Petro Pesonen & Tuija Kirkinen

TWO MICROPARTICLE ANALYSES OF STONE AGE QUARTZ TOOLS IN FINLAND

Petro Pesonen, Archaeological Field Services, Finnish Heritage Agency, P. O. Box 913, FI-00101 Helsinki, Finland: petro.pesonen@museovirasto.fi, ORCID ID 0000-0003-4076-7305
Tuija Kirkinen, Department of Cultures, Archaeology, University of Helsinki, P. O. Box 59, FI-00014 University of Helsinki, Finland: tuija.kirkinen@helsinki.fi, ORCID ID 0000-0001-5572-4426

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INTRODUCTION

Microparticle analysis has in recent years been explored as a potential new avenue for explaining the otherwise hidden resource utilisation in Stone Age sites. For example, in Finnish acidic soils, bone material survives usually only as burnt and even then, as tiny fragments with a low degree of species identification. Discovery of microparticles (hair, fibres, and feathers) has also shown the species that were not recognized in the osteological analyses of the

Figure 1. The location of the two sites, Korsunlahti in Rautalampi and Spångkärret in Loviisa, discussed in text. Illustration P. Pesonen, map data from Natural Earth Data (naturalearthdata.com).

site (e.g., Kirkinen et al. 2023, this volume). Moreover, the microparticle analysis also gives direct knowledge of the actual tool uses. This paper presents two further cases, Korsunlahti in Rautalampi and Spångkärret in Loviisa (Fig. 1), where the microparticle analysis has been carried out on single tools, a quartz scraper and a flake. We especially want to pay attention to the find contexts of these items, and for future best practices, discuss whether the special conditions of these sites may have helped in the survival of the microparticles.

TWO STONE AGE SAMPLE SITES

Rautalampi Korsunlahti – a Mesolithic site with a red ochre grave

Korsunlahti site is located in Rautalampi, North Savo. The site was discovered in 2005 during the basic survey of Rautalampi municipality (Pesonen 2005). Already during the survey, a red ochre patch was discovered in the cut of a small sand road leading to the shore cabins of the

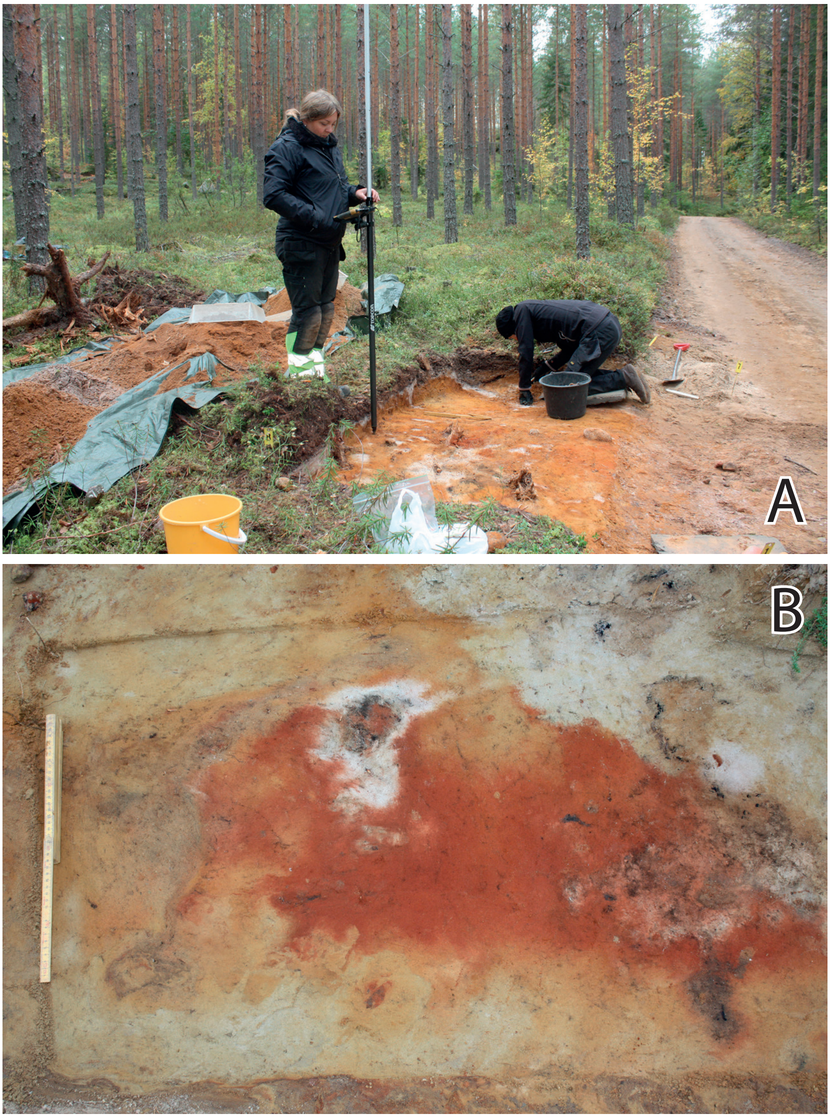

Figure 2. a) The ongoing excavation in the Korsunlahti site, Rautalampi, and b) the red ochre grave in excavation level 5 (c. 20–25 cm below surface). Photos: P. Pesonen, Finnish Heritage Agency.

Figure 3. Test excavation in progress at the Spångkärret site in Loviisa, southeastern Finland. Photo: P. Pesonen, Finnish Heritage Agency.

Korsunlahti bay of the Lake Niinivesi. The red ochre grave was excavated in 2021 as a rescue excavation by the Finnish Heritage Agency's test excavation group in addition to testpitting the site (Fig. 2a; Pesonen 2021a). It appeared that the red ochre grave measured c. 105 x 50 cm, it contained no grave goods, and it contained only c. 5 cm of red ochre in the thickest parts of the feature (Fig. 2b). From the same excavation area, but not in direct contact with the grave, a quartz flake (KM 43336:46) was found and selected as a sample for the microparticle analysis. It was not handled but was immediately packed in aluminium foil and a zip-lock bag. Otherwise, the finds in the area consisted of a few quartz flakes and pieces of burnt bone from beaver (*Castor fiber*), pike (*Esox lucius*), perch (*Perca fluviatilis*), cyprinids (Cyprinidae), and unspecified mammals and fish (Nurminen 2021a). Based on the lake history and the elevation of the site, it is likely that the site derives from the Late Mesolithic or Early Neolithic Stone Age (c. 5000–4000 calBC). Unfortunately, radiocarbon dates are unavailable so far. Considering its size, the red ochre grave may be interpreted as being a child's grave (counterparts, e.g., Pesonen et al. 2014; on the general background of red ochre graves, see Ahola 2019).

Loviisa Spångkärret - a Middle Neolithic site with pithouses

Spångkärret site is located in Loviisa (formerly Pyhtää), Uusimaa region. The first finds from the site were collected by a local amateur archaeologist already in 2014–2015 but the site was not inspected until 2017. In this connection also the 12 pithouses were registered. In 2018, the site was visited again, this time samples for sediment DNA were taken from two of the pithouses (Pesonen 2018; Peltola 2019). Test excavations in 2021 were launched because of the forest management plans concerning the forested mire next to the settlement site (Pesonen 2021b). Three-room pithouse was test-pitted to find out if this feature really was a pithouse and to get datable material for the radiocarbon analysis (Fig. 3). It turned out that it really is a multi-room pithouse and test pits to all three rooms yielded a number of finds: quartz, organic-tempered pottery and burnt bone. In the middle-room test pit a quartz scraper (KM 43337:11) was selected for the microparticle analysis, wrapped in aluminium foil and left totally unhandled. One big mammalian bone was radiocarbon dated to the Middle Neolithic (Ua-72797; 5124±37 BP; 5850±65 calBP). The dating result is in conflict with the assumed Middle/Late Neolithic Pyheensilta-type affiliation of the organic-tempered pottery (see Pesonen 2021b) and the most probable shoreline dating to the Late Neolithic (c. 5000–4500 BP; according to the shore-line curve of the Loviisa region, see Miettinen et al. 1999). It is still possible that the site was inhabited already during the Middle Neolithic when the water level was some metres higher. Obviously, the chronological settling of the site needs still more data. The osteological analysis (Nurminen 2021b) of the burnt bones revealed mostly seals (Phocidae), several unidentified mammal bones, and in addition, only one bone of perch (*Perca fluviatilis*).

MICROPARTICLE ANALYSIS

In a clean room, the foil wrappings were opened, and the loose sand was shaken off gently. The quartz artefacts were sealed in clean zip-lock bags with a small amount of distilled water. The bags were placed in an ultrasonic cleaner and cleaned for 10 minutes. The resulting liquid from the bags was divided into Eppendorf-tubes and centrifuged at 2500 rpm for seven minutes. The extraction was pipetted on microscope slides and studied by transmitted light microscope with 100x-400x magnification. The findings were documented by photographing, and the fibres were analysed by using identification keys (Tóth 2017; Dove & Koch 2011) and a reference collection that covers Fennoscandian species. The samples were prepared in a room dedicated to microscopic

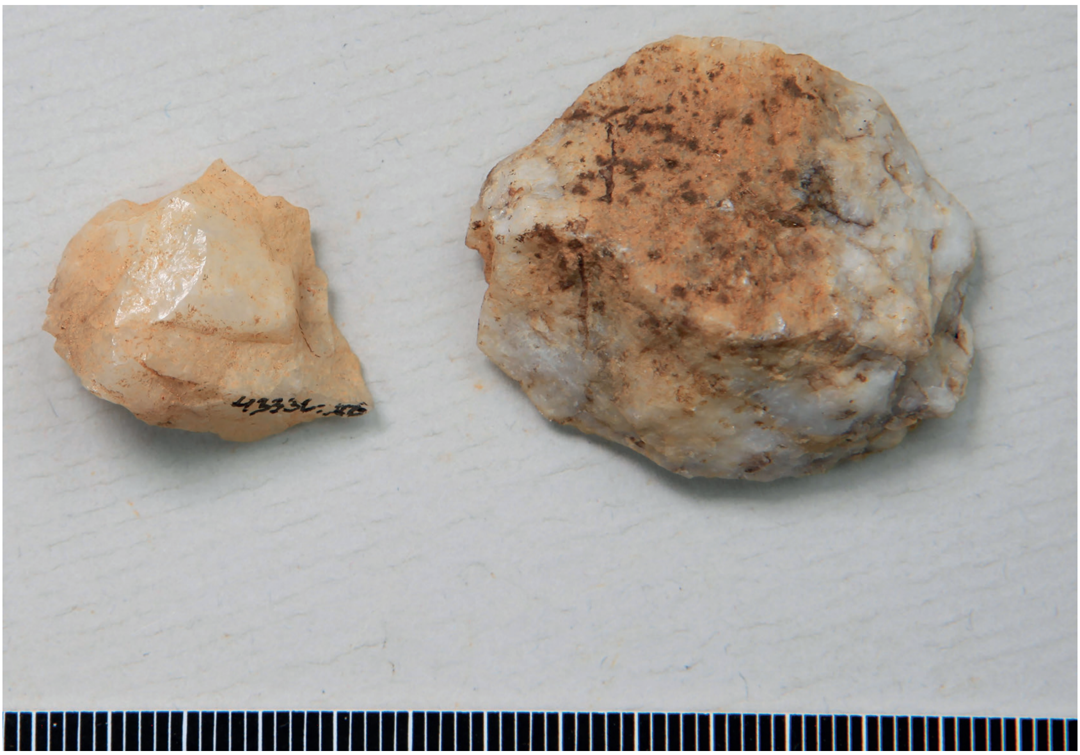

Figure 4. The two quartz items from Korsunlahti site (left) and Spångkärret site (right). Photo: P. Pesonen.

Figure 5. Proximal section of the shaft of a hair K1 at the Korsunlahti site. Note the sharply cut ends. Photo: T. Kirkinen.

examination, and the room was cleaned carefully by wiping it down before every work session.

The results of the microparticle analysis of the Korsunlahti quartz flake were really promising as in total seven hair fragments (K1-K4, K6-K8) were detected. These guard hairs were 0.2–0.8 mm in length and 37–41.8 µm in width. They were brown in colour and scale structure, when identifiable, was waved figureless (see Tóth 2017: 53). The medulla was preserved only in one hair, K1, and it was amorphous and fragmented. Most interestingly, in hairs K1 (Fig. 5), K7 and K8 the ends of the hairs had sharp edges, which might indicate that they have been sectioned by man. The hairs were mostly quite poorly preserved, but the pigmentation, width, and scale structure hint at the possibility that they might be from the same species. Although the hairs could not be identified by species, as they shared no diagnostic features, it is possible to exclude cervids and seals.

At Loviisa Spångkärret, the microparticle analysis resulted in five hair fragments (K1-K3 and K5-K6) and one bird-feather fragment, a barbule (K4). The hairs were all very badly preserved, 0.2–0.4 mm in length and 26.3–39.5 µm in width (Fig. 6). The scale structure was barely visible and there were no remains of the medulla. In K6, possibly a sharp cut mark can be identified. The bird barbule was 0.5 mm in length. It had distal prongs which are not diagnostic to any specific group of birds, however, they are common for waterfowl (Anseriformes) in general.

DISCUSSION AND CONCLUSIONS

The search for microparticles in soil samples (Äyräpää 1931; Ahola et al. 2018; Kirkinen et al. 2022) and on the surfaces of quartz artefacts (Kirkinen et al. 2023, this volume) have provided

Figure 6. A badly preserved hair fragment K5 at Spångkärret site. Photo: T. Kirkinen.

evidence that less than 1-mm-long remains of soft organic materials such as hairs, plant fibres and feathers can be preserved in Stone Age contexts in Finland.

The preservation of fibres varies from site to site from the total lack of microparticles to still identifiable hairs. It is known that keratins of hairs and feathers are favoured by acidity, while in alkaline soils they tend to degrade more rapidly (Janaway 2002: 382; Rowe 2010: 45). There are also different kinds of keratins with different qualities also affecting their preservation. Compared to hairs in which beta-keratin dominates, feathers are composed mostly of alfa-keratin, which is a stronger type of keratin (Janaway 2002: 382). Human scalp hairs, in turn, appear to be more fragile than animal hairs.

In Finland, the preservation of fibres in Stone Age contexts has been discussed along the Majoonsuo red ochre burial case (Kirkinen et al. 2022). In this study, it was proven that the addition of red ochre (iron oxides) to the burial pit changed the chemical properties of the soil by increasing its acidity, changing the dominant charge of the soil particles, and also by increasing the content of the finer particles. Most importantly, a more acidic environment can reduce bacterial attack on organic remains, and small accumulations of silt-clay can concentrate on animal fibres' surfaces covering them and protecting hairs and feathers from bacteria. The latter statement is supported by empirical work, which indicates that the finer the soil, the better is the preservation of fibres.

In this paper, the contexts of the quartz items (close to a red ochre burial and a housepit) indicate the possibility of good preservation conditions in special kinds of find contexts. The flake – which was not covered with the red ochre – was found close to a red ochre burial at the Korsunlahti site. The afore mentioned acidification of soil next to the grave has not been studied but may still have benefited the preservation of the microparticles in this case. In housepits, the intensity of the habitation and the waste accumulation creates cultural layers that may be much thicker than in normal open-air sites. We do not have good data on the preservation conditions in this kind of strata, but it is possible that also here the conditions favour the survival of microparticles. So far, the study of microparticles has only just begun; we are examining the possibilities and the results are already looking promising. One of the future steps will certainly be to formulate the best practices of microparticle sample collecting, both from the soil and from artefacts and to also assess which contexts are the most favourable for the preservation of microparticles. We also want to point out that in addition to actual tools, there is also a potential for microparticles in items that are not formal tools, e.g., the flake from Korsunlahti site.

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