Micro-wear analysis of the Middle Palaeolithic quartz artefacts from the Lurgrotte, Styria

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Abstract: A use-wear analysis, based on the method described by K. Knutsson (1988a), of the quartz artefacts from the new excavations in the Lurgrotte (Fladerer et al., same volume) was conducted. This analysis showed that the artefacts had been affected only little by mechanical and chemical processes in the sediment. On three of the larger artefacts with a natural backing, different types of striations indicate that these artefacts were used for cutting a soft to middle hard material transversally to the edge, possibly during butchering activities. These artefacts do not exhibit traces of intensive use. The fourth artefact with clear use-wear traces seems to have been used for sawing a middle hard to hard material. The excellent preservation of the artefacts is promising for future investigations of the cave.

Zusammenfassung: Die bei den neuen Grabungen in der Lurgrotte gefundenen Quarzartefakte (Fladerer et al., gleicher Band) wurden auf mikroskopische Gebrauchsspuren hin untersucht. Diese Untersuchung baute auf der Analyse der Oberfläche der einzelnen Quarzkörner auf (vgl. Knutsson 1988a) und ergab, daß die Artefakte relativ geringen mechanischen und chemischen postdepositionellen Prozessen ausgesetzt waren. Auf drei der größeren Artefakte mit einem „natürlichen Rücken" deuten verschiedene Arten Striae darauf hin, daß diese Artefakte zum Schneiden - transversal zur Kante - eines weichen bis mittelharten Materials gedient haben (Fig. 1,1u.4). Dabei könnte es sich um eine Tätigkeit im Rahmen des Zerlegens von Tieren handeln. Diese Artefakte scheinen nicht allzu intensiv/lange verwendet worden zu sein. Das vierte Gerät, das deutliche Gebrauchsspuren aufweist, scheint zum Sägen eines mittelharten bis harten Materials gedient zu haben (Fig. 1,3). Die gute Erhaltung der Artefakte ist vielversprechend für weitere Untersuchungen der Höhle.

Introduction

In this study I analyse the 15 quartz artefacts from the new Middle Palaeolithic excavations from the Lurgrotte, Styria for use-wear traces to investigate the conditions for a functional interpretation (for further information on these artefacts, the other remains and the excavations, see Fladerer et al., same volume). During earlier excavations at this site flakes made of quartz were found but these artefacts are unavailable nowadays (Fuchs 1994, 89). A functional analysis of quartz artefacts is especially important since characteristic tool types occur more rarely among quartz artefacts than among flint artefacts. Thus, use-wear analysis is necessary to prove that quartz artefacts really were regarded as tools.

At the Palaeolithic sites in the Styrian Alps, quartz or quartzite was generally used very frequently as raw material for stone tools. According to M. Mottl (1951, 28) about 68 % of the lithic artefacts from the Repolusthöhle were made of quartzite. More than 99 % of the lithic artefacts from the Drachenhöhle were made of quartz or quartzite (Kyrle 1931) and about 90 % of the artefacts from the Tunnelsteinhöhle, which are available now, were made of quartz (Fuchs and Ringer 1996).

Method

The artefacts were examined for use-wear features described by K. Knutsson (1988a; for use-wear on quartz, see also Sussmann 1985; 1987 u. 1988), as far as they can be detected under an incident light microscope. The wear on single quartz grains was interpreted and use-wear appears here mainly as different types of striations, abrasion and as smoothing of the surface. The microscopes used were a stereomacroscope Nikon SMZ-U (7.5–75X magnification) and a metallurgical incident light microscope Nikon Epiphot (40X and 20X objective used). For a closer look at the wear traces on and under the surface, selected areas of the 4 artefacts with clearly visible use-wear traces were also scanned with a confocal laser-scanning microscope (CLSM; Leica IRBE) after they had been dyed with fluorescent colour (C.I. 42555; Sigma C-3886; cf. Derndarsky and Ocklind 2001). The 488 nm argon laser was used for scanning. Maximum projection was used to reduce the image stack to a single slice. The resulting images (Fig. 7 and 8) were further enhanced with Adobe Photoshop 5.5 for optimal brightness and contrast.

Cleaning

There are different opinions whether archaeological artefacts should be cleaned with chemical solutions or not. On one hand, chemical cleaning might destroy residues and impedes chemical analyses of the surface, resp. the evaluation of their results. On the other hand, adhering soil particles covering parts of the surface will hinder a correct observation. In the case of quartz, this might lead to the idea that the surface is more abraded than it actually is.

To gain as much information as possible, the artefacts were scanned with the stereomacroscope (at 30X magnification) before cleaning. The residues detected consisted of yellowish sandy sediment and dark brown spots, which were situated on all artefacts all over the pieces and could thus be regarded as negligible. After the first cleaning process, where only mild detergent and distilled water in the ultrasonic tank were used, they were scanned at 400 and 200X magnification. Since sediment particles were still adhering to the surface after this cleaning process, it proved necessary to further clean the artefacts in 5 % HCl at room temperature which is regarded as not destroying silica (Rodon Borras 1990, 181) but could remove the more persistent residues. Other residues could not be noted.

Prerequisites

Raw material

There are different types of veined quartz, some of which are more suited for use-wear analysis comparable to different types of chert. The ideal quartz consists of large crystals. On the relatively even surface, striations can be detected easily; use-wear is often spread quite regularly. The edges of this kind of quartz are often so regular that edge scarring can be distinguished rather easily under low magnification. Artefact LP 93 belongs to that group.

On the surface of quartzes consisting of smaller crystals, the crystals lie on different levels, some edges are sticking out and provide high-friction areas in use and non-use situations. Thus, the wear on these surfaces is more irregular. Also the irregularity of these edges makes the interpretation of edge scarring under low magnification difficult. All the other artefacts from the cave display smaller, more irregular grains, which differ in size on the single artefacts.

One of the small pieces (LP 97/2) consists of quartzite and contains a microcrystalline mass between rather small quartz grains. Here, the analysis of the quartz grains would be even more complicated. On this last type of surface, which is macroscopically matt, the grain size is too small for the analysis of individual quartz grains and the surface resembles coarse grained, irregular microcrystalline stones.

Post depositional surface modifications (PDSM)

At first sight, it can be stated that the surfaces of the artefacts from the Lurgrotte seem to have suffered far less from chemical attack than the younger artefacts from the Late Upper Palaeolithic open-air site of Rosenburg (cf. Derndarsky 1997). In contrary to the etched out striations on the latter site, there are still striations of different nature visible on the artefacts from the Lurgrotte.

Also, mechanical damage did not seem to have affected the artefacts to a large extent. Most artefacts displayed rather sharp edges. Only the edges of LP 103/3, a tiny spall, were clearly rounded, which was already visible under low magnification. Under high magnification, heavy abrasion could be seen all over the surface, which indicates that this piece must have moved in the sediment. Still, minor movement in the sediment, possibly already during the original use of the cave, is likely to have occurred since all artefacts display some abrasion and striations in the inland. Though it was thought that stones and soil particles would leave traces characteristic for contact with hard materials, the striations in the inland are not always typical for 'hard materials'. Thus, a tool can only be interpreted if obviously more striations are situated at the edge than in the inland and if these use-wear features coincide with the often hardly recognisable edge scars and the morphology of the tool. The quality of the raw material also plays a decisive role for the possibilities of interpreting the tools since artefacts made of large grained quartz suffer far less abrasion in the inland than artefacts consisting of small crystals.

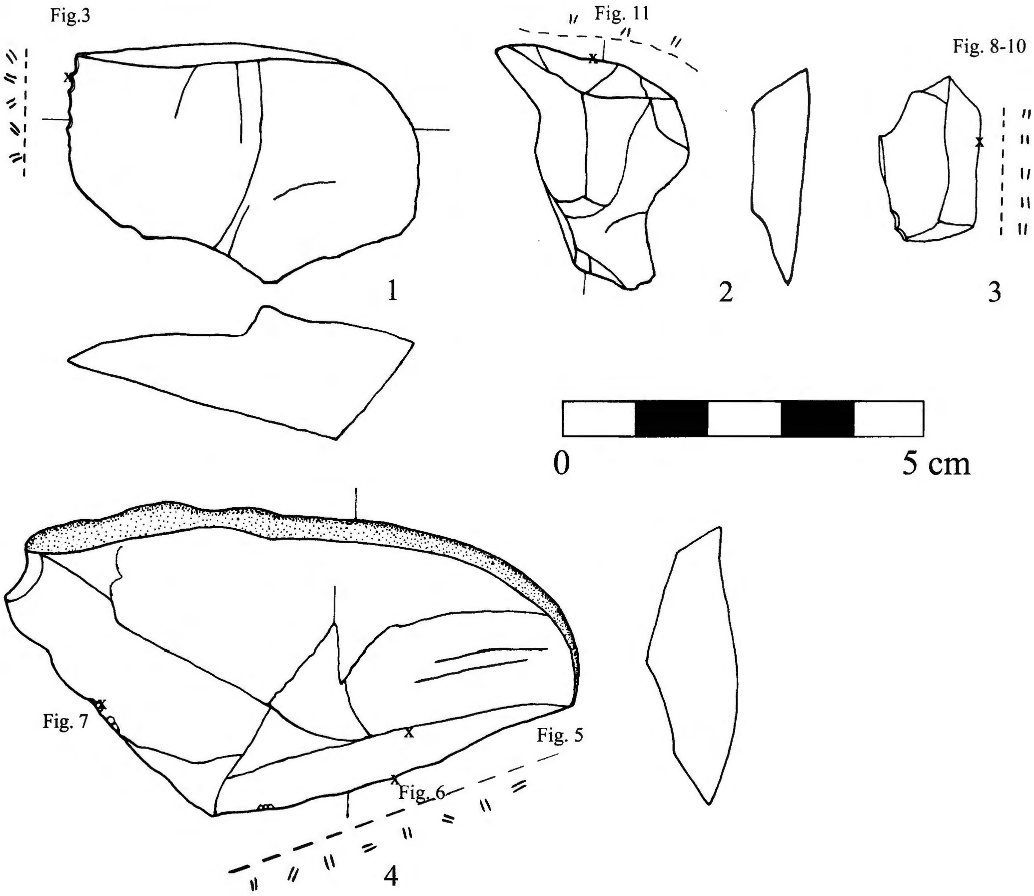

Fig. 1. Quartz artefacts from the Lurgrotte with possible traces of use-wear (//=: directions of striations; 1: LP 36, 2: LP 84, 3: LP 103/1, 4: LP 93).

Description of the wear traces (cf. Fig. 1)

LP 36, edge 'b':

Plan view: straight to slightly convex
Cross section: convex – straight
Edge angle: 40 degree
Length: 19 mm

Striations transversal, oblique and more rarely parallel to edge b can be found on the dorsal and ventral aspect (Fig. 3). The striations are partly rather faint, partly more clearly visible and of the regular type. Also the occurrence of edge scarring (Fig. 2) might confirm that this edge was used, probably for cutting soft to middle hard material transversally to the edge. This artefact consists partly of large regular crystals, partly of smaller ones.

LP 93, edge 'a':

Plan view: straight
Cross section: plane – plane
Edge angle: 55–65 degree
Length: 47,5 mm

This artefact was made of high quality quartz with large grains and displayed only little abrasion in the inland (80 to 90 % of the quartz grains seem to be intact). Still, some striations running exactly parallel to each other, long in the inland, transversally to the edge named above (Fig. 5), indicate some non-use wear traces, which might also have caused some of the scarring of this edge. Closer to edge 'a' the wear is increasing. Many striations parallel and transversal to the edge could be detected. These striations are partly broad and regular, partly narrow and partly of the sleek type and can also be found in the lower part of the microtopography, which indicates cutting and sawing a soft or middle hard worked material (Fig. 6).

LP 93, edge 'a2':

Plan view: straight
Cross section: plane – plane
Edge angle: 55–60 degree
Length: 39 mm

There are some large striations (Fig. 7) running parallel to edge 'a', and thus oblique to 'a2', and even a few deep surface cracks, which indicate an event as an impact on a hard material. Their distribution is concentrated to one area. The edge scarring here is rather irregular and consists of larger scars. Thus, this edge is not interpreted as used but the wear is more likely to be related to the use of edge 'a', as f. ex. contact with bones during butchering, or to a non-use incident.

LP 42, edge 'b':

Plan view: straight to slightly convex
Cross section: concave – convex
Edge angle: 35–40 degree
Length: 22.5 mm

Many faint striations transversal, oblique and more rarely parallel to the edge could be detected on both aspects, which indicates the edge had been used for cutting. The worked material is likely to have been rather soft (meat, fresh hide, soft plants). In the inland of the tool the amount of wear (abrasion and striations) is considerably higher than on the former tools, which is probably due to the small crystals of this raw material and makes the interpretation of this tool more insecure.

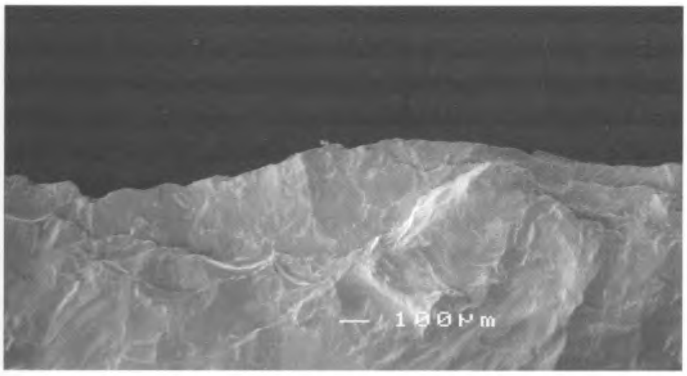

Fig. 2. Lurgrotte, LP 36, ventral, 50X (SEM): The rather regular edge-scarring indicates wear induced by use.

Fig. 3. Lurgrotte, LP 36, ventral, 200X: Striation transversal and oblique to the edge indicate the use of this edge for cutting transversally to the edge.

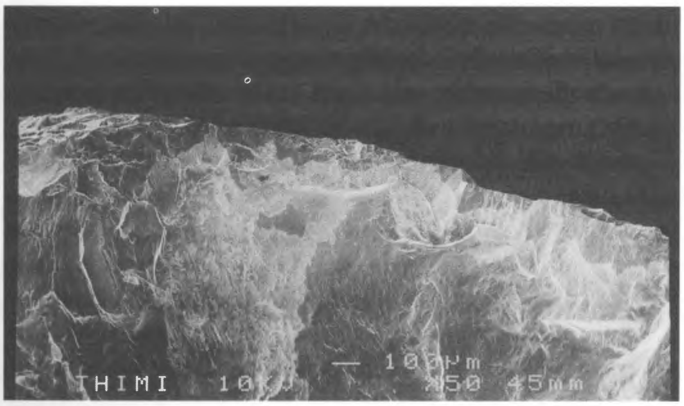

Fig. 4. Lurgrotte, LP 93, ventral, 50X (SEM): Also on this artefact, regular edge-scarring can be detected.

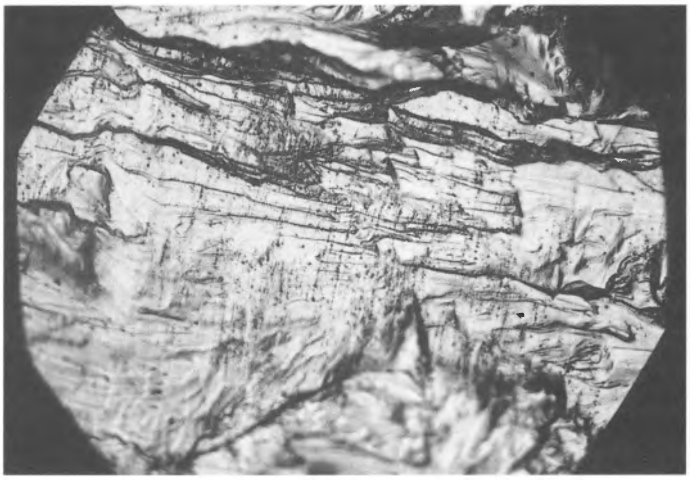

Fig. 5. Lurgrotte, LP 93, ventral, 200X: Many exactly parallel striations in the inland indicate PDSM.

Fig. 6. Lurgrotte, LP 93, ventral, 200X: Very fine striations normal to the working edge are located at different levels of the microtopography.

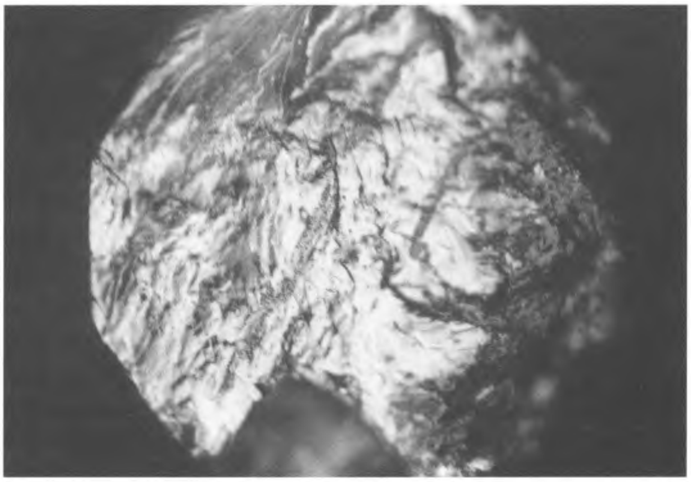

Fig. 7. Lurgrotte, LP 93, ventral, 200X: Large rows of incipient Hertzian cone cracks indicate damage by a very hard material.

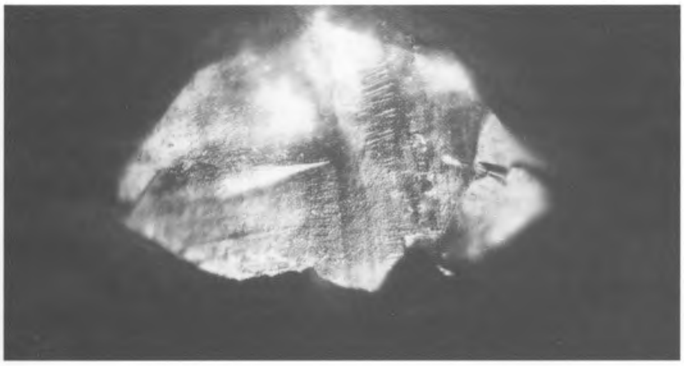

Fig. 8. Lurgrotte, LP 103/1, dorsal, 400X: Under the incident light microscope many lines of faint incipient Hertzian cone cracks are visible. The outermost part of the edge seems to have been smoothed.

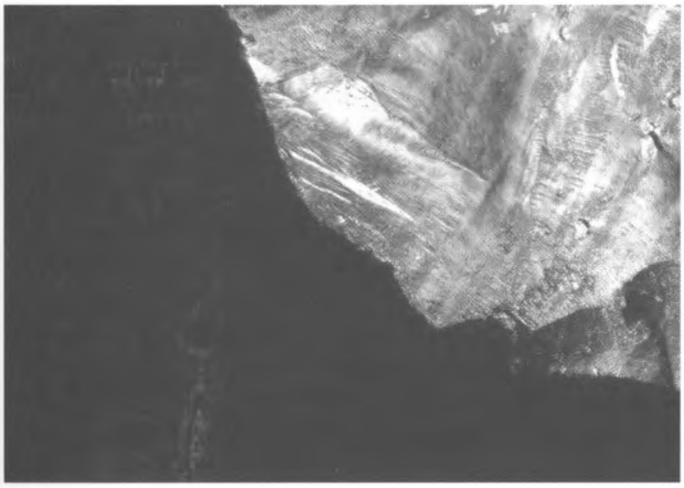

Fig. 9. Lurgrotte, LP 103/1, dorsal, 400X (10X objective, 4X zoom): Same area as fig. 6, but taken with the CLSM under reflected light: On this image the topography of the surface is more clearly discernible. Striations can mainly be seen on the oblique plane on the right side.

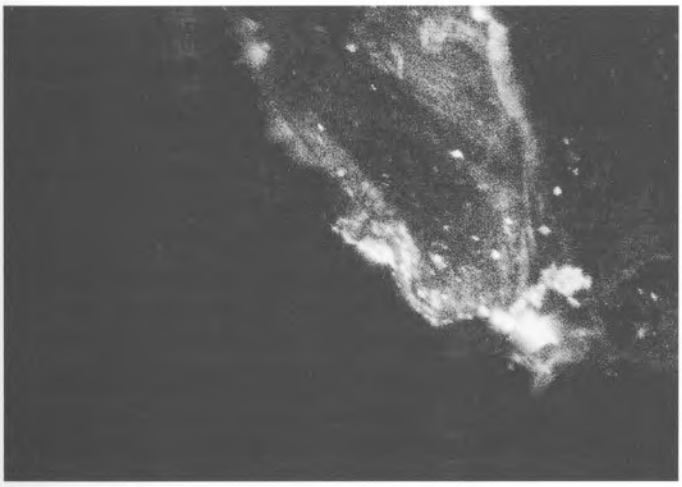

Fig. 10, Lurgrotte, LP 103/1, dorsal, 400X (10X objective, 4X zoom): Same area as fig. 6, but taken with the CLSM under fluorescent light: On this image the cracks under the surface, which have been filled with fluorescent dye, mark the faint striations.

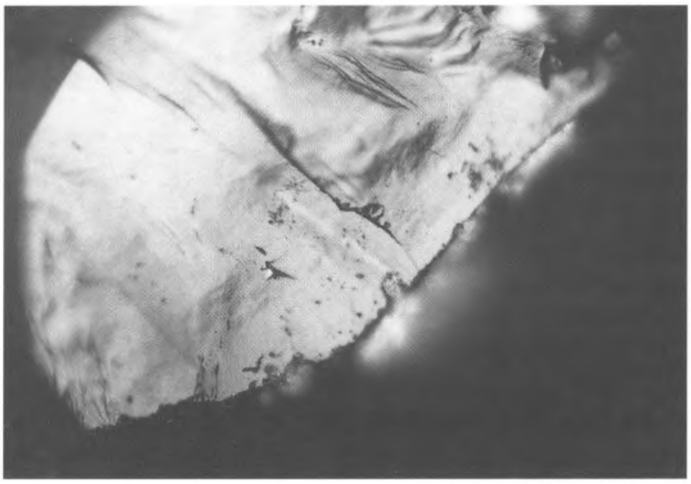

Fig. 11. Lurgrotte, LP 84, ventral, 400X: Slight abrasion and faint striations normal to the edge could indicate that this tool was used to scrape soft material.

LP 42, edge 'a' ventral and dorsal edge:
Plan view: straight
Cross section: plane – plane
Edge angle: 95 degree, resp. 90–100 degree
Length: 26 mm

Along both edges striations transversal to the edges could be found. Because of the amount of non-use wear in this area and the fact that edge scarring could not be ascertained here either, due to the irregularity of raw material, it was refrained from an interpretation.

LP 103/1, edge 'b':
Plan view: straight to slightly concave
Cross section: plane – plane
Edge angle: 50–60 degree
Length: 16 mm

Broad striations parallel to the edge were situated close to edge 'b'. The repeated occurrence of this type of striations along the edge together with edge scarring on both aspects indicates that this edge was used for sawing a middle hard to hard material. On a protruding area smoothing seemed to have occurred beside many striations, which would be comparable to a 'polished chert surface', under the metallurgical incident light microscope (Fig. 8). This kind of wear has been caused by heavy friction in a use-situation. The difference between striations and edges of cleavage planes is more clearly visible on the reflected light image of the CLSM. The area, which seems to be smoothed under the metallurgical incident light microscope, still displays some roughness, on the image taken by the CLSM (Fig. 9). There the faint striations on the surface cannot be discerned. These striations were also made visible on the image taken with fluorescent light with the CLSM where the cracks under the surface were filled with fluorescent colour (Fig. 10). On the oblique surface, striations showed up on the reflected light image taken with the CLSM. There, even the single crescent shaped cracks can be observed.

LP 84, edge 'a':
Plan view: straight
Cross section: plane – plane
Edge angle: 75 degree

Length: 26.5 mm

Many striations were visible all over this artefact. These striations were partly rather faint. Thus, the faint striations transversal to edge 'a' could be seen as deriving from scraping soft material (Fig. 11) but they do not seem to suffice for an interpretation as use-wear.

LP 91, edge 'a':

Plan view: straight (resp. convex)

Cross section: plane – plane

Edge angle: 85 degree

Length: 59 mm

The dorsal aspect of this tool is covered with cortex. Even though the main part of the ventral surface consists of rather large quartz grains, the quality of the raw material decreases towards the edges, i.e. the cortex area, where a micro-wear analysis is not possible. Striations transversal to the only edge outside the cortex area might indicate use but there is too little wear for a reliable interpretation.

Discussion

The main problem for interpreting micro-wear on archaeological artefacts is distinguishing use-induced wear from post-depositional wear. In the field of micro-wear studies of quartz artefacts, only initial experiments have been conducted (Knutsson 1988a, 88-103; Knutsson and Lindé 1990). R. K. Pant, who wrote his thesis about the quartz tools from the Arago Cave already in 1979, did not discuss eventual post depositional effects on the tools (Pant 1989). The effects of post-depositional surface modification (PDSM) on archaeological quartz artefacts were discussed in K. Knutsson (1988b, 114–123) and Y. Huang and K. Knutsson (1995). On the Middle and Upper Palaeolithic artefacts from Chinese caves, the dominant PDSM features were mechanical abrasion of ridges and flat surfaces situated on protruding parts of the surface. It was stated that an interpretation should be based on the regularity of the distribution and the type and directions of striations (Huang and Knutsson 1995, 37–42). As discussed above, the regularity of the distribution of use-wear as well as PDSM seems to be largely dependent on the quality of the raw material. Artefacts consisting of small-grained quartz proved to have suffered far more post depositional mechanical damage than artefacts made of high quality quartz due to the higher frequency of protruding areas. This fact aggravates an analysis of the also more irregular use-wear features. A discussion whether some artefacts might have moved more in the sediment than others, based on non-use wear features, should thus be omitted for the moment. The occurrence of varying non-use striations, similar to those caused by rather soft materials, on the artefacts from the Lurgrotte demands further experimentation simulating post-depositional movements in the sediment. The low frequency of mechanical damage on the quartz artefacts is in accordance with the results of the analysis of the bones and the sediment conditions (see Fladerer et al., same volume) and is promising for future investigations of this cave.

While some of the interpretations of the artefacts can be regarded as rather certain (LP 36, 93, 42, 103/1), the use of others (LP 84, 91) can neither be assured nor excluded. This is a rather large proportion of used artefacts, considering that 6 artefacts were tiny spalls. Here, the different character of use-wear traces on quartz and flint/cherts has to be taken into consideration: Striations, which are the main use-wear attribute on quartz, are produced even by soft, non-abrasive materials and during short use while for a clear smoothing of the surface of flint tools much more time is needed, especially when working soft, non abrasive materials. In addition, soil chemicals often destroy this uppermost layer and thus use of flint artefacts might become undetectable. Since the striations on quartz tools are stable and might be even become more pronounced by chemical weathering (Knutsson 1988b, 122), it can be expected that the percentage of quartz tools with use-wear traces characteristic for soft materials or traces derived by short use will be much higher than the percentage of flint tools with characteristic use-wear traces, which had been used in the same way. The slight use-wear traces on the artefacts from the Lurgrotte, with the exception of LP 103/1, indicate a rather short use.

The small spalls were mainly inspected under low power magnification. On one hand, handling these pieces is rather difficult. On the other hand, even if striations and other features of abrasion can be discerned, they cannot be distinguished from 'features in the inland' due to the size of the pieces.

No traces of very hard materials (deep surface cracks, rows of large Hertzian cone cracks) could be detected except on an edge, which is not likely to have been used. The worked materials seem to have been soft to middle hard, except on LP 103/1, where the worked material was harder (middle hard to hard).

Three of the artefacts, which can with high probability be regarded as used, display a natural backing opposite to the used edge where hafting would not be necessary. Use-wear traces are frequently found on edges lying opposite to natural backing, cf. f. ex. the Middle Palaeolithic artefacts from Grotta Breuil and La Combette (Lemorini 2000). The size of the last artefact, which displays use-wear, and the intense striations at the edge make the use of a haft likely. This tool contrasts with LP 36 and 42 in the proportion between the length of the used edge in relation to the distance between the used edge and the opposite edge as well as in the mode of use, i.e. mainly parallel to the edge vs. mainly transversal to the edge, which could be related to the aptitude of the tools for these actions. Regarding the interpretation of the site as a hunters' camp, it can be stated that the motion and the hardness of the use-wear of the three tools with natural backing could indicate their function as tools, which were used for butchering activities.

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