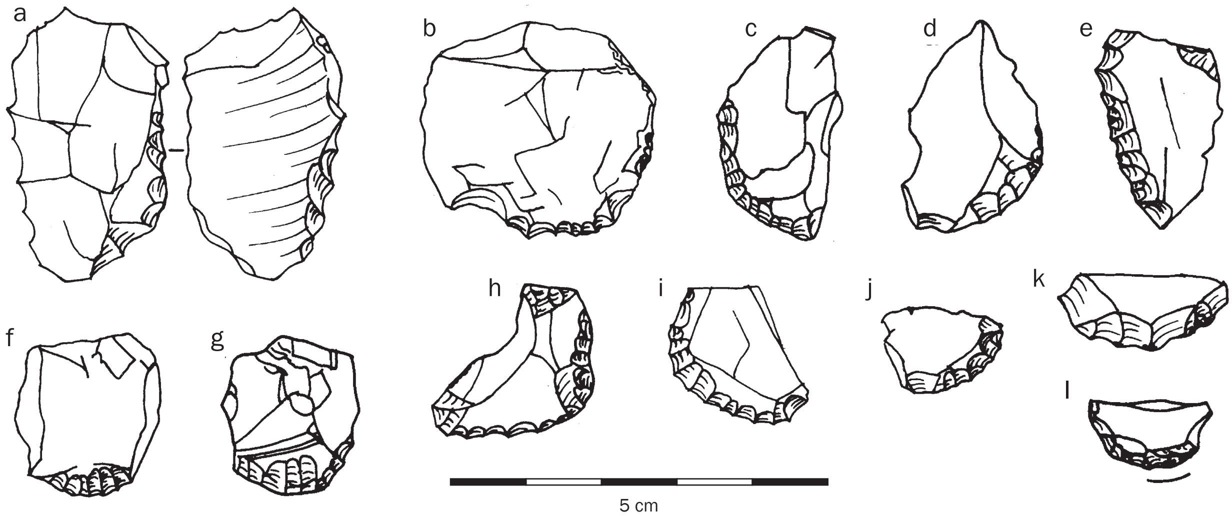


Figure 16. A selection of quartz scrapers from Kaaraneskoski. a–b, g, i, and k from Area 5; d–f, h, and j from Area 3; l from Area 2; c is a stray find. Scale in centimetres. Drawings by T. Rankama.

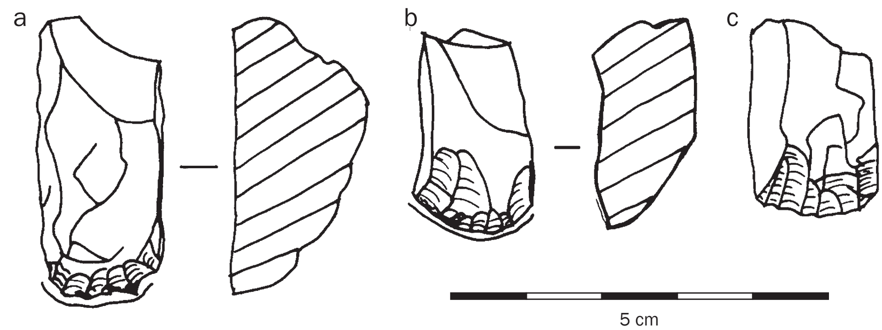


Figure 17. Long, narrow, and high quartz scrapers from Kaaraneskoski. a from Area 2; b–c are stray finds. Scale in centimetres. Drawings by T. Rankama.

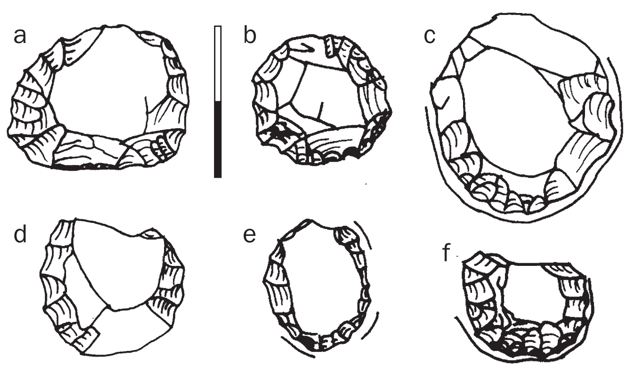


Figure 18. Circular "thumb-nail" quartz scrapers from Kaaraneskoski. a and d from Area 5; b stray find; c from a test pit; e from Area 3; f from "Paula's pit". Scale in centimetres. Drawings by T. Rankama.

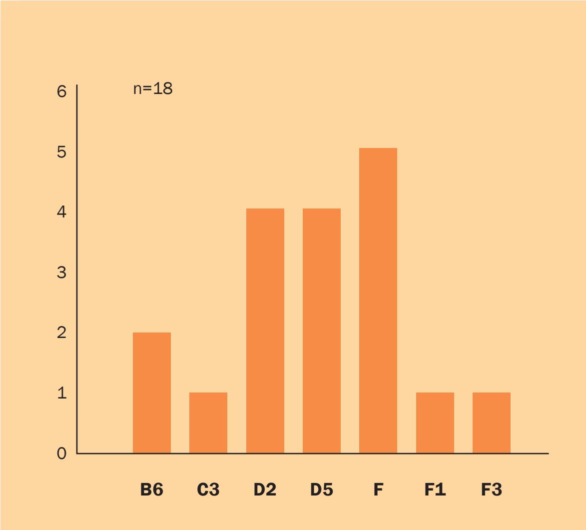


Figure 19. Fragment classification of scrapers from Kaaraneskoski.

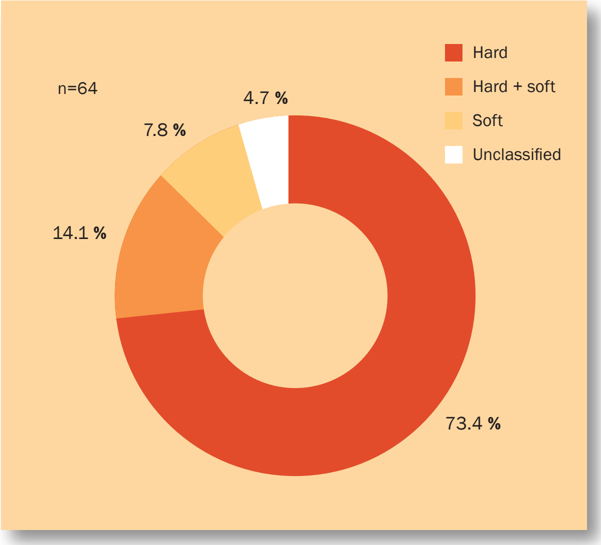


Figure 20. Scraper use wear at Kaaraneskoski.

form flakes, and one from a platform-on-anvil flake. This goes against the expectation that platform flakes would make better blanks for scrapers. The small number of the sample, however, renders the result equivocal. In addition, two scrapers were made from bipolar cores. This mode of behaviour has been observed also in Sweden, where it is considered common (Knutsson 1988:100).

Fragment classification of the scrapers faced the same kind of problem as method classification: due to the extensive secondary modification, the fragment was identified in only 18 scrapers, or 21% of the total. The identified fragments display an interesting, if predictable, pattern (**Fig. 19; Appendix 1: Table 6**). Scrapers are most commonly made from complete flakes (F) and the largest fragment types (cf., **Fig. 8**): side fragments (B6, D5) and middle fragments (D2). The three other fragment types identified (C3, F1, F3) may represent intentional truncation, although evidence of it was not recognised in the analysis (cf., Knutsson 1998:150, Fig. 93). The pattern of blank selection agrees well with what has previously been recorded in Finland (Rankama 2002:95–96, Table 4) and Sweden (Callahan *et al.* 1992:50–54).

Scraper macrowear at Kaaraneskoski shows the same general pattern as at the Kauvonkangas site in Tervola (Rankama 2002:92–93, Fig. 13–14). A total of 88 scrapers from all excavation areas (including stray finds) were analysed. Slightly over a quarter of them (28.1%) displayed no recognisable wear marks at magnifications up to 24x. Of the 64 scrapers with use wear, 73.4% had hard wear, an additional 14.1% both hard and soft wear, and a mere 7.8% soft wear (**Fig 20; Appendix 1: Table 7;** cf., Broadbent & Knutsson 1975). This emphasises again the fact that the use of scrapers was more versatile than generally believed, i.e., that their use was not restricted to soft materials. Seven of the twelve thumb-nail scrapers had hard wear and three had no recognisable wear at all. This seems to suggest that this particular tool form was meant primarily for working hard materials.

Notched implements

Notched implements are a characteristic tool form at Kaaraneskoski and have also been encountered in other assemblages in Finland (e.g., Rankama 2002:90, Fig. 11:1–2). As can be seen in **Figure 21**, they come in various shapes and sizes. The common factor is a notch shaped by retouch. Attempts to quantify the size of the notch to find some patterning have so far failed.

Piercers and borers

Piercers and borers are implements that have a pointed but sturdy shape with either use wear or very small retouch on the point (**Fig. 22**). The retouch, which can be the result of use rather than intentional modification, can often be found on two surfaces indicating use with a twisting motion. **Figure 22:c** is a piercer with a thin and narrow straight edge suitable, e.g., for poking a hole in leather.

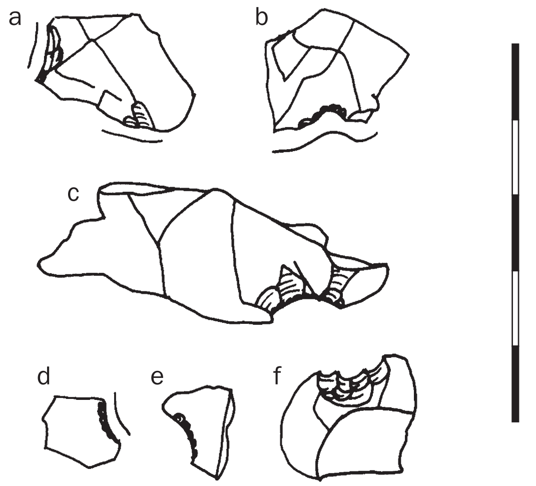


Figure 21. Notched quartz implements from Kaaraneskoski. a from Area 5; b stray find; c–f from Area 3. Scale in centimetres. Drawings by T. Rankama.

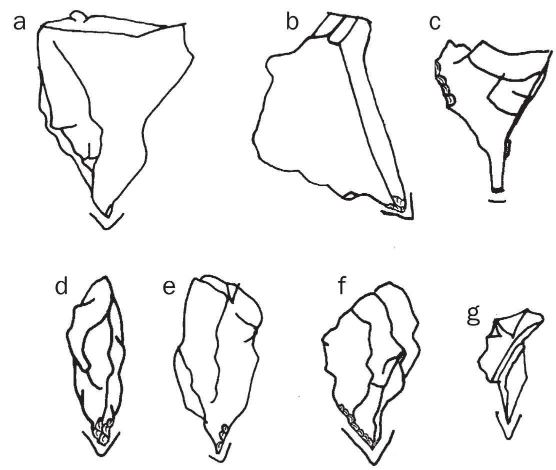


Figure 22. Quartz piercers and borers from Kaaraneskoski. a, b, d, e from Area 5; c, f, g from Area 3. Scale in centimetres. Drawings by T. Rankama.

Knives

Knives are the most numerous tool category in the Kaaraneskoski quartz assemblage (see **Fig. 13**). They come in various sizes and shapes but are always characterized by a thin, sharp edge with small retouch formed either by intentional modification or during use. **Figure 23** shows a selection of knives. Some of the knife edges are straight (**Fig. 23:i**), others convex or even concave (**Fig. 23:m**). The length of the cutting edge varies. Some pieces have evidence of use on more than one side of the flake (**Fig. 23:b**). The shape of most of the pieces suggests that they have not been hafted but held in the hand.

Among the knives, one can distinguish a number of special tools referred to as corner knives (**Fig. 24**). These implements are usually fairly large and wider than

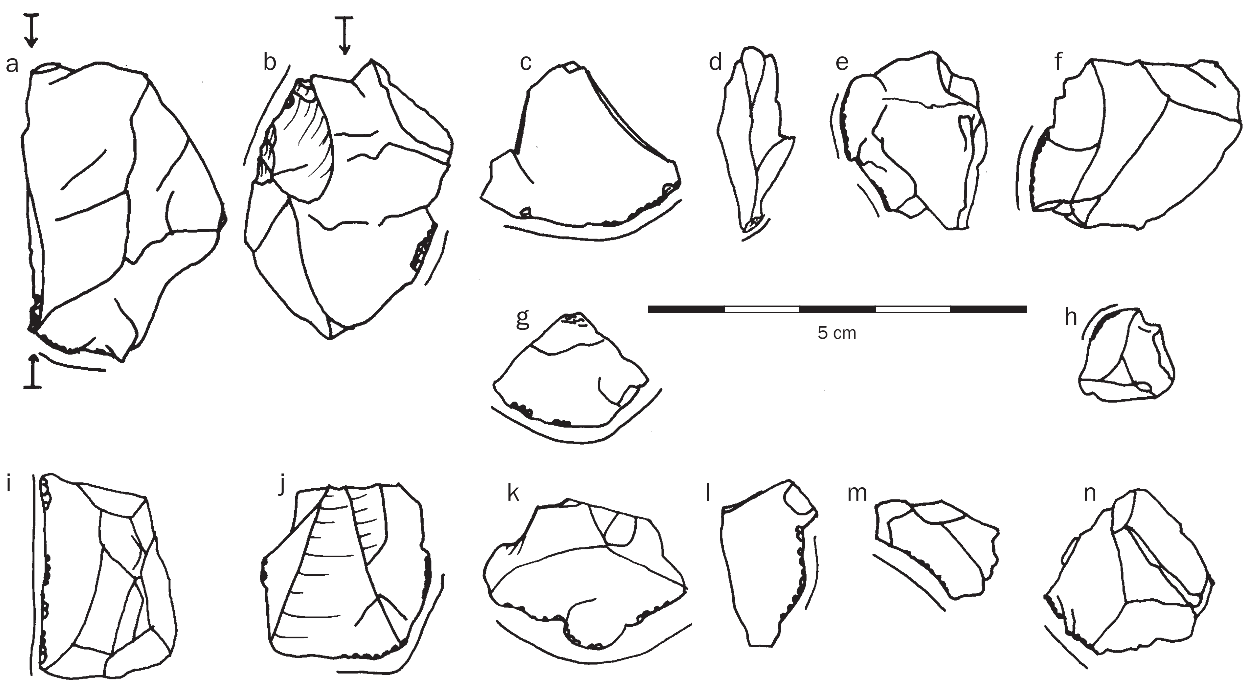


Figure 23. A selection of quartz knives from Kaaraneskoski. a, i from Area 3; b, d, e, k–n from Area 5; c stray find; f from Area 2; g and j from "Paula's pit"; h from Area 4. Scale in centimetres. Scale in centimetres. Drawings by T. Rankama.

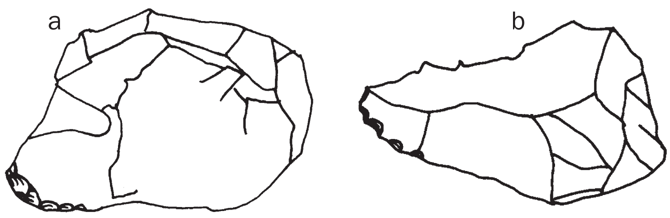


Figure 24. Corner knives of quartz from Area 5 at Kaaraneskoski. Scale in centimetres. Drawings by T. Rankama.

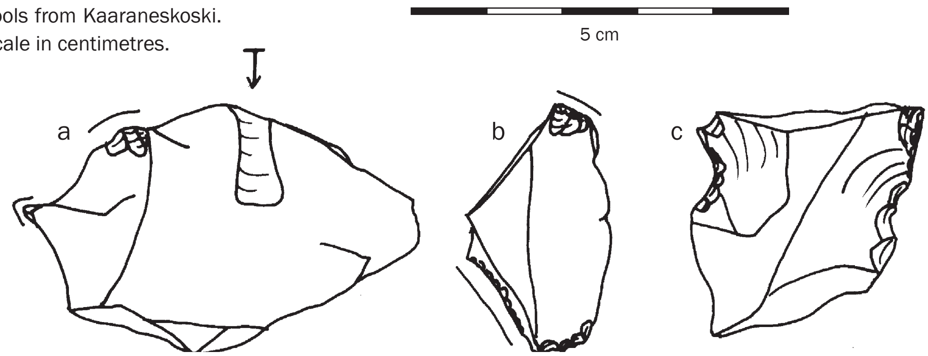


Figure 25. Multipurpose quartz tools from Kaaraneskoski. a–b from Area 5; c from Area 3. Scale in centimetres. Drawings by T. Rankama.

their length; they fit well between the thumb and the first finger, and have retouch around one corner. The tool type was first recognized within the Early Metal Age assemblage from the Ala-Jalve site in Utsjoki (Rankama 1997:14, Fig. 8:9) and is included also in the Kauvonkangas assemblage from Tervola (Rankama 2002:88–89, Fig. 9).

Multipurpose tools

Using a single piece of quartz for several purposes was a typical mode of behaviour at Kaaraneskoski, as indicated by several tools with more than one working edge recognisable through the presence of retouch and/or use wear. Their mode of use depended on the shape of the flake: if it had both a suitable point for perforating and a long thin edge for cutting, it could be used for both purposes. Several multipurpose tools have been recognised. They include, for example, cutting and scraping edges in different combinations with notches, piercers, and so on (**Fig. 25**).

Patterns of quartz tool blank selection

The above drawings have illustrated the great range of variation of shape among the blanks selected for use or secondary modification at Kaaraneskoski. A look at the reduction methods used for producing the tool blanks

Method	bipolar	platform
Area 3		
scraper	2	0
plane	1	1
multipurpose tool	2	0
corner knife	1	1
notched implement	4	1
perforator/piercer	10	2
burin	2	3
knife	2	11
oblique point	0	1
other	16	16
total	**40**	**36**
Area 5		
scraper	3	3
plane	1	0
multipurpose tool	3	2
corner knife	0	2
notched implement	1	0
perforator/piercer	4	1
burin	2	1
knife	21	3
other	19	7
total	**54**	**19**

Figure 26. Reduction methods of tool blanks in Areas 3 and 5 at Kaaraneskoski.

reveals that 36.9% of the tools from Area 3 and 36% of the tools from Area 5 lent themselves to be classified as to blank production method. **Figure 26** shows that out of the 76 classified tool blanks in Area 3, 40 (52.6%) are bipolar flakes and 36 (47.4%) are platform flakes. In Area 5, bipolar flakes dominate more clearly: 54 blanks out of a total of 73 classified (74%) are bipolar, while platform flakes only total 19 (26%). This goes against the assumption that platform flakes would have been sought after as tool blanks because of their sturdiness and better resistance to breakage. The pattern can, however, be at least partly explained by the large general size of bipolar flakes at Kaaraneskoski (**Fig. 10**). In Area 3, the largest number of classified production methods can be found in the "other" category, in which the bipolar and the platform method are tied at 16 pieces each. The other large tool categories are perforators/piercers, among which bipolar flakes dominate 10:2, and knives, where platform flakes dominate 11:2. No clear pattern, thus, emerges in Area 3.

In Area 5, it is specifically the tool categories "knife" and "other" that cause the clear domination of the bipolar method. This is an understandable pattern, since both knives and retouched flakes, many of which were probably used in some kind of a cutting action, can be expected to benefit from the thinness and straightness of a typical bipolar flake. The fact that bipolar flakes remain unfragmented more often than platform flakes (Callahan *et al.* 1992; Driscoll 2011) renders them even more desirable as blanks for cutting implements. The rest of the tool categories are so few in number that no patterns can be detected.

As regards the flake fragments that were selected as tool blanks, in Area 3 it was possible to classify 113, or 61.7% of the tools (**Fig. 27**). In Area 5 the percentage

Fragment	A1	A3	B1	B2	B3	B5	B6	C1	C2	C3	D1	D2	D5	F	F1	F2	F3	total
Area 3																		
scraper														2			1	3
plane												1				1		2
multipurpose tool										1			1		1			3
corner knife							2					2		2				6
notched implement							1					2	4	1			1	9
piercer							1				1		3	3	1		1	10
perforator					1				1		1		1					4
side blade																		0
burin							1						1	2				4
knife		1			4		2							11	1	1	4	24
oblique point												1		1				2
other implement					1		6		1			10	5	13	4		6	46
total		**1**			**6**		**13**		**2**	**1**	**2**	**16**	**15**	**35**	**7**	**2**	**13**	**113**
Area 5																		
scraper							2					2	2		1			7
plane																		0
serrated flake																		0
multipurpose tool														3			1	4
corner knife													1	1				2
notched implement												1					1	2
piercer																		0
perforator							2							4				6
burin								1					1		1			3
knife						1	7			3		2	9	6			2	30
other implement	1		1	2	1	1	3	1	2	1		8	4	6	2	1	5	39
total	**1**		**1**	**2**	**1**	**2**	**14**	**2**	**2**	**4**		**13**	**17**	**20**	**4**	**1**	**9**	**93**

Figure 27. Identified fragments from which tools in Areas 3 and 5 have been manufactured.

was lower, 93 implements or 46.7%. The pattern here is similar to that already detected among the scrapers. Complete flakes (F) dominate as tool blanks in both analysed areas, and the most common fragments used as tools are the largest ones: side fragments (B6, D5) and middle fragments (D2). The large number of distal fragments from complete flakes is also notable.

The patterns of blank selection are very close to those recorded in the assemblage from Kauvonkangas in Tervola (Rankama 2002:91–93, 95–96, Table 3, 4). They also agree well with what has been observed in Sweden (Callahan *et al*. 1992:50–54; Darmark *et al.* 2005; Vogel 2006a; 2006b).

Slate points

The oblique point made of slate has already been discussed above, but it is not the only slate arrowhead from Kaaraneskoski. The assemblage includes three other slate points that seem to form a "type". The points are small, thin, long, and narrow, and although made from slate they are shaped by retouch. Their surfaces have not been ground or polished, and all in all they have the air of being improvised from accidental slate fragments. **Figure 28** shows the points that have been found in different areas around the site: one in Area 1 in the east, one in Area 5, and one as a stray find at the lower edge of the sand quarry.

The authors are not aware of any exact parallels to the Kaaraneskoski slate points in Finland. At the Riitakanranta site close to Lake Sierijärvi in Rovaniemi, some 74 kilometres east-south-east of Kaaraneskoski, ten small coarsely worked slate points, as well as some fragments and roughouts, were encountered in 1990 (Kotivuori 1996:93). These have been assigned to the "Slettnes type" named after the Slettnes site on Sørøya, northern Norway (cf., Hesjedal *et al.* 1996:173–174, Fig. 170), although the association can be questioned. Two slate points more clearly associated with the "Slettnes type" have been found at the nearby Jokkavaara site in Rovaniemi (Torvinen 1999:234, Fig. 15). Both the Riitakanranta and the Jokkavaara site have yielded early pottery of the Sär 1 type and can, thus, be considered slightly younger than Kaaraneskoski. The slate points from these sites differ from the Kaaraneskoski points in being tanged. At least the Jokkavaara points are also more carefully made, while the Kaaraneskoski points are more haphazard in workmanship. It may, nevertheless, be significant that the three sites are located fairly close to each other and are also of fairly similar age.

Cores

Most of the quartz cores from Kaaraneskoski represent the normal bipolar or irregular platform core types (cf., **Fig. 11**). In addition, the assemblage includes a few microblade cores that are worth a closer look. The first one is an almost cubical core from Area 3 (**Fig. 29**). It is made from very high quality quartz with barely any internal flaws, and has been struck from several directions. The first face (on the left in **Fig. 29**) is bi-directional. The striking platforms at each end are flat and the striking angle is c. 90˚. The second face from the left shows a part of the scars of the first face, but also scars in a different direction emanating from the lower right corner. To work the third face the core has been turned 90˚ anti-clockwise and another flat surface has been used as the striking platform. Even here the striking angle is close to 90˚. The width of the last microblades detached from the core is only about 4–5 mm.

The core brings to mind the cubical cores from Zhokov Island in the Siberian High Arctic, dated to c 7800 BP (Giria and Pitul'ko 1994:32, 34–43, Fig, 6–10). That site is, of course, too early and too far away to have had any direct influence on Kaaraneskoski. It is difficult to find any counterparts for the core from less remote areas, however. The core shape may, of course, be purely opportunistic, but the approach of the knapper appears quite purposeful and demonstrates a high degree of determination.

Two other microblade cores, both from Area 5, display features that are not typical of Finnish quartz assemblages. Although irregular due to the quartz raw material, they have an elongated shape with blade detachments only at one narrow end (**Fig. 30**), and the base of the core in **Figure 30:a** has been shaped to a keel with several detachments from below. They can, thus, be assigned to the handle core category typical for Late Mesolithic assemblages in Sweden and the rest of (southern) Scandinavia (Knutsson 1993; Olofsson 1995; Olofsson 2003; Manninen & Knutsson *this volume).*

This core type is not at home in Finnish Mesolithic contexts. Its presence has been claimed in several assemblages in southern Finland (Schulz 1990), but Knutsson

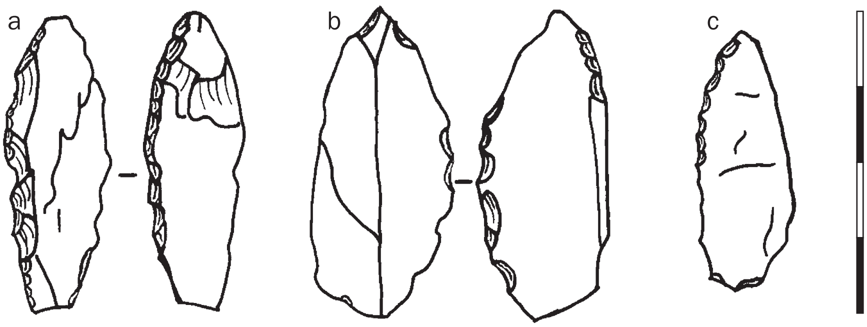


Figure 28. Slate points from Kaaraneskoski. a from Area 5; b stray find; c from Area 1. Scale in centimetres. Drawings by T. Rankama.

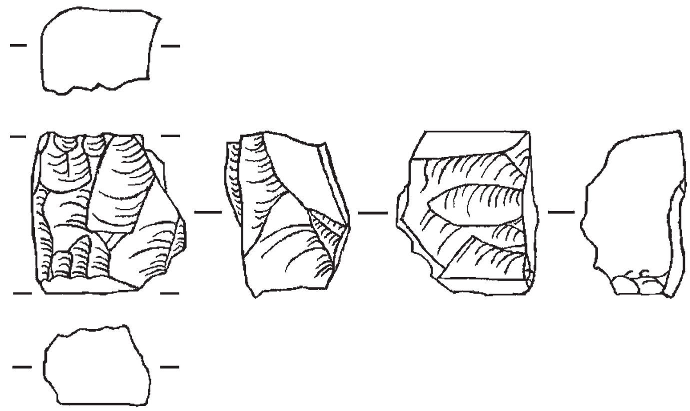
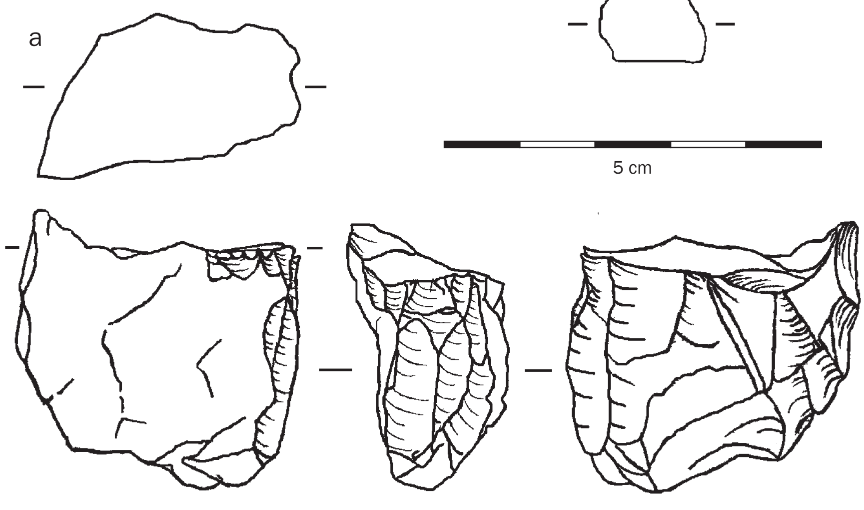
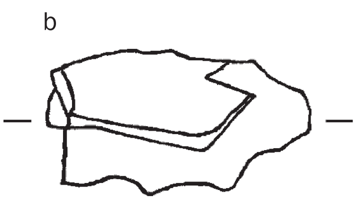


Figure 29. Microblade core of quartz from Area 3 at Kaaraneskoski. Scale in centimetres. Drawing by T. Rankama.





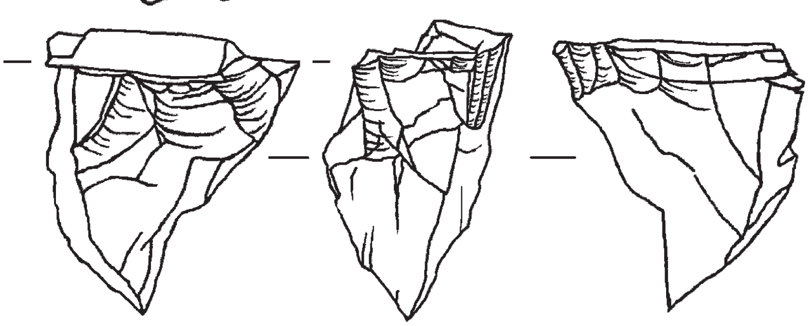


Figure 30. Handle cores of quartz from Area 5 at Kaaraneskoski. Scale in centimetres. Drawings by T. Rankama.

questioned the identification soon after the original publication (Knutsson 1993). According to Knutsson's interpretation, the pieces identified by Schulz as handle cores (or "boatshaped cores" in Schulz's terminology) more probably represent broken bipolar cores that have microblade-like flake scars (Knutsson 1993:12).

Our survey of the cores identified as "boatshaped cores" by Schulz indicates that the group includes no handle cores, and even their classification as platform cores is often questionable. For example, the core from Hopeanpelto in Askola (KM 13064:313; Schulz 1990:Fig. 6g) has a "platform" slanted in two directions, from which detachments would not have been possible – certainly not in the direction of the scars depicted by Schulz. Another core from Koppeloniemi in Hyrynsalmi (KM 20634:114-4; Schulz 1990:Fig. 6e) displays a distinct crushed bipolar saddle where Schulz indicates the striking platform. The edge is so rounded that no platform detachments could have been made. Similar comments can be made about the other "boatshaped cores" identified by Schulz.

Since the Kaaraneskoski site lies so close to the Swedish/Scandinavian "handle core area" (Manninen & Knutsson *this volume*, Fig. 11), it was reasonable to ask whether other Late Mesolithic sites in the vicinity might have yielded handle cores as well, and whether the "handle core area" might in that way be eventually expanded eastwards. There are, however, few excavated Late Mesolithic assemblages in Finland at a reasonable distance from Kaaraneskoski. The closest one is from the above-mentioned Jokkavaara site in Rovaniemi, where both a Late Mesolithic and an Early Neolithic component have been identified. Excavations have been carried out at Jokkavaara several times between 1954 and 1991 (see Torvinen 1999). Because of a theoretical possibility of finding counterparts for the Kaaraneskoski handle cores at Jokkavaara, the Late Mesolithic quartz assemblage was studied in April 2008. No handle cores were identified in the assemblage. Kaaraneskoski, thus, remains the only Finnish site where handle cores of quartz have been encountered.

Microblades

Even though the assemblages include seven quartz cores classified as microblade cores, the number of artefacts that can be classified as microblades is minuscule. Only eleven microblades or "microblade shaped flakes" are included, five from Area 3, three from Area 5, two from Area 4 and one from Area 2. Two of the microblades from Area 5 and one from Area 3 have been retouched; one of them is, in addition, notched. They do not, however, display the characteristics of side blades, as one would expect if they had been used as insets in slotted bone implements. Apparently they have not been used in the typical microblade fashion, or if they have, they have not been retouched (cf., e.g., Olofsson 2002:74).

The small number of microblades would seem to suggest that although microblade cores are definitely present, they were not reduced to a great degree at Kaaraneskoski. They were probably brought to the site ready-shaped, and were for some reason discarded there. One core (KM 31377:27), nevertheless, appears to be exhausted. Another explanation for the scarcity of microblades might be that most of the produced microblades were transported away from the site, or that they were so small and prone to breakage that they have not been preserved or identified in the recovered assemblages.

Fracture patterns

Although the value of fracture analysis in the form presented by Callahan and co-workers (Callahan e*t al.* 1992) has recently been questioned (Tallavaara *et al.* 2010), it may be useful to have a look at the fracture patterns in the Kaaraneskoski assemblage. Even if much benefit cannot be gained by comparing them with experimental fracture patterns, it is still possible to compare them with each other and with other archaeological assemblages.

The fracture patterns for Areas 3 and 5 are presented in **Figure 31** (also **Appendix 1: Table 9;** see **Appendix 1: Table 8** for the grouping of fragment categories). As can be seen, the patterns look very similar – so much so that one might begin to suspect a bias caused by the analyst. However, when the diagrams are compared with the diagram from House 35 at Kauvonkangas in Tervola, analysed by the same person, a clear difference emerges (**Fig. 32**; Rankama 2002:Fig. 17). In the Kauvonkangas diagram whole flakes dominate, while side fragments are much more common at Kaaraneskoski. Since these categories are difficult to confuse, the patterns from Kaaraneskoski must be considered valid.

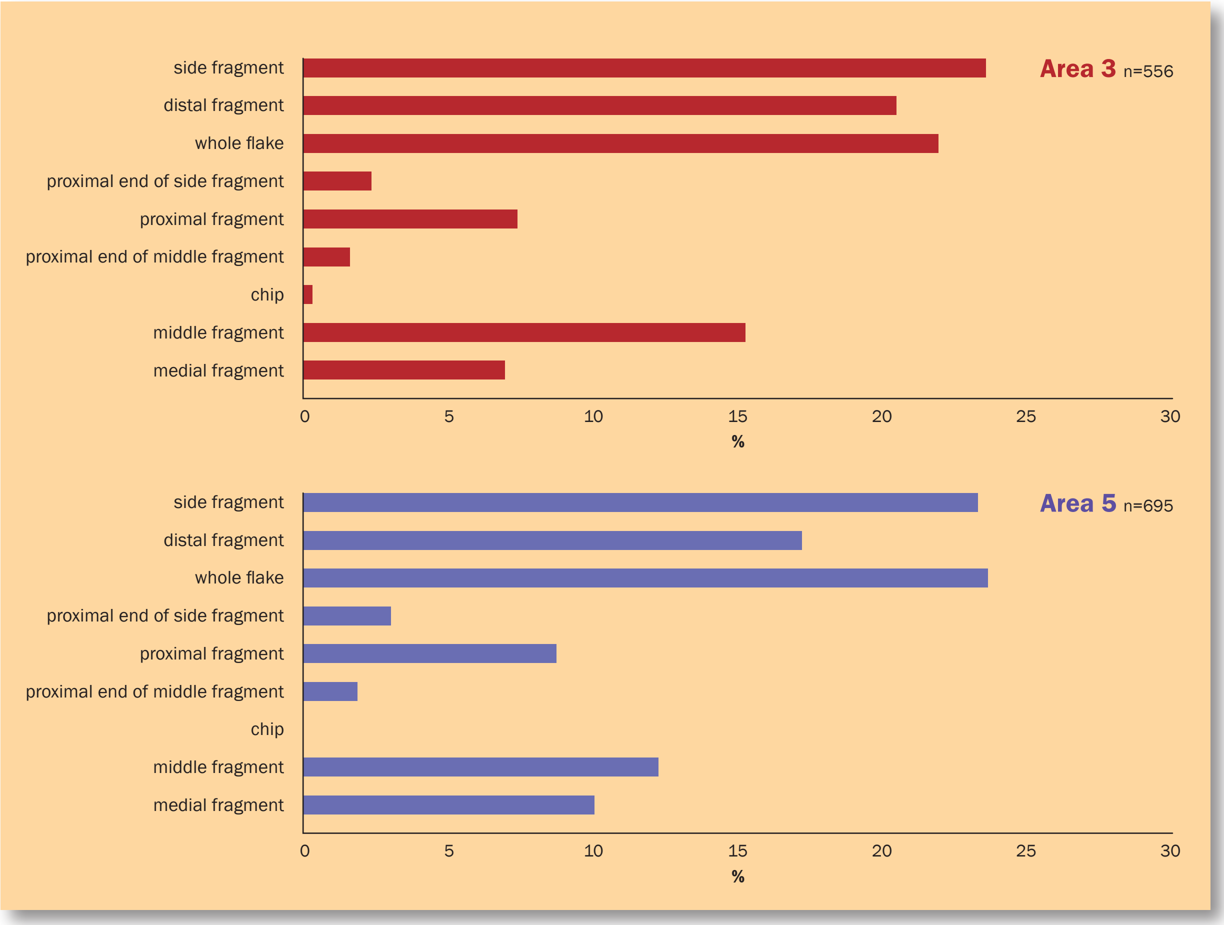


Figure 31. Quartz fracture patterns of Areas 3 and 5 at Kaaraneskoski.

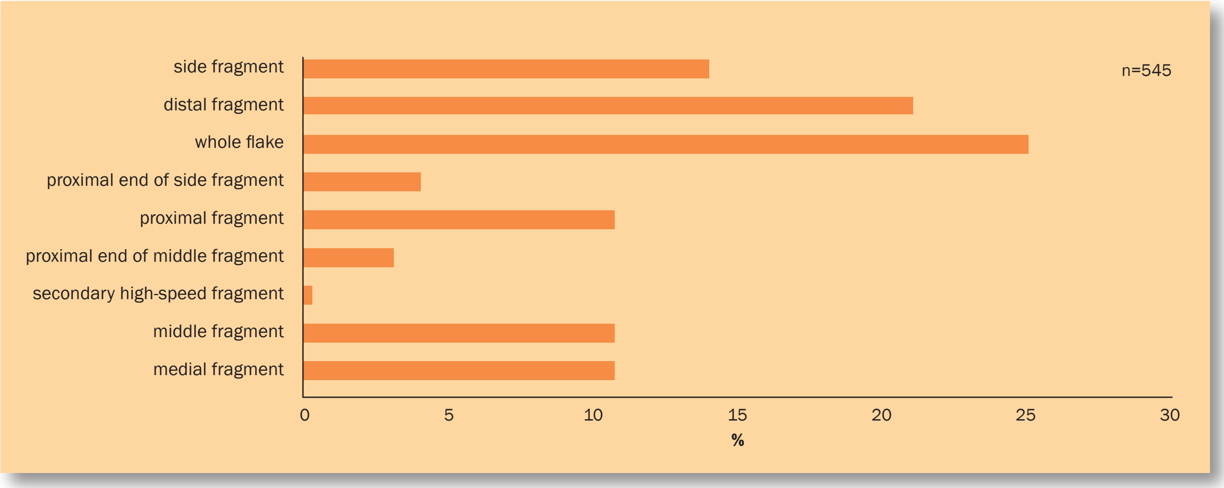


Figure 32. Quartz fracture pattern from House 35 at Kauvonkangas in Tervola.

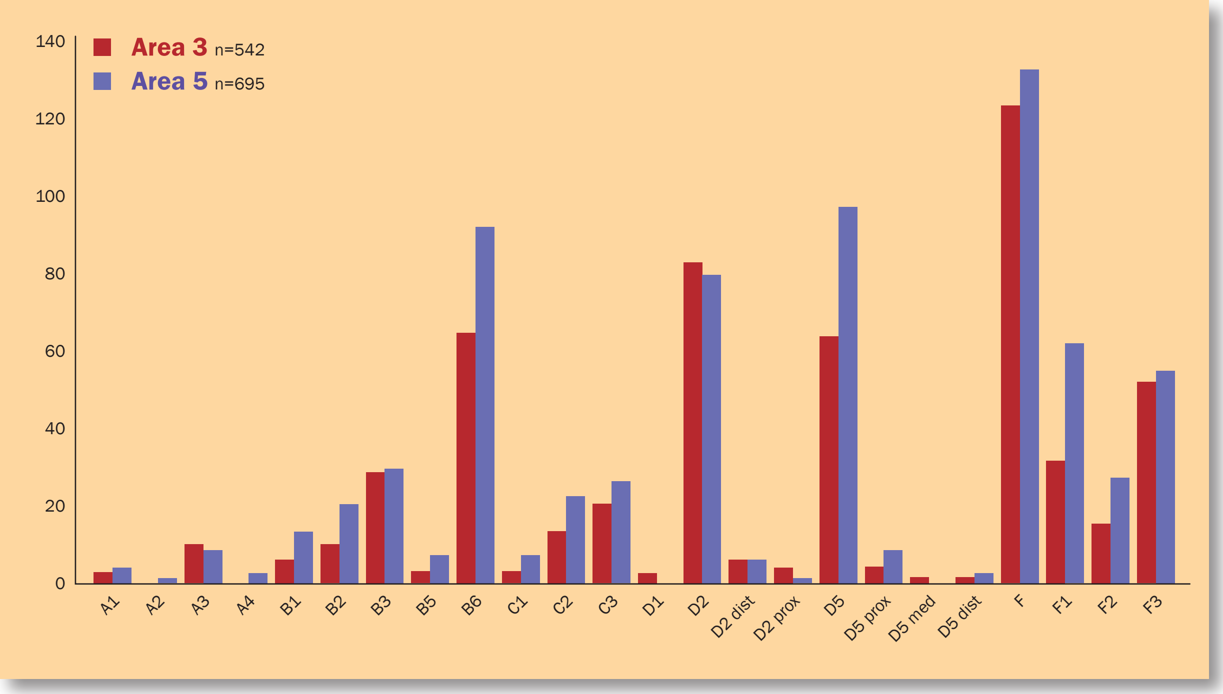


Figure 33. Detailed quartz fracture patterns from Areas 3 and 5 at Kaaraneskoski.

A more detailed look at the fragment distribution at Kaaraneskoski (**Fig. 33; Appendix 1: Table 10**) reveals an interesting pattern. Like all fracture pattern diagrams in this paper, this diagram includes only the unused flakes and fragments – the tools are excluded. In both analysed areas the most common fragments are B6, D2, D5, and F. These are the very same fragments that are most commonly used as tools (cf., **Fig. 27**), i.e., unbroken flakes and the largest side and middle fragments (**Fig. 34**).

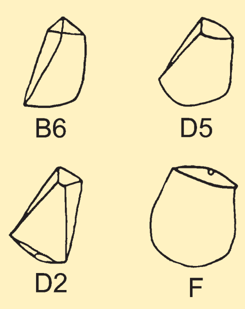


Figure 34. The most common quartz flake fragments at Kaaraneskoski.

The prevalence of these fragments among both the unused flakes and the tools might suggest that the quartz users at Kaaraneskoski have simply taken the fragments that were the most numerous in the knapped assemblage to use. In the absence of valid experimental "ideal fragment distributions" it is difficult to judge whether a pristine knapped assemblage might have had a fragment distribution of the kind present at Kaaraneskoski, and to what degree, for example, the hardness of the hammer might have influenced the fragment distribution. A look at fracture mechanics suggests otherwise, however. As indicated above, quartz fragmentation is caused by two parallel forces. Radial fracturing causes the flakes to split lengthwise, while perpendicular breaks are bending fractures caused by vibrations in the flake after detachment (Callahan *et al.* 1992:30–32, 38–38, 50, Fig. 2). If these forces act in parallel but independently, one would expect the number of bending fractures to remain constant regardless of whether the flakes remained initially whole or fractured radially. In other words, if a flake that splits lengthwise during detachment is also fractured by bending, it should produce twice as many proximal, medial, and distal fragments as a flake that does not split radially. In the Kaaraneskoski assemblages bending fractures of whole flakes (F1, F2, F3) are, however, much more

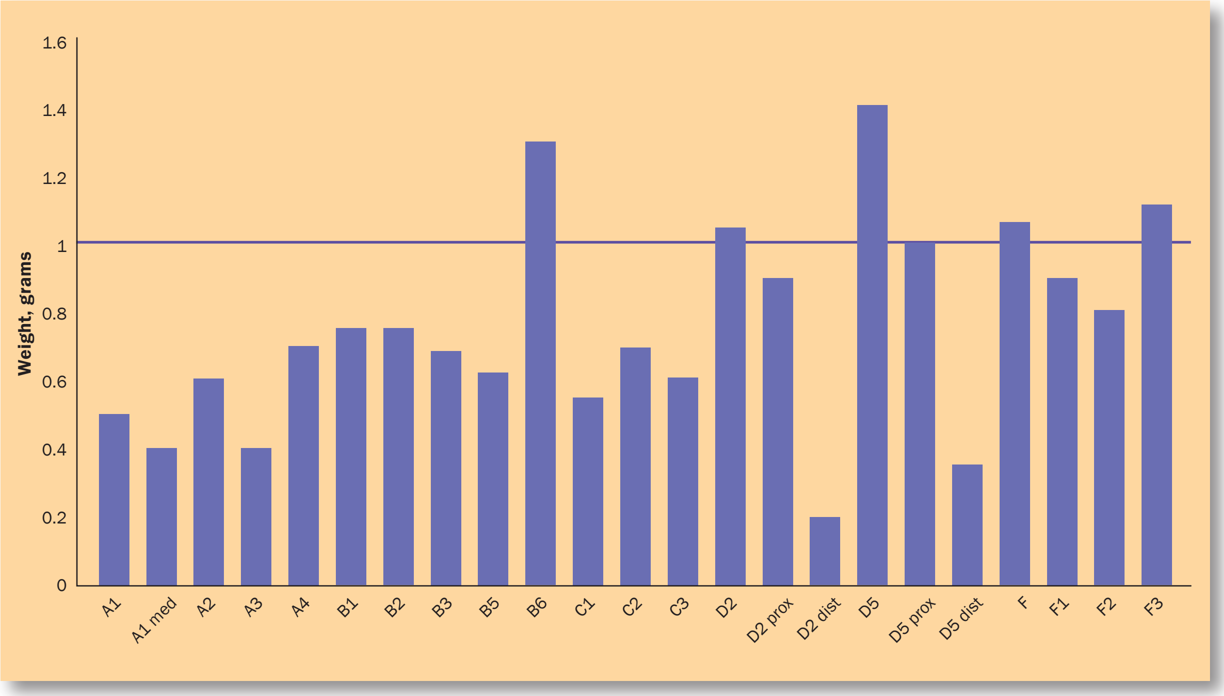


Figure 35. Average weights of different quartz fragment categories in Area 5 at Kaaraneskoski.

common than bending fractures of side or middle fragments (B1, B2, B3, C1, C2, C3, D2 prox/dist, D5 prox/med/dist). This suggests that the Kaaraneskoski assemblages do not consist of material knapped *in situ*, but are selected. In both Area 3 and Area 5 the quartz flake assemblage, thus, seems to consist largely – but not exclusively – of tool blanks that have been brought to the site ready-made from somewhere else.

To study this proposition further, the average weights of the different fragments were calculated in the Area 5 assemblage. The purpose of this was to see if the preferred fragments were indeed larger, and thus, more usable as tools than the rest of the fragments. The fact that these fragments look large in the illustration of fragment types (**Fig. 8**) is misleading, since in reality, for example, side fragments of small flakes may, of course, be much smaller than, say, distal ends or middle fragments of large flakes.

The weight calculations are adjusted. Since the flakes have been weighed by catalogue number, average weights had to be used for those catalogue numbers that included more than one artefact. Nevertheless, the result should be close enough to reality to give an idea of the situation. The average fragment weights in Area 5 can be seen in **Figure 35** (also **Appendix 1: Table 11**). The diagram has been adjusted by removing a few very heavy obvious outliers. As can be seen, the heaviest fragments on average are B6, D2, D5, F, and F3, i.e., the ones that are the most abundant in the assemblage. These are the only fragments with an average weight above 1 gram. This supports the conclusion that the assemblage has been selected in favour of tool blanks.

The excavated areas at Kaaraneskoski, thus, do not appear to be where the primary reduction of cores took place. This is supported by the fact that small chips are practically absent from the analysed assemblages. A primary reduction site should contain a large amount of small chips, which are formed in every stage of quartz reduction. The 4 mm mesh screening will have excluded a part of the potential chip population, but more than a couple of chips would have been recovered during trowelling, had they been abundant in the assemblage.

The fact that the assemblage, nevertheless, contains a fairly large number of cores suggests that other parts of the site may have been used for primary reduction. The assemblages found in the excavated areas could have been selected from the knapping areas. Some ready-made tools were, however, also undoubtedly brought to the site from the mobile groups' previous campsites.

Spatial analyses

Area 3

Figure 36 shows the distribution of all quartz artefacts in Area 3. Two distinct clusters can be detected: one in the south-western corner of the area (Cluster 1) and another practically in the middle (Cluster 2). The north-eastern corner of the area has a less concentrated spread of artefacts. Cluster 1 is separated from the rest of the area by a curving band devoid of finds. Whether this represents the wall line of a circular dwelling, as the pattern might

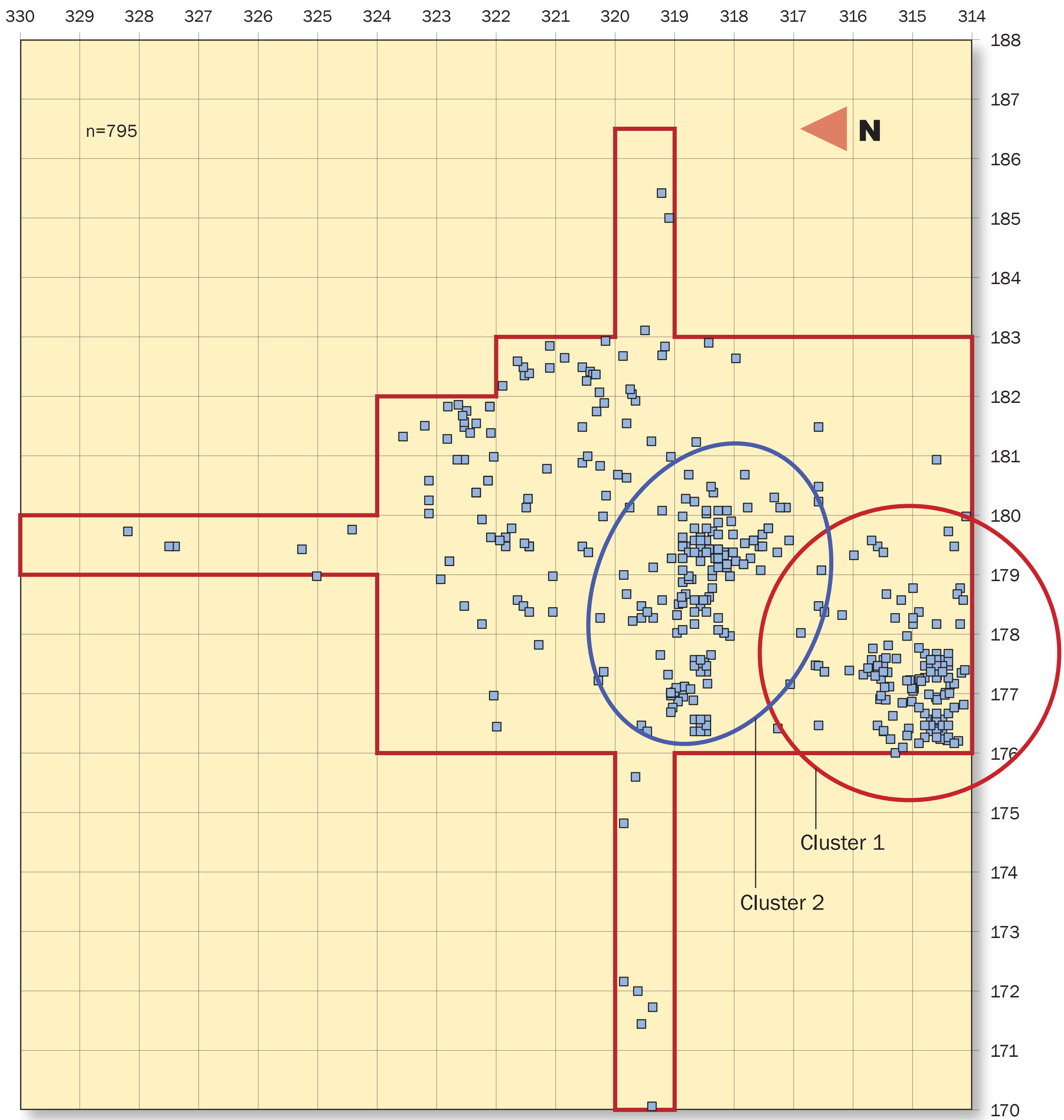


Figure 36. The distribution of all quartz artefacts in Area 3 at Kaaraneskoski.

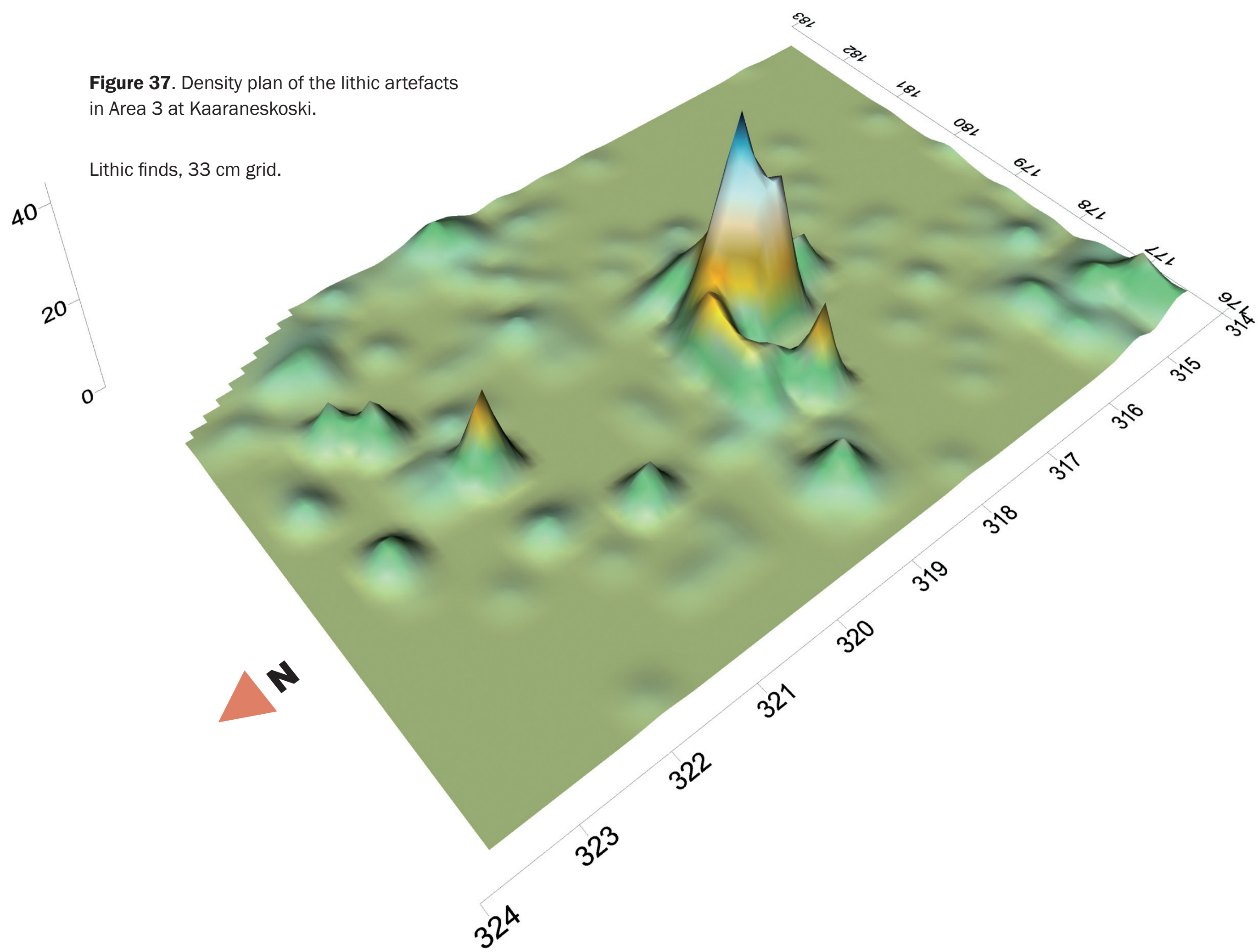
suggest, is difficult to judge, since in that case only a quarter of the potential dwelling would have been excavated. The topographical survey of the site does not indicate any house pit in this area.

A distribution plan of this kind does not give a full picture of the finds density. Because of this, another plan was made using the Surfer program (**Fig. 37**). This plan includes a third dimension and shows that the highest density of artefacts is actually in Cluster 2. Cluster 1 shows as a much lower peak. The difference between **Figures 36** and **37** is due to the fact that the three-dimensional distribution diagram is able to take into account the fact that several finds may have been found on the same spot (and, consequently, be denoted by a single symbol), which the two-dimensional plan cannot display. The question then is whether there are any differences in the artefact composition between the clusters in Area 3.

Figure 38 shows the distribution of different kinds of tools in Area 3. Most of the tool categories are fairly evenly distributed. A few interesting patterns can, however, be observed. The scrapers and planes, for example, concentrate heavily in Cluster 1 and in the north-eastern corner, but are scarce in Cluster 2. Hardly any piercers and borers have been found outside Clusters 1 and 2. Burins are almost exclusively found in Cluster 2. The numbers of tools in each category are, of course, small and the results, thus, not statistically reliable, but

Figure 37. Density plan of the lithic artefacts in Area 3 at Kaaraneskoski.

Lithic finds, 33 cm grid.



the pattern, nevertheless, suggests some kind of differentiation in activities within the area.

The distributions of the most common fragments in Area 3 (**Fig. 39**) show slight variation. All of the fragment types are common in Cluster 2, but in Cluster 1 all except D2 are scarce. Whole flakes (F) are more numerous outside the clusters than any of the fragments. Combined with the tool data this might suggest that D2 fragments were considered particularly suitable for scraper blanks. This result is in agreement with what has

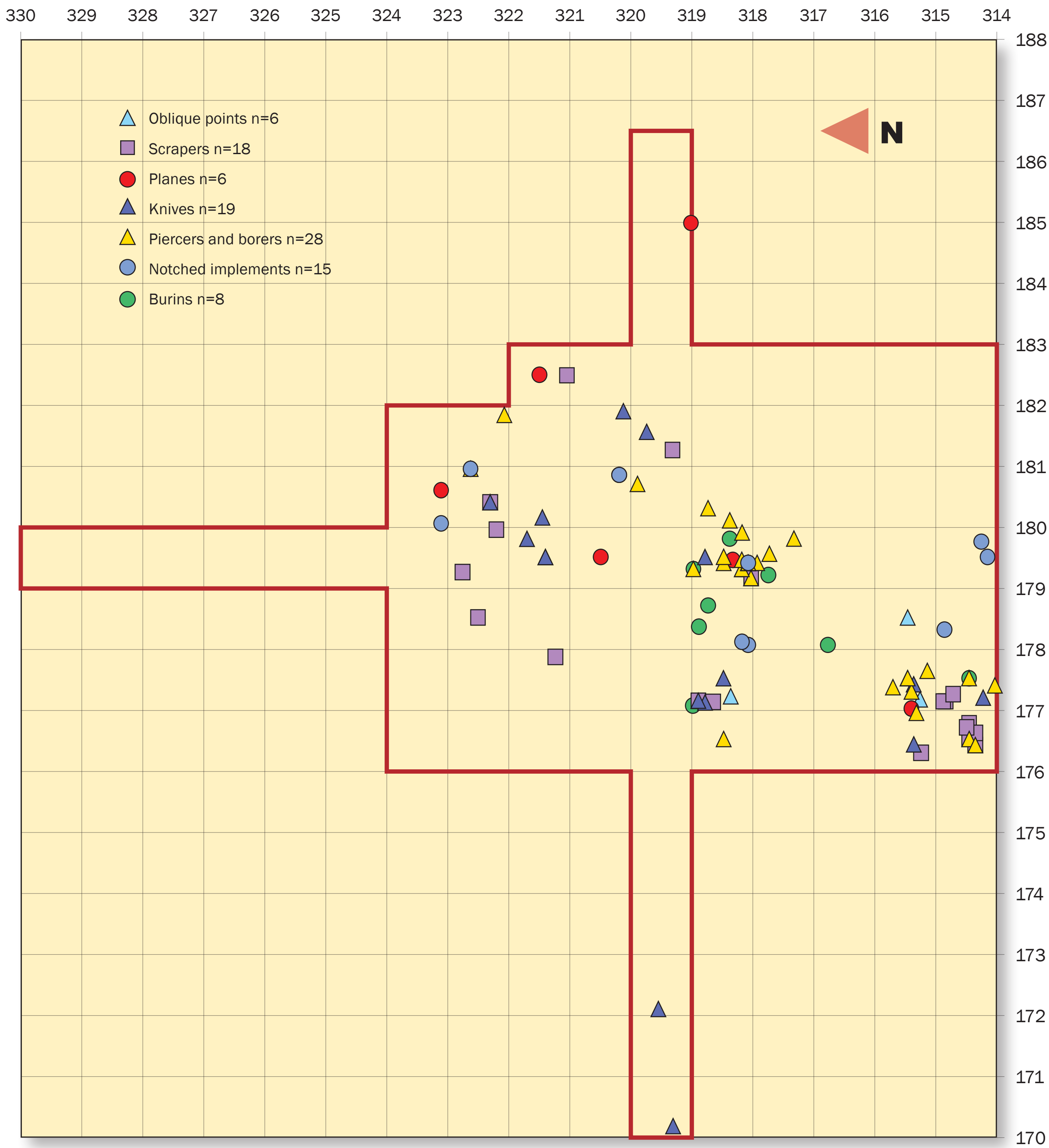


Figure 38. The distribution of tools in Area 3 at Kaaraneskoski.

earlier been found in the analysis of the Kauvonkangas site in Tervola (Rankama 2002:104–106, Fig. 27).

All in all, the distributions of the tools and fragments in Area 3 are so even that definite conclusions based on them are extremely difficult to draw. One way to look at the distribution, nevertheless, is to see a circular tent in Cluster 1, an intense activity area in Cluster 2, and an area of less intense activity in the north-eastern corner. The validity of this interpretation is impossible to test with the current distribution studies.

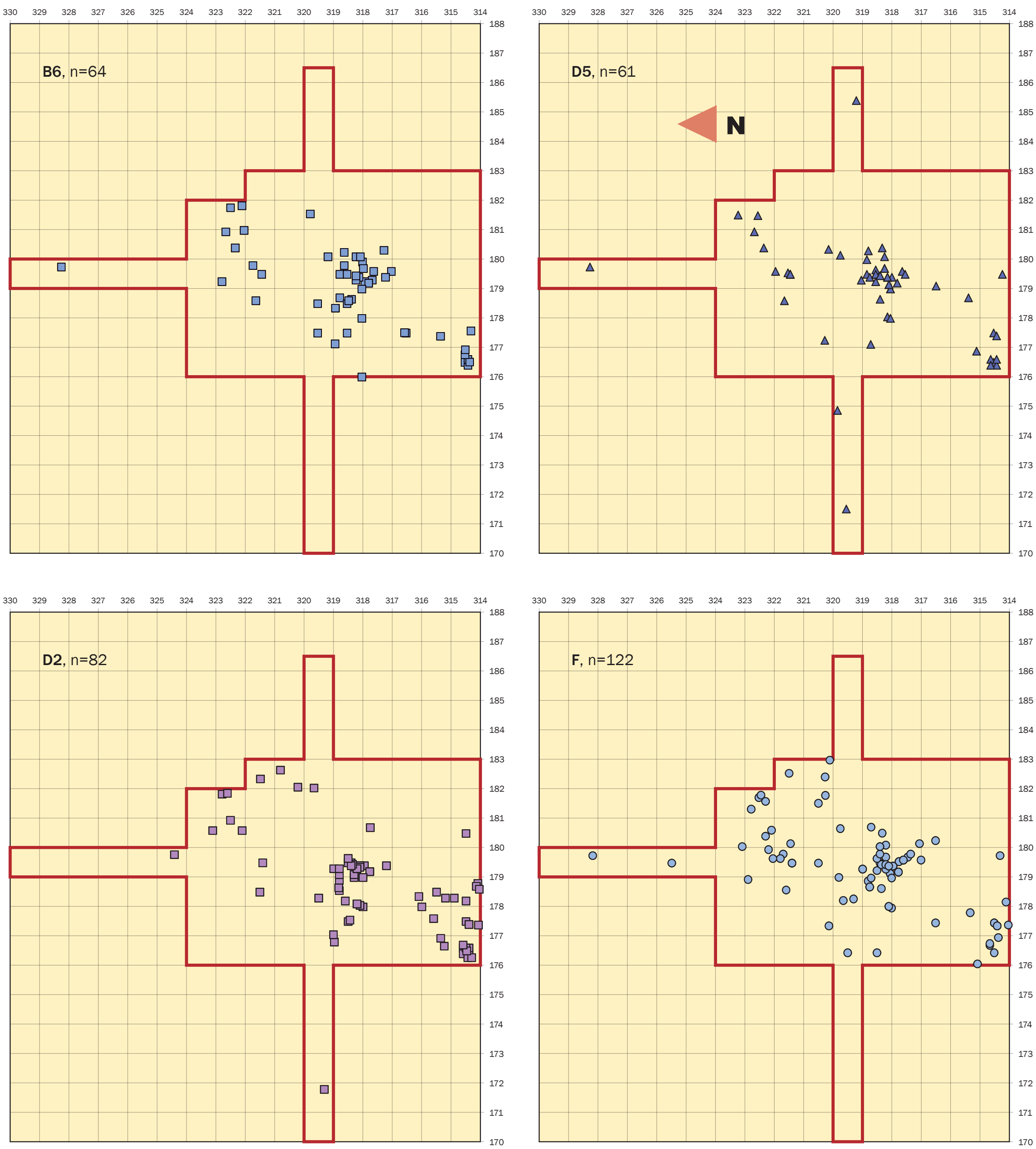


Figure 39. Fragment distributions in Area 3 at Kaaraneskoski.

Area 5

Figure 40 shows the distribution of all quartz artefacts in Area 5. In the eastern N–S trench (interval 130–131) the untouched podsol soil was discovered during excavation to have been covered by a layer of sand that was almost 20 cm thick in places. This was apparently the result of gravel quarrying activities where the top sod and sand from the quarry east of this excavation area was pushed away with a bulldozer before the area was taken into gravel production. The finds from this part of Area 5 are, thus, mixed and consist partly of artefacts

Figure 40. The distribution of all quartz artefacts in Area 5 at Kaaraneskoski.

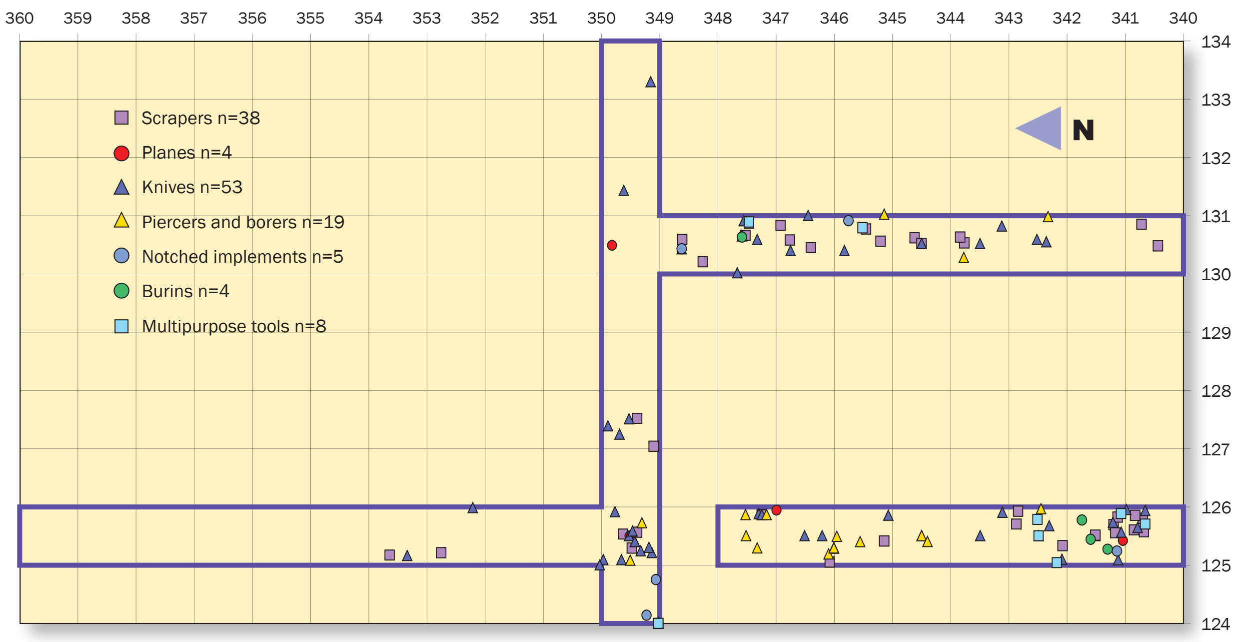


Figure 41. The distribution of tools in Area 5 at Kaaraneskoski.

from the area that has been quarried away. The artefact distributions in this area are, thus, not reliable and will be disregarded.

What remains for study, then, are predominantly the finds in the western N–S trench (interval 125–126). The distribution here appears to consist of five tight, separate clusters. The concentration of the finds in such tight clusters is strange in itself, but can hardly be studied further because of the narrowness of the trenches.

The distribution of different tool types in Area 5 (**Fig. 41**) shows more variation than in Area 3, i.e., the composition of the clusters varies. Scrapers and planes are the most numerous in Cluster 1 but the other clusters only contain one or two of these. Knives are spread somewhat more evenly, but the largest number is found in Cluster 4. Piercers and borers are concentrated in Clusters 2 and 3, and are practically absent elsewhere, whereas notched implements and burins are found almost exclusively in Cluster 1. It appears, thus, that there has been more differentiation between activity areas in Area 5 than in Area 3. The numbers of tools in the main categories are high enough to render the distributions valid.

The distributions of the main fragment types (**Fig. 42**) are also interesting. Cluster 1 contains the highest concentration of D2-fragments, whereas B6-fragments and complete flakes (F) concentrate in Cluster 4 more than anywhere else. The coexistence of scrapers/planes and D2 fragments in Cluster 1 again suggests that D2 fragments were the prime scraper blanks. This is understandable, considering the usually sturdy quality of D2 fragments (see **Fig. 34**). B6 fragments and complete flakes, on the other hand, appear to be associated with knives. This pattern again agrees with what has been found in the analyses of the Kauvonkangas site in Tervola (Rankama 2002:104–106, Fig. 27). Whole flakes and side fragments with long, sharp cutting edges make excellent knives even without secondary modification and have been gathered in the "cutting (tool) area" in Area 5.

The distributions of identified tools and fragments, thus, indicate that activity areas have been differentiated in Area 5. With the long and narrow excavation areas it is difficult, however, to find out what kinds of larger patterns these separate activity clusters might represent. The analysis has, nevertheless, shown that distribution studies of fragments and tools are worth the effort and might produce even more interesting results when applied to larger area excavations. The results also support the interpretation of the Kaaraneskoski assemblages as highly selected collections of tool blanks.

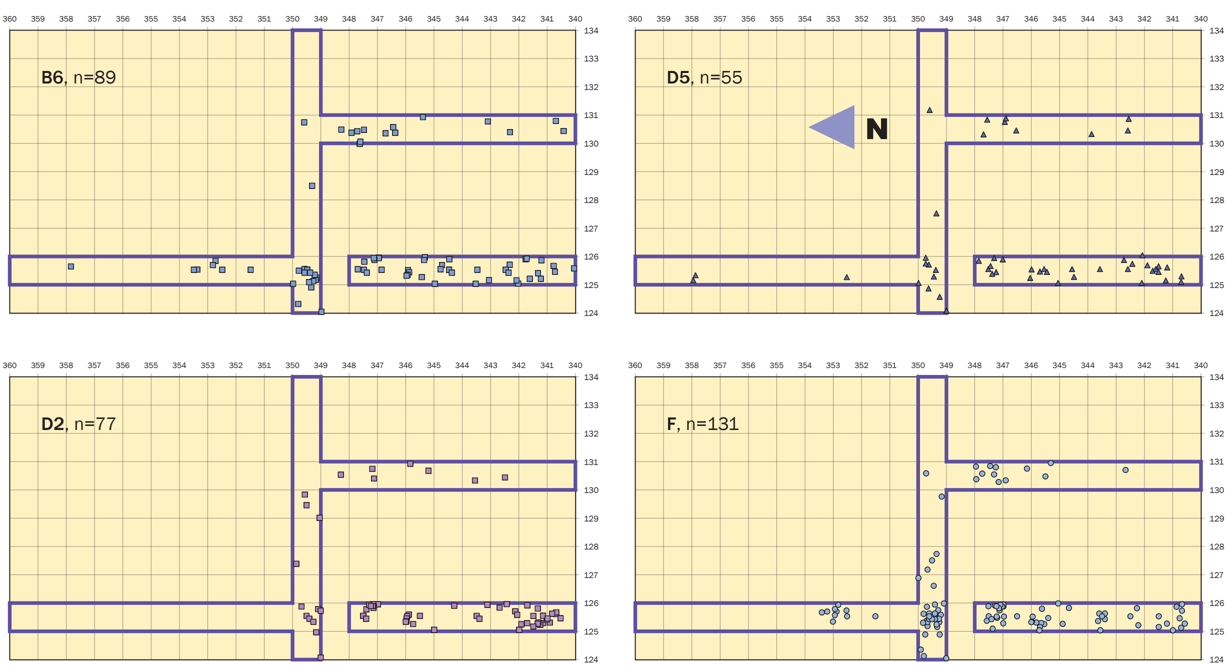


Figure 42. Fragment distributions in Area 5 at Kaaraneskoski.

Discussion

The quartz assemblages from the different excavation areas at Kaaraneskoski show remarkable uniformity in spite of the potentially 400 year age difference between the upper and lower ends of the site. This suggests a continuation of activity patterns throughout the site's occupation span. The analyses of the material suggest that the site was one stop in the migration pattern of mobile hunter-gatherers. The uniformity of the quartz assemblages may be taken to indicate that the residents belonged to the same demographic unit that used the site generation after generation. There is evidence of continuity in activity patterns throughout the history of the site, suggesting culturally reproduced modes of behaviour as regards both lithic reduction and use. This can be seen also in the innovative attitude of the residents towards the use of slate as a tool material, which seems to continue through time.

The large quantity and diversity of tools found in the excavated areas and also around the site as stray finds suggest that Kaaraneskoski was not a single purpose site, such as a hunting station. Instead, a variety of activities took place. The assemblage includes tools for cutting, scraping, piercing, and grooving, as well as for hunting. The wear marks on the scrapers indicate that these tools were not exclusively used in activities associated with the processing of prey. Accordingly, it can be suggested that the groups residing at Kaaraneskoski at different times were demographically varied, probably representing whole family units.

The quartz assemblage as a whole suggests that the primary reduction took place somewhere else than in the excavated areas at Kaaraneskoski. If quartz had been knapped *in situ*, the debitage to tool ratio should have been different. Knapping always produces large amounts of unusable debitage, including small chips that were absent at Kaaraneskoski. Accordingly, the assemblages should have contained much more debitage and fewer tools if they had been produced in the excavated areas. The fragment distribution can also be taken to indicate selection. The assemblages are dominated by whole flakes and large side and middle fragments that can be interpreted as tool blanks carried to the excavated areas from somewhere else. The size of the blanks is deduced not only from the fragment type but also from the average weights of the different fragment categories.

It follows from the above that the *chaîne opératoire* of quartz reduction at Kaaraneskoski is highly incomplete: it begins away from the excavated areas and the recovered artefacts are selected. The results of the analysis, nevertheless, allow a reconstruction of certain features of the chain(s). There is evidence of five different reduction concepts at the site. These are the bipolar method, the platform method, and three different concepts of microblade production: from handle cores, from conical cores, and from a (single) cubical core. It is questionable how much microblade production actually took place. Since one of the conical microblade cores is exhausted, at least some microblades may have been produced. Otherwise one would expect the core to have been discarded at the previous stop of the group residing at Kaaraneskoski.

As regards the bipolar and platform flake production, the analyses indicate that they represent different *chaînes opératoires* in the Kaaraneskoski assemblage. The bipolar flakes are as large as, or larger than, platform flakes, which indicates that bipolar reduction began with large nodules instead of almost exhausted platform cores, as is often suggested to have happened in Sweden. Nor are there discrepancies in the numbers of bipolar and platform cores as compared with the numbers of bipolar and platform flakes. This supports the conclusion that these two methods were used side by side, not as successive parts of a single *chaîne opératoire*.

Tool production was opportunistic in the sense that any blanks with an edge suitable for the purpose the user had in mind could be selected, and there was no effort to produce formal tool types. There were no restrictions about using one blank for several purposes. Most of the tools display a minimal amount of modification. Only the scrapers and the oblique points have more evidence of deliberate shaping. In the other tools, the functional edge or point sufficed.

Nevertheless, the selection of tool blanks from among the fragments was very consistent at Kaaraneskoski throughout its occupation period. The choices seem functionally obvious and have parallels in other assemblages both in Finland and in Sweden. Therefore, it is difficult to judge whether any cultural factors influenced the selection. The fact that bipolar flakes were preferred makes one wonder why platform reduction was employed at all. The picture may be slightly distorted, however, by the fact that the sturdiest implements, viz. scrapers, were in most cases impossible to classify as to reduction method. One might expect platform reduction to have been preferred for scraper blank production, but this cannot be substantiated with actual evidence.

The use of the platform method may have been opportunistic and dependent on the shape of the quartz nodules. On the other hand, it might have been culturally determined. What was certainly culturally determined was the microblade concept and the shape of the handle cores – but not by the Kaaraneskoski residents' own culture. The assemblage as a whole is quite at home with what we know about the Finnish quartz using Stone Age, which is characterised by the prevalence of the bipolar method, the separation of the bipolar and platform methods in the *chaîne opératoire*, and the virtual absence of typologically distinct tool forms. The presence of the oblique point as a concept strong enough to have been applied to slate also supports the conclusion that the Kaaraneskoski population was part of the eastern quartz technocomplex. On the other hand, the facts that the handle cores and other microblade cores appear to have been barely reduced at the site and that no typical microblade objects, such as inserts for bone implements, are included in the assemblage, suggest that the cores might have been acquired through contacts with neighbours in the south-west. This might explain even the presence of the exhausted microblade core: it may have been obtained as a curiosity, not as a functional object.

The use of the tools and blanks and the spatial distribution of activities at the site may also be defined as parts of the *chaîne opératoire*. The evidence for the spatial differentiation of activities is stronger in Area 5, but a case can be made for its presence also in Area 3. Both specific functional tool categories and blanks suitable for these tools are concentrated in particular locations in the excavation areas. In Area 5 these are separated by empty spaces, emphasising the differentiation. The small size of the excavated areas makes further inferences about the spatial distributions difficult, however.

Conclusions

The Kaaraneskoski site in Pello can be interpreted as a locality that has been used by groups of Late Mesolithic mobile hunter-fisher-gatherers as one stop in their regular mobility pattern. The site consists of a number of small, consecutive living floors at different elevations that attest to its recurrent use by people camping close to the shoreline over a period of a few hundred years. The evidence supports the conclusion that whole family units were present and that they belonged to the same population throughout the use period of the site.

The site is located at the interface of two major Late Mesolithic interaction spheres: the south-western handle core area and the eastern oblique point area. The Kaaraneskoski assemblage includes elements derived from both of these spheres. This indicates contacts between the eastern and western groups in this region.

The eastern elements are more strongly represented at Kaaraneskoski than the south-western ones. As a consequence, the site can be regarded as an eastern settlement with contacts towards the west. Whether the groups residing at Kaaraneskoski included areas west of the Tornionjoki River in their regular mobility pattern is difficult to judge. It is possible, however: an overlap in the distributions of handle cores and oblique points in northern Sweden suggests a degree of eastern activity there, and there are also later sites with Finnish pottery types in the region (e.g., Halén 1994). The current national border at the Tornionjoki River would obviously have been of no consequence in the Late Mesolithic.

The Kaaraneskoski quartz assemblage is selected from material knapped somewhere else than in the excavated areas. The selection has been deliberate and consistent throughout the use period of the site. The same applies to the reduction methods employed. This attests to a culturally reproduced way of approaching the quartz raw material. Further evidence of this is found in the mode of tool production.

The analyses of the quartz assemblages at Kaaraneskoski have made it possible to provide answers to the questions about site structure, the character of the occupation, the character of the lithic assemblage, and the activities performed at the site as outlined in the beginning of this paper. The *chaîne opératoire* approach has made it possible to look at the Kaaraneskoski assemblages as parts of a wider whole and throw light on the organisation of lithic production, as well as on contacts between Late Mesolithic societies in the region.

The analyses have also served their purpose in adding to the bulk of comparative material on quartz use in Finland. Much more is needed, however, before conclusions about possible regional or chronological differentiation in quartz technology during the Finnish Stone Age can be drawn.

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Appendix I. Raw data of the quartz analyses of the Kaaraneskoski assemblage 1/2

	Bipolar	Platform	Total
Area 3			
Flakes	159	122	281
Tools	42	36	78
Cores	21	15	36
Area 5			
Flakes	319	86	405
Tools	54	17	71
Cores	17	20	37

Table 1. Quartz reduction methods in Areas 3 and 5 at Kaaraneskoski (cf. Fig. 9).

Whole flakes	
Area 3	grams
Platform, n= 37	0.60
Bipolar, n=42	1.55
Area 5	
Platform, n=28	0.89
Bipolar, n=72	1.11

Table 2. Mean weights of unfragmented quartz flakes in Areas 3 and 5 at Kaaraneskoski (cf. Fig. 10).

Cores	
Area 3	grams
Bipolar, n=21	8.00
Platform, n=11	10.29
Bipolar + platform, n=1	11.40
Microblade, n=4	2.45
Area 5	
Bipolar, n=17	5.82
Platform, n= 17	15.66
Bipolar + platform, n= 1	6.00
Microblde, n= 3	25.70

Table 3. Mean weights of quartz cores in Areas 3 and 5 at Kaaraneskoski (cf. Fig. 11).

Category	Area 3	Area 5
Flakes	512	641
Tools	221	204
Cores	37	38
Total	**770**	**883**

Table 4. Major artefact categories in the analysed quartz assemblages at Kaaraneskoski (cf. Fig. 12).

Tool categories	Area 3	Area 5
Oblique point	6	0
Scraper	18	38
Notched implement	13	5
Piercer	16	3
Borer	10	16
Corner knife	6	6
Knife	13	47
Plane	6	4
Burin	11	4
Burin spall implement	1	1
Crescent shaped implement	1	0
Serrated tool	0	1
Multipurpose tool	5	8
Other tool/ retouched flake	114	70
Total	**220**	**203**

Table 5. Quartz tool categories in Areas 3 and 5 at Kaaraneskoski (cf. Fig. 13).

Fragment	pcs
B6	2
C3	1
D2	4
D5	4
F	5
F1	1
F3	1
Total	**18**

Table 6. Fragment classification of scrapers at Kaaraneskoski (cf. Fig. 19).

Scraper use wear	pcs
Hard	47
Hard + soft	9
Soft	5
Unclassified	3
Total	**64**

Table 7. Use wear on worn scrapers at Kaaraneskoski (cf. Fig. 20).

Grouping by Callahan et al. 1992	All included fragments
side fragment	A2, B5, B6, D5, D5 (-B4), D5+D5, D5+D4, B6/D5, B6+D5
distal fragment	A3, A7, B3, C3, F3, B2+B3, F2+F3, D2/F3, D5/F3
whole flake	F, G1, F (-B4), F (-B4+D4)
proximal end of side fragment	A5, B1, B1+B2, B1/B3, D5/B1, D5/F1, D5/F1/F3
proximal fragment	F1, F1/F3, F1+F2
proximal end of middle fragment	C1, D2/F1, D2/F1/F3, D2/A1/F1, C1/C3
chip	B4, D1, D1/E1, E1
middle fragment	A1, A1/D2, A4, D2, D2+D2, D2+D5, G1-2xG2
medial fragment	A6, B2, C2, D5/F2, F2

Table 8. Fragment grouping in accordance with Callahan *et al.* 1992 (cf., Figs. 31 and 32).

Appendix I. 2/2

Fragments	Area 3	Area 5
side fragment	131	162
distal fragment	114	120
whole flake	122	164
proximal end of side fragment	13	21
proximal fragment	41	61
proximal end of middle fragment	9	13
chip	2	0
middle fragment	85	85
medial fragment	39	69
Total	**556**	**695**

Table 9. Fragment distribution in Areas 3 and 5 at Kaaraneskoski (cf. Fig. 31).

Fragment	Area 3	Area 5
A1	3	4
A2	0	1
A3	10	8
A4	0	2
B1	6	13
B2	10	20
B3	28	29
B5	3	7
B6	64	91
C1	3	7
C2	13	22
C3	20	26
D1	2	0
D2	82	79
D2 prox.	6	6
D2 dist.	4	1
D5	63	96
D5 prox.	4	8
D5 med.	1	0
D5 dist.	1	2
F	122	131
F1	31	61
F2	15	27
F3	51	54
Total	**542**	**695**

Table 10. Raw fragment data for Areas 3 and 5 at Kaaraneskoski (cf. Fig. 33).

Fragment	grams
A1	0.50
A1 med	0.40
A2	0.60
A3	0.40
A4	0.70
B1	0.75
B2	0.75
B3	0.69
B5	0.62
B6	1.29
C1	0.54
C2	0.69
C3	0.61
D2	1.05
D2 prox.	0.90
D2 dist.	0.20
D5	1.39
D5 prox.	1.00
D5 dist.	0.35
F	1.05
F1	0.89
F2	0.80
F3	1.11

Table 11. Average weights of fragments in the Area 5 assemblage at Kaaraneskoski (cf. Fig. 35).

Appendix II. List of catalogue numbers of artefacts shown in the illustrations

Figure 14. a) KM 31377:98
b) KM 31377:146
Figure 15. KM 30721:322
Figure 16. a) KM 31377:359
b) KM 31377:316
c) KM 31377:1106
d) KM 31377:232
e) KM 31377:48
f) KM 31377:1
g) KM 31377:847
h) KM 31377:185
i) KM 31377:940
j) KM 31377:38
k) KM 31377:804
l) KM 30721:282
Figure 17. a) KM 30721:273
b) KM 30721:511
c) KM 31377:1096
Figure 18. a) KM 31377:805
b) KM 31377:1122
c) KM 30721:474
d) KM 31377:520
e) KM 30721:240
f) KM 31377:1069
Figure 21. a) KM 31377:365
b) KM 31377:1117
c) KM 31377:157
d) KM 30721:13
e) KM 30721:115
f) KM 31377:22
Figure 22. a) KM 31377:522
b) KM 31377:663
c) KM 30721:143
d) KM 31377:703
e) KM 31377:890
f) KM 31377:50
g) KM 31377:2
Figure 23. a) KM 31377:161
b) KM 31377:770
c) KM 31377:1120
d) KM 31377:892
e) KM 31377:523
f) KM 30721:278
g) KM 31377:1074
h) KM 30721:439
i) KM 31377:147
j) KM 31377:1072
k) KM 31377:476
l) KM 31377:488
m) KM 31377:507
n) KM 31377:262
Figure 24. a) KM 31377:440
b) KM 31377:718
Figure 25. a) KM 31377:283
b) KM 31377:633
c) KM 31377:178
Figure 28. a) KM 31377:500
b) KM 31377:1110
c) KM 30721:353
Figure 29. KM 31377:77
Figure 30. a) KM 31377:515
b) KM 31377:368