# The Use of Mineral Raw Materials in Lithic Knapping in Stone Age Northern Ostrobothnia, Finland

*Teemu Mökkönen & Kerkko Nordqvist*

**Teemu Mökkönen**, Eastern and Northern Finland / Cultural Environment Services, The Finnish Heritage Agency. P.O. Box 913, 00101 Helsinki, Finland, e-mail: teemu.mokkonen@gmail.com
**Kerkko Nordqvist**, Department of Cultures, University of Helsinki, Unioninkatu 38, 00014 Helsingin yliopisto, Finland; Department of Archaeology, University of Tartu. Jakobi 2, 51014, Tartu, Estonia, e-mail: kerkko.nordqvist@helsinki.fi

## Abstract

Although quartz predominates in Stone Age knapped assemblages in Finland, the selection of raw materials was not similar throughout the period. This article takes a closer look at the choice of lithic raw materials in Northern Ostrobothnia (Finland) during the 6th–3rd millennia calBC. It demonstrates that changes in lithic raw materials and other cultural development, including pottery production, do not always go hand in hand. A comparison of Northern Ostrobothnia with the Lake Saimaa area shows that there are certain similarities in lithic assemblages (raw material use and technology) during some cultural phases despite the different local raw material base, although diverging trends and regional variation can also be identified.

## 1 Introduction

The enormous quantity of (vein) quartz that makes up the majority of lithic assemblages is probably the main reason why the selection of Stone Age raw materials is a marginally studied topic in Finland. Only two short periods with a large amount of imported flint – the pioneer settlement right after the last glaciation in the 9th millennium calBC and the Typical Comb Ware period in 3900–3400 calBC – have aroused more interest (Hertell & Tallavaara 2011; Jussila et al. 2012; Kankaanpää & Rankama 2014; Kinnunen et al. 1985; Mökkönen et al. 2017a; Rankama et al. 2006; Vuorinen 1982). Quartz is often considered a profoundly bulk material. Its irregular internal structure makes it a difficult material to control when knapping (e.g. Rankama et al. 2006: 249–250), and quartz assemblages with a lot of debris and few diagnostic artefacts are common.

Due to the lack of studies summarising the regional use of various raw materials, the overall picture of Stone Age lithics in Finland is perceived as being rather monotonous. Recent papers by the present authors have shown variation in the selection of raw materials and detected both temporal and geographical trends (Mökkönen & Nordqvist 2016; Mökkönen et al. 2017a). This article is a direct continuation of these studies. It provides an overview of the development of lithic raw materials used in knapping in the province of Northern Ostrobothnia (Finland) from the 6th to the 3rd millennium calBC (Fig. 1). In the following, we will focus on the general characteristics of the lithic raw material use, as well as their temporal and technological changes, and place them

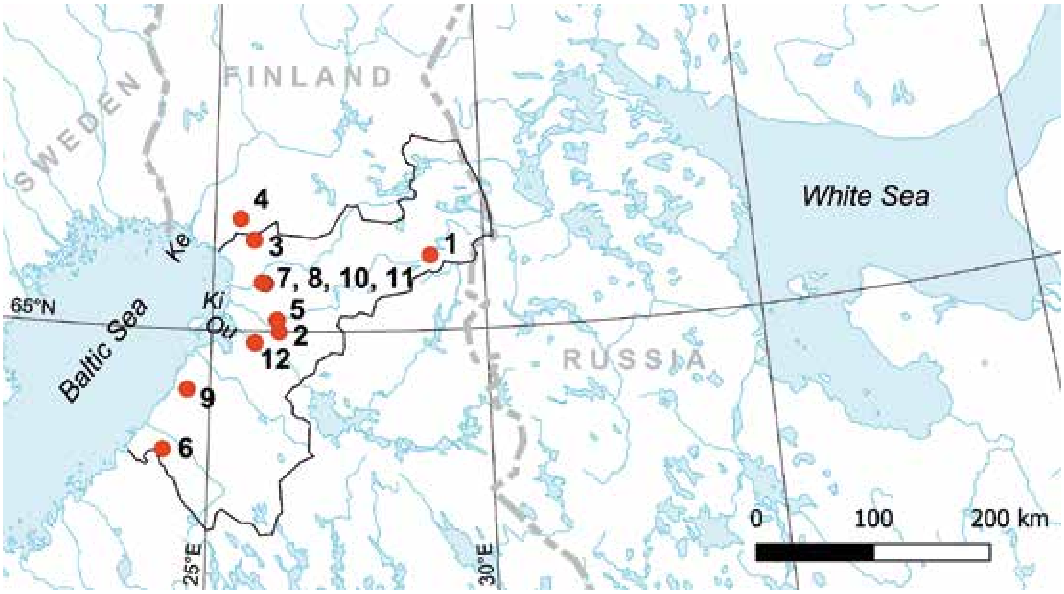


Figure 1. The location of the studied sites. The solid line shows the borders of the province of Northern Ostrobothnia, Finland. In the Stone Age, all sites were located on the seacoast (except for no. 1). Sites: 1 – Tervaniemi, Ahola; 2 – Vepsänkangas; 3 – Veskankangas; 4 – Tainiaro; 5 – Latokangas; 6 – Kivimaa; 7 – Kierikin sorakuoppa; 8 – Kierikinkangas; 9 – Kauniinmetsänniitty 1; 10 – Kuuselankangas; 11 – Purkajasuo-Korvala; and 12 – Hangaskangas E. Rivers: Ke – Kemijoki; Ki – Kiiminkijoki; and Ou – Oulujoki. Map: T. Mökkönen, 2020, vector base map by Natural Earth.

in a wider context by comparing the results with the situation in the Lake Saimaa area (eastern Finland).

The analysed assemblages are divided into five phases that roughly correspond to the general Finnish archaeological periodisation and pottery sequence (see Nordqvist & Mökkönen 2017) (Table 1, Appendix 1). *Phase 1: 6000–5000 calBC* encompasses the Late Mesolithic and the first centuries of the Neolithic (defined in the research area by the appearance of pottery from 5300 calBC), *Phase 2: 5000–4000 calBC* corresponds to the time of the earliest pottery traditions (Säräisniemi 1 Ware, Sperrings 1 and 2 Wares), *Phase 3: 4000–3500 calBC* covers the Typical Comb Ware period, *Phase 4: 3500–3000 calBC* includes the asbestos- and organic-tempered Kierikki and Pöljä Wares as well as local late variants of the Comb Ware tradition, and *Phase 5: 3000–2000 calBC* matches with the Late and Final Neolithic, but is not associated with any pottery in the studied assemblages. This division was also used in our previous studies.

The province of Northern Ostrobothnia is located on the eastern coast of the Bothnian Bay in the Baltic Sea but extends to the Finnish-Russian border. Its geography is characterised by a relatively short coastal strip, which is connected to the vast inland areas by an extensive network of waterways. The most common soil is moraine, but there are several different bedrock areas in the region. In addition, the geologically diverse area of southern and central Lapland (Silvennoinen 1998) is situated to the north of it. The latter environment set the stage for the development of a particular regional lithic industry, whose influence was also felt in the research area. A short excursion into this northern 'slate culture' can serve as a prologue to our study.

| | calBC | Sites | Lithics (g/pcs) | Lithics per m² (g/pcs) |
|---|---|---|---|---|
| Phase 1 | 6000–5000 | 1 | 5911/3198 | 19/10 |
| Phase 1+2 | 6000–4000 | 2 | 69 988/13 559 | 145/28 |
| Phase 2 | 5000–4000 | 1 | 133 562/14 586 | 266/36 |
| Phase 2+3 | 5000–3500 | 1 | 18 144/4 065 | 25/6 |
| Phase 3 | 4000–3500 | 4 | 61 530/12 552 | 71/14 |
| Phase 3+4 | 4000–3000 | 1 | 50 023/21 849 | 95/41 |
| Phase 4 | 3500–3000 | 1 | 22 209/12 467 | 126/71 |
| Phase 5 | 3000–2000 | 1 | 2 078/1 100 | 43/23 |
| Total | | 12 | 363 445/83 376 | |

Table 1. Chronological phases used in the study and the volume of lithics per phase (for data, see Appendices 1 and 2).

## 2 Close to the slate zone

In southern Lapland, slates, in addition to quartz, were a characteristic part of the Stone Age raw material kit for a long time. The term 'slate' used by archaeologists (and also retained here) is imprecise and can cover the various (meta)tuffs, phyllites, shales, schists, quartzites, etc. available in outcrops to the west of the Finnish-Swedish border (see Silvennoinen 1998; Sarala 2012). One key area with significant local raw material deposits is known to be located in the municipality of Tervola in the lower Kemijoki valley, and it is believed to have been a production centre for the so-called Bothnian ground stone tools (Kotivuori 1996: 67; see also Eranti 2020; Huurre 1983: 105; Kelloniemi 2020).

The use of local slate outcrops gained momentum in the 7th millennium calBC at the latest and intensified further between the 6th and 4th millennia calBC when new polished artefact types appeared (Huurre 1983: 100–109, 160–168; Kotivuori 1996: 57–63; Nunez 1998; see Hallgren 2008: 255–260 for the corresponding 'slate culture' in northern Sweden). It has been estimated that during the most intensive phase of slate utilisation in southern Lapland the knapping of quartz and slate was equally common, and quartzite was used, too (Kotivuori 1996: 63, 67). Still, knapped slate artefacts are poorly studied, and formal (retouched) artefacts are rare (see below): slate raw materials often fracture neatly along smooth cleavage plains, resulting in sharp flakes that can be used as tools without further processing.

Pottery technology, which began to spread after 5300 calBC, was initially rather weakly rooted in the research area and rarely crossed the present Finnish-Swedish border (but see Norberg 2008: 23–24 for more western encounters). Typically, only a small volume of pottery is found at the sites (Huurre 1983: 137, 146; Nordqvist 2018: 94–97), at least when compared to further south in Finland, and many areas occupied by the 'slate culture' remain aceramic. Thus, our research area – Northern Ostrobothnia – can be described as a transition zone located at the crossroads of several routes and cultural traditions; this also characterizes it in the later phases of prehistory.

## 3 Analysed sites and materials

The studied materials come from 12 settlement sites excavated between 1984 and 2012 (Fig. 1, Appendix 1), and include 83 376 lithic objects with a total weight of over 363 kg (Table 1). These materials have not been used in previous quantitative lithic studies and were analysed by the authors at the premises of the Finnish Heritage Agency.

Recently excavated single-period contexts (assemblages) with a sufficient level of documentation and find recovery (sieving) were preferred in order to facilitate reliable comparisons between phases, sites and regions. The analysis of the materials focused on recording a predefined set of variables and was performed with the naked eye (for the analytical procedures, see Mökkönen & Nordqvist 2016: 44–45).

All the studied localities are situated in Northern Ostrobothnia, with the exception of the Tainiaro site, which is located a few kilometres away in Lapland province. During the Stone Age, these were all coastal sites except for the Tervaniemi, Ahola site, which was located inland. Due to the rapid land uplift in the area (current rate of ca. 7 mm/year), the settlement sites following the changes of the seashore were typically occupied for only a limited span of time. This creates good conditions for the formation of short-lived settlement sites and for the recognition of temporal changes in material culture. Based on radiocarbon data, the analysed sites have been inhabited for about two or three centuries, but less than 500 years (Appendix 2). The dates of the Latokangas and Kauniinmetsänniitty 1 sites indicate a longer settlement history, even if the typologically diagnostic materials belong only to the older settlement phase (see also Pesonen 2013a). Wood charcoal dates with large standard deviations place the Tervaniemi, Ahola site only roughly to the 6th millennium calBC.[1]

The material covers the period from the 6th to the 3rd millennium calBC, and the studied assemblages also represent all the main pottery types encountered in the area (Appendix 1). Two of the early sites, Tervaniemi, Ahola and Veskankangas, do not contain pottery, although the latter is already coeval with the early use of ceramics in the area. The youngest assemblage – the Hangaskangas E site, which dates to the Final Neolithic – also lacks pottery.

Due to the long period of time studied here, the phases are mostly represented by only one or two clean (unmixed) assemblages, and broad dates link some sites to two phases. Therefore, the results and temporal trends presented in this article for Phases 2 through 4 can be considered preliminary, while the oldest and youngest phases should be approached with caution.

## 4 Results and discussion

### 4.1 Raw material selection

Quartz, which is one of the most abundant locally available minerals in Finland, was the key material in Northern Ostrobothnia throughout the Stone Age (Fig. 2, Appendix 3). Its share of all lithics is typically around 80% (here and below, per cent by weight), and at some sites it can reach nearly 100%. Quartz is followed by slate, the proportion of which can reach 30–90% of all lithics, especially in the early phases. Quartzite is present in some amount throughout the Stone Age, while other raw materials (flint and other stones[2]) are found in smaller quantities.

Phase 1 is only represented by the quartz-dominated (>95%) inland site of Tervaniemi, Ahola. The Phase 2 sites illustrate the lithic use at a time when the earliest pottery was spreading in the area. The two northernmost sites of the study, Veskankangas and Tainiaro, are also the sites most strongly characterised by slate. In contrast, the other two Phase 2 sites (Latokangas and Vepsänkangas), located approximately one hundred kilometres south of the slate-rich sites, are much more consistent with the quartz-dominated profiles of the younger sites in the research area. This indicates that the geographical proximity to the slate outcrops of southern Lapland was an important factor in their utilisation and, together with the properties of the raw material itself, contributed to the way and volume of lithic working (see e.g. Manninen & Knutsson 2014). Slate artefacts from the analysed sites include several items typical for the industry of southern Lapland (and especially sites containing the earliest pottery; see Kotivuori

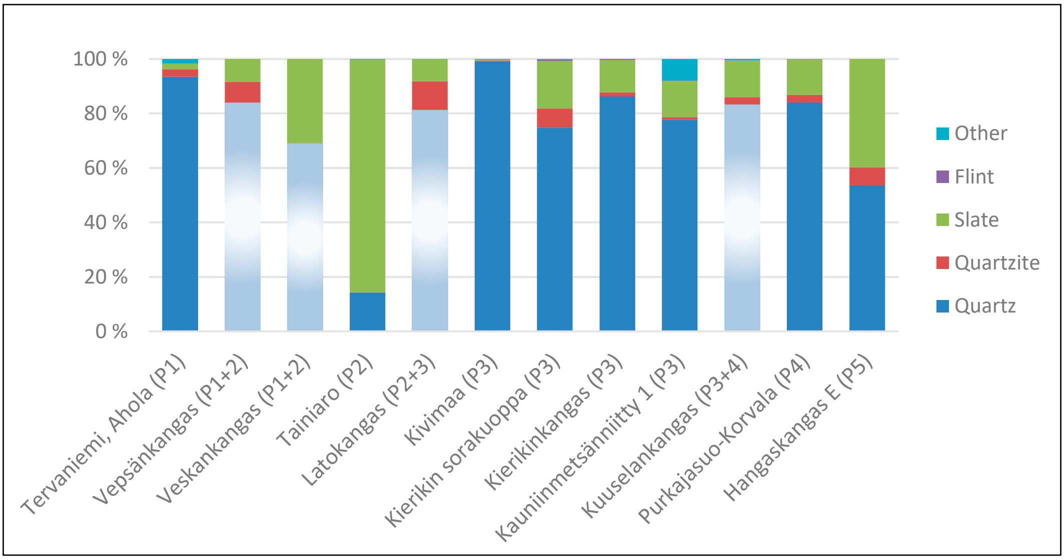


Figure 2. Percentage distribution of the lithic raw materials by weight at the analysed sites. Materials dating to two phases are indicated by a soft gradient colour on the quartz bars. The phases are shown in parentheses.

1996: 61–62, 93), such as slightly retouched or polished knives, tanged scrapers, points and blades, as well as retouched flakes and reused fragments of ground stone tools (Fig. 3). They show that the border of different lithic traditions, one relying on quartz and the other intensively using slates, runs in the 5th millennium calBC in the northern part of Northern Ostrobothnia.

The lithic profiles of the Phase 2 sites also suggest that no particular lithic technology spread alongside the early pottery traditions (Säräisniemi 1 and Sperrings 1 Wares), and that the appearance of ceramics did not change the local traditions of lithic raw material use. This is similar to the situation observed in the Lake Saimaa area (Mökkönen & Nordqvist 2016) and elsewhere in northeastern Europe (Gerasimov & Kriiska 2018: 307; Núñez 1990: 41). The Veskankangas site, which is rather rich in slate, also hints that some groups may not have been directly involved in the contacts that spread the early pottery, or for other reasons chose not to adopt or use ceramics in all contexts.

Our results also confirm previous observations that the appearance of Typical Comb Ware (Phase 3) did not lead to large-scale import of flint in Northern Ostrobothnia (see Vuorinen 1982: 81–82; also Mökkönen et al. 2017a) (Fig. 2). The largest share of flint is present at the Kierikin sorakuoppa site, but the amount – 1% – is insignificant compared to the Lake Saimaa area, where the corresponding figure averages around 30% (Mökkönen & Nordqvist 2016; Mökkönen et al. 2017a). In addition, flint often came to Northern Ostrobothnia in the form of ready-made artefacts and not as a raw material, as in the south. In the Lake Saimaa area, the intensified use of flint also triggered the use of local rock crystals (on average 17% of the analysed catalogue sub-numbers; Mökkönen et al. 2017a), but this is not clearly visible in Northern Ostrobothnia (Appendix 3). An increased content of high-quality quartzes is only recorded at the aforementioned Kierikin sorakuoppa site (8%) and the fully quartz-dominated Kivimaa site (10%); the latter is the southernmost of the analysed locations and has direct water connections to central and eastern Finland. Thus, even if the emergence of Typical Comb Ware was associated with a new lithic technology in

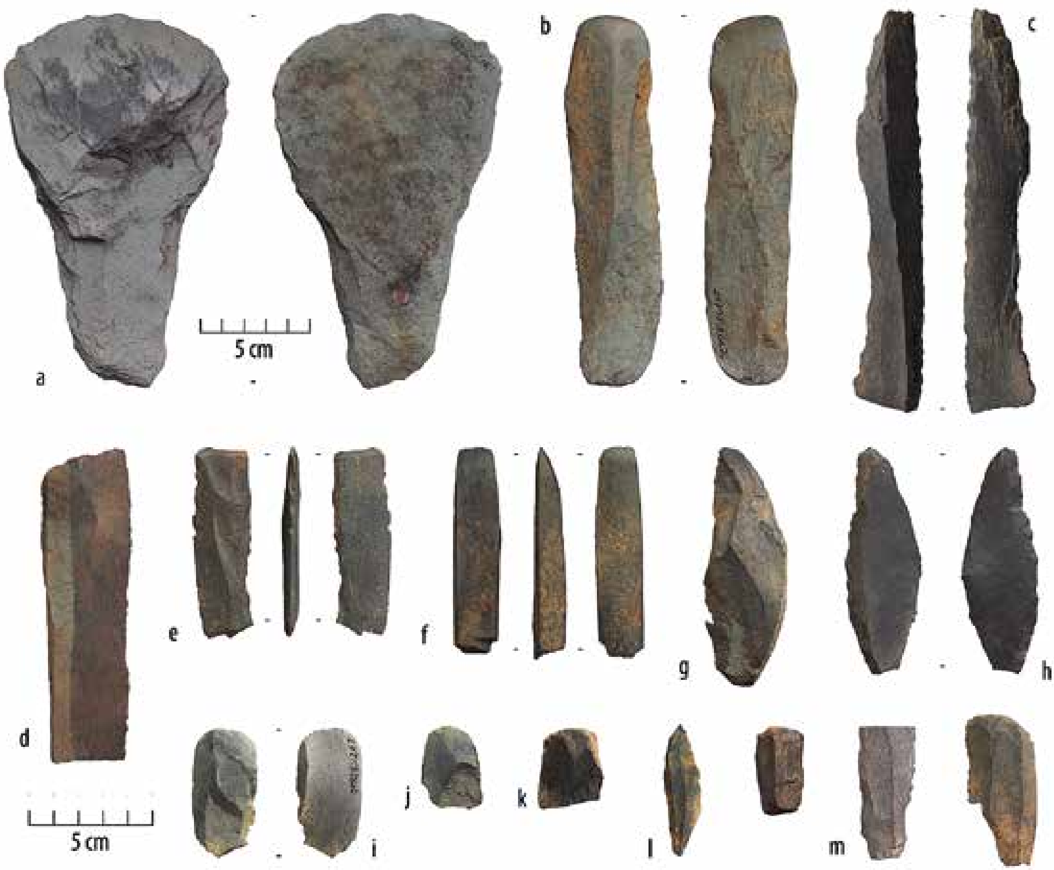


Figure 3. Slate artefacts from the Tainiaro (a–h, m) and Veskankangas (i–l) sites: tanged scraper (a); axes/adzes (b, e, f); knives (c, d, h); awls, points and blades (g, l, m); scraper (k); scrapers retouched from fragments of polished artefacts (j, l). Tools that take advantage of the naturally sharp edges of split pieces with minimal retouch are typical of the slate industry. a – KM 25797: 634; b – KM 25797: 2062; c – KM 24925: 933; d – KM 22398: 619; e – KM 22398: 375; f – KM 25797: 1701; g – KM 22398: 227; h – KM 22398: 546; i – KM 24928: 1261; j – KM 24928: 783; k – KM 27365: 250; l – KM 24423: 324; m – KM 22398: 67. Photos: T. Mökkönen, 2014, illustration K. Nordqvist, 2020.

the Lake Saimaa area, the development in Northern Ostrobothnia followed a slightly different path, which is also illustrated by other material culture (Mökkönen & Nordqvist 2018).

The transition to Phase 4 is marked by the appearance of asbestos- and organic-tempered potteries (Kierikki and Pöljä Wares). However, in Northern Ostrobothnia the lithic raw material profiles remain practically unchanged in comparison with the preceding phase (only the few high-quality quartzes disappear; Appendix 3). In the Lake Saimaa area, this period is characterised by a sharp decline in the flint import and a return to the almost complete predominance of (vein) quartz (Mökkönen & Nordqvist 2016; Mökkönen et al. 2017a). Again, despite general similarities within the ceramic-centric narrative of cultural development, the local backgrounds and development trajectories differ in these areas.

Material dating to the 3rd millennium calBC (Phase 5) may indicate an increase in

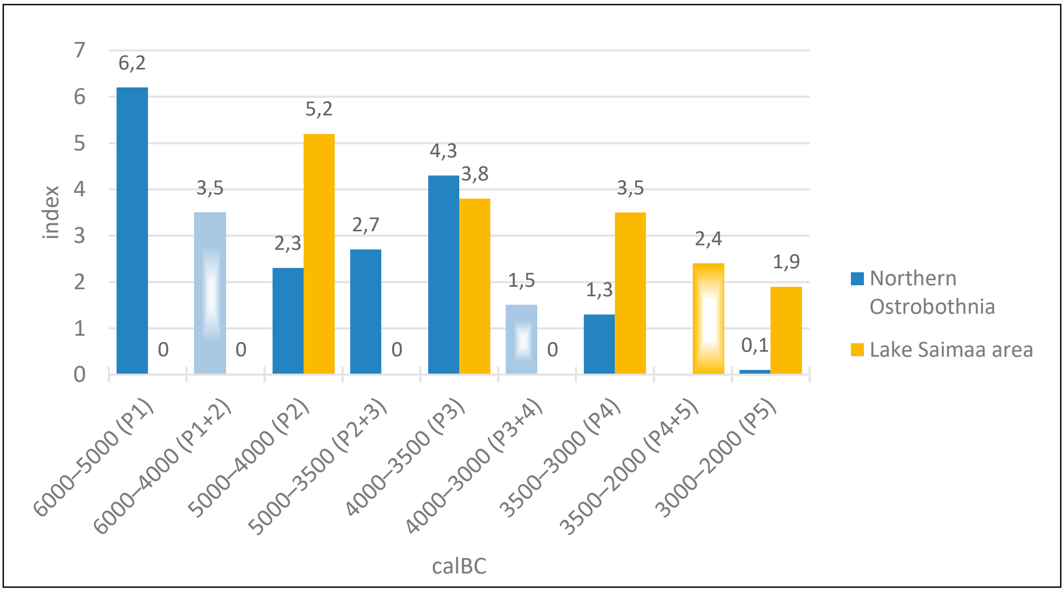


Figure 4. The quartz tool-to-flake ratios in Northern Ostrobothnia (site n 12) and the Lake Saimaa area (n 18) according to phases (pcs); index values are the average values for each period multiplied by 100, with the exception of Northern Ostrobothnian Phases 1, 2, 2+3, 3+4, 4, 5, as well as Phase 4 of the Lake Saimaa area, each of which is represented by only one site. The higher the value, the greater the proportion of tools in relation to debitage. Materials dating to two phases are indicated by a soft gradient colour on the quartz bars. The phases are shown in parentheses. Data for Lake Saimaa after Mökkönen & Nordqvist 2016.

slate use at the very end of the Stone Age in the River Oulujoki area (Fig. 2), but there is too little material for reliable conclusions.

### 4.2 Technological choices and quartz

The largest proportion of pieces with cortex is present at the early sites (Phases 1+2 and 2), on average 12% of the analysed catalogue sub-numbers (Appendix 4). The high frequency of cortex indicates firstly that quartz pebbles were used as raw material, and secondly that early phases (initial reduction) of the knapping sequence took place at the site. At younger sites, the share of cortex pieces remains 9% and lower, with the exception of the Kivimaa (18%, Phase 3) and Hangaskangas E (17%, Phase 5) sites. Thus, the trend in Northern Ostrobothnia is quite the opposite of the Lake Saimaa area, where the highest values (up to 12–14%) are reached in Phases 4 and 5, and the lowest (4–6%) in Phases 2 and 3 (Mökkönen & Nordqvist 2016).

The tool-to-flake ratio (Fig. 4) is generally decreasing over time. This indicates that the number of formal quartz tools in relation to debitage found at the sites is decreasing, i.e. that the knapping done at the sites (or in our analysed areas) has increased in volume and/or included more stages of the entire reduction process. Likewise, preferences for the production of formal tools and their discard patterns may have changed. However, the apparent rise in the tool-to-flake ratio in Phase 3 indicates that during the Typical Comb Ware period a larger part of the knapping sequence took place outside of the settlements. Together with a simultaneous decrease in the share of cortex pieces, this can also indicate a shift in the raw material base from pebbles to vein quartz or, alternatively, a pretreatment of pebbles (cores) elsewhere.

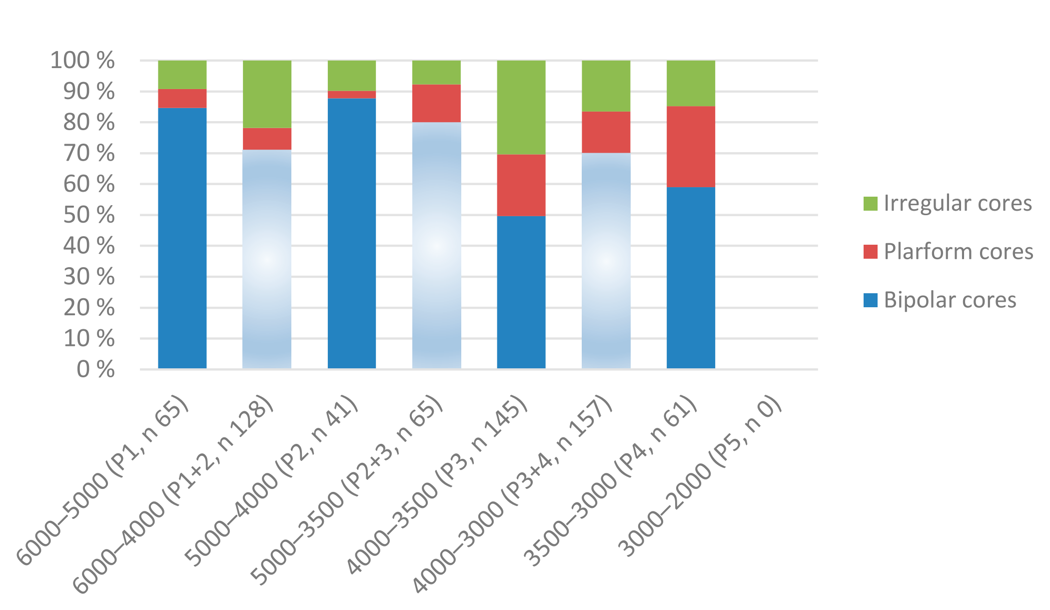


Figure 5. Percentage distribution of the quartz core types. 'Irregular cores' include undefined, fragmentary or exhausted cores. Materials dating to two phases are indicated by a soft gradient colour in the bipolar bar. The phases and number of cores (n) are shown in parentheses.

Based on the core data, bipolar technology prevailed in quartz-dominated knapping throughout the Stone Age (Fig. 5, Appendix 4), but its ratio to platform flaking varied in different phases[3]. In Northern Ostrobothnia, the largest share of bipolar cores is recorded in Phases 1–2, when they account for up to >90% of the quartz cores. Their proportion deceases during Phases 3 and 4 and usually remains between approximately 70 and 85%, although some assemblages with a much higher proportion of platform cores (especially Kierikin sorakuoppa, >40%) indicate site-level variations in technology during Phase 3. However, the general trends differ from those in the Lake Saimaa area (Fig. 6). There, the share of bipolar quartz cores in Phase 2 is moderate (ca. 55%) and increases in Phase 3 (about 80%, but just ca. 15% in flint cores) and after it, reaching up to 90% in Phases 4 and 5 (Mökkönen & Nordqvist 2016). These changes are fairly consistent with the changes in the use of quartz raw materials described above.

The differences in the knapped lithics in Northern Ostrobothnia and the Lake Saimaa area reflect not only local resource bases, but also regional traditions, development trajectories and contact networks. The slate-based industry prevailing in the north during Phases 1–2 (Fig. 3) is a case in point and attests to the importance of the local raw material base and the deep roots of local lithic working traditions. At the beginning of the 4th millennium calBC (Phase 3), the introduction of Typical Comb Ware in both areas was accompanied by changes in the lithic knapping performed at the sites (e.g. a high tool-to-flake ratio and a low proportion of cortex pieces). It is noteworthy that in Northern Ostrobothnia there was no broad introduction of flint-based platform flaking or large-scale use of high-quality quartzes. At the same time, some of the Phase 3 sites, primarily Kierikin sorakuoppa, but also Kivimaa, exhibit qualities that are more reminiscent of Lake Saimaa and evidence of differences in development

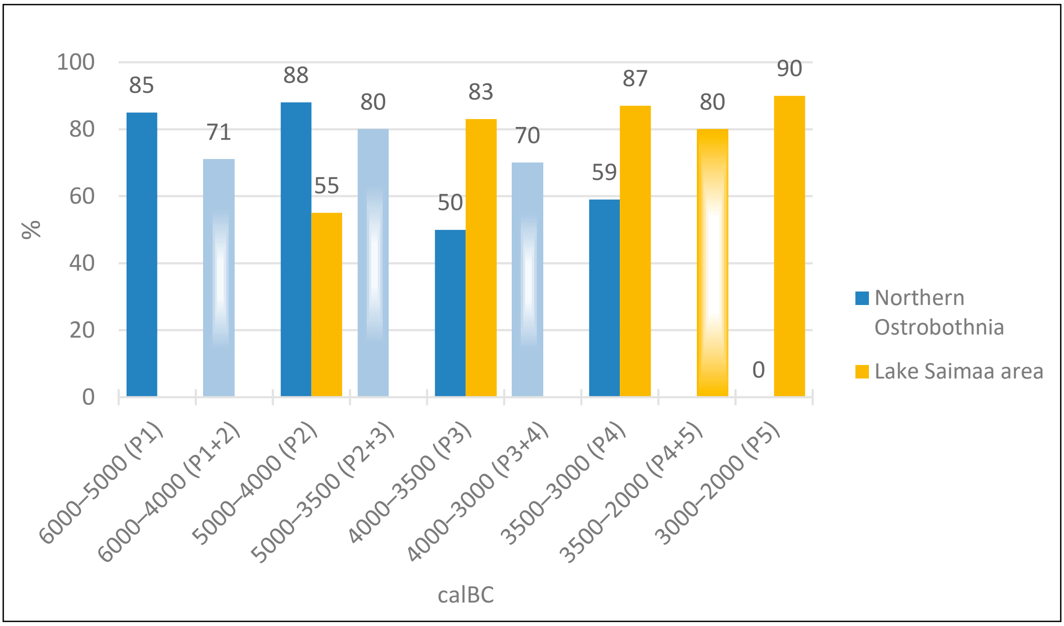


Figure 6. Proportion of bipolar cores from quartz corers in Northern Ostrobothnia and the Lake Saimaa area. Materials dating to two phases are indicated by a soft gradient colour. Data for Lake Saimaa after Mökkönen & Nordqvist 2016.

and contacts within the research area (see also Mökkönen & Nordqvist 2018). The transition to Phase 4 is signalled by asbestos- and organic-tempered potteries, as well as the disappearance of flint and high-quality quartzes and an overall quantitative increase in quartz lithics in both areas (pcs/g per excavated m$^2$; see Table 1 and Mökkönen & Nordqvist 2016). Despite this, the lithic profiles remain different (Figs. 4 and 6), and the changes in Northern Ostrobothnia are more subtle than in the Lake Saimaa area, where the later 4$^{th}$ millennium calBC is characterised by a sharp turn to the bipolar reduction of vein quartz.

## 5 Concluding remarks

This paper presents an overview of the lithic raw material use by hunter-fisher-gatherers who inhabited the coastal areas of Northern Ostrobothnia between the 6$^{th}$ and 3$^{rd}$ millennia calBC. The assemblages are mainly dominated by quartz and appear monotonous at first. Nevertheless, a closer look at the basic metrics (the proportion of pieces with cortex, the tool-to-flake ratio, the frequency of different core types) and a comparison with similar data from the Lake Saimaa area reveal different but also partially overlapping developments in these two areas.

During the early phases (1–2, 6$^{th}$–5$^{th}$ millennia calBC), the slate industry was still prevailing in the northernmost part of the research area but did not reach the River Kiiminkijoki area (the Latokangas and Vepsänkangas sites); corresponding ground slate tools found further south are interpreted as being imported from the north (Äyräpää 1950: 35). This slate industry was basically aceramic, and even if Phases 1–2 coincide with the introduction of early pottery technology (Säräisniemi 1 and Sperrings 1 Wares), the research area is near the northwestern limit of its distribution. There is no indication that the arrival of pottery craft would have directly influenced the local lithic working traditions.

Except for the slate-rich northern sites, quartz prevails at all sites studied. In contrast to the Lake Saimaa area, the appearance of Typical Comb Ware (Phase 3) did not result in a sharp increase in imported flint and platform flaking. However, there are certain indicators in general knapping practices (e.g. the tool-to-flake ratio, the proportion of pieces with cortex) and especially at the site level (see the Kierikin sorakuoppa site with more flint, high-quality quartzes and platform flaking) that link the two areas. In Phase 4, similarities can be found in the general quantitative increase of quartz lithics, but here too the lithic profiles are different, as the Lake Saimaa area shows a much more acute turn towards bipolar working of (vein) quartz compared to the previous phase.

Current material from Northern Ostrobothnia shows that, despite the similar broad outlines of general cultural development, the differences between the analysed assemblages and periods are quite large. These can often be explained by the geographical location of the sites, both in relation to raw material sources and the direction of communication routes (waterways) and social ties. The slate industry is an example of a phenomenon based on links to the north, while the emergence of pottery, as well as changes during Phases 3 and 4, are associated with connections to the east and southeast. In Northern Ostrobothnia, however, there are no such abrupt changes that occurred at the beginning of Phase 3 in the Lake Saimaa area and were probably associated with the arrival of a new population (see Mökkönen et al. 2017b: 185; Nordqvist 2018: 101–103). Rather, changes in material culture, technology and lifestyle are the result of other forms of mobility and processes bringing new features into the research area that was at the intersection of different cultural areas and impulses.

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## Notes

1 5471–4949 calBC (Hel-3666, 6250±100 BP) and 6233–5779 calBC (Hel-3669, 7140±110 BP) (Raike 1994).

2 Other knapped lithics include porphyry rocks (several in Kauniinmetsänniity 1), as well as individual pieces of sandstone, imported chert (Kivimaa, Kuuselankangas, Korvala), lydite (Latokangas) and jasper (Tervaniemi, Ahola).

3 In addition to bipolar and platform cores, Appendix 4 includes so-called irregular cores, undefined (multitechnology), fragmentary or exhausted cores, the proportion of which in assemblages ranges between 0 and 37%.

## Appendix 1

Material used in the study. Phases: 1 – 6000–5000 calBC; 2 – 5000–4000 calBC; 3 – 4000–3500 calBC; 4 – 3500–3000 calBC; 5 – 3000–2000 calBC. Ceramics: Sär1 – Säräisniemi 1 Ware; Spr1 – Sperrings 1 Ware (also Older Early Comb Ware); Spr2 – Sperrings 2 Ware (also Younger Early Comb Ware); EAP – early asbestos-tempered pottery; TCW – Typical Comb Ware; SDCW – sparsely decorated Comb Ware; Kierikki – Kierikki Ware; Pöljä – Pöljä Ware. Excavations: researcher and year of investigation, the excavated area(s) included in the study are indicated in parentheses (research reports are archived by the Finnish Heritage Agency, Helsinki). Area: acreage of the excavated area included in the study ($m^2$). KM: the studied collection numbers (the National Museum of Finland), sub-numbers are given when only a part of the material catalogued under this main number is included in the study.

| No | Site | Municipality | Phase | Ceramics | Excavations (analysed areas) | Area ($m^2$) | KM | Site type |
|---|---|---|---|---|---|---|---|---|
| 1 | Tervaniemi, Ahola | Taivalkoski | 1 | – | Saukkonen 1993 (areas 1 and 2); Raike 1994 (area 1, trenches 110 and 115): Raike 1995 (area 1995; x 102–104/y 534–536) | 313 | 28128: 1–1302; 28687: 1–554; 28899: 1–815 | Settlement |
| 2 | Vepsänkangas | Oulu | 1+2 | Sär1 | Koivisto 1997 (all) | 210 | 30561: 1–1001 | Settlement |
| 3 | Veskankangas | Ii | 1+2 | – | Wallenius 1988 (area 1); 1989 (area 2); 1992 (part of area 6) | 453 | 24423: 263–621; 24928: 1–1525; 27365: 1–1000 | Settlement |
| 4 | Tainiaro | Simo | 2 | Spr1; Sär1; Spr2 | Wallenius 1984 (x 509–532/y 989–1003); 1989 (x 510–518/y 984–992); 1990 (x 499–509/y 990–1003) | 273 | 22398: 1–634; 24925: 734–1544; 25797: 762–2376 | Settlement; burials |
| 5 | Latokangas | Oulu | 2+3 | Sär1, Spr1, EAP | Sarkkinen 1988 (main areas); Mäkivuoti & Sarkkinen 1989 (areas F, G, M); Mäkivuoti 1990 (areas 'Heimo' and 'Sär1') | 740 | 24377: 1–374; 24740: 1–1159; 25731: 1–401 | Settlement |
| 6 | Kivimaa | Kalajoki | 3 | TCW | Kotivuori & Halinen 1986 (areas I–III); Halinen 1987 (areas I–V) | 242 | 23381: 1–560; 24123: 1–1192 | Settlement |
| 7 | Kierikin sorakuoppa | Oulu | 3 | TCW | Schulz, E. 1986 (main area); Pärssinen 1987 (main area) | 332 | 23431: 1–893; 23728: 1–768 | Settlement; housepits |
| 8 | Kierikinkangas (north) | Oulu | 3 | TCW | Pesonen 1999 (sub-areas B and C, excavation areas 7–9) | 147 | 31829: 2418–3116 | Settlement |
| 9 | Kauniinmetsänniitty 1 | Raahe | 3 | TCW | Pesonen 2007 (areas A–C; K, x 494–505/ y 702–716) | 148 | 36937 (1938 sub-numbers) | Settlement; housepits |
| 10 | Kuuselankangas | Oulu | 3+4 | TCW; Kierikki; SDCW | Koivunen & Korolainen 1995 (main area); Koivunen & Franzen 1996 (main area); Halinen 1996 (main areas); Pesonen 1999 (area 1) | 529 | 30666: 1023–2676; 30667: 20–759; 29907: 1–2085; 32220: 1–7243 | Settlement; housepits |
| 11 | Purkajasuo-Korvala | Oulu | 4 | Pöljä | Schulz, H.-P. 2000 (area 9) | 176 | 32134: 1–2267 | Settlement; housepits |
| 12 | Hangaskangas E | Oulu | 5 | – | Pesonen 2012 (areas 7a; 7b; 9) | 48 | 39158: 1147–1312, 1313–1327, 1439–1756 | Settlement |

## Appendix 2

Radiocarbon dates of the studied materials. Dates of loose charcoals from the cultural layer and dates with standard deviation greater than ±75 years have been excluded. All dates are calibrated with OxCal 4.4 (Bronk Ramsey 2009) using IntCal20 (Reimer et al. 2020) and given with a 95.4% probability. For abbreviations of pottery types, see Appendix 1.

| No | Site | Lab-code | BP | ± | calBC | (2 σ) | $\delta^{13}C$ | Material (type/context) | Pottery type | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Tervaniemi, Ahola | – | – | – | – | – | – | – | – | – |
| 2 | Vepsänkangas | GrA-63484 | 6135 | 40 | 5211 | 4952 | -26,58 | crust | Sär1 | Nordqvist & Mökkönen 2016 |
| | | Hela-236 | 6120 | 75 | 5290 | 4844 | -26,30 | crust | Sär1 | Koivisto 1997; Torvinen 2000 |
| | | Hela-235 | 6065 | 75 | 5209 | 4797 | -27,50 | birch bark tar ('chewing resin') | – | Koivisto 1997; Torvinen 2000 |
| | | Hela-128 | 5995 | 65 | 5042 | 4721 | -22,20 | crust | Sär1 | Torvinen 2000 |
| | | Hela-312 | 5990 | 60 | 5027 | 4723 | -27,30 | birch bark tar ('chewing resin') | – | Koivisto 1998 |
| 3 | Veskankangas | GrA-63889 | 5980 | 40 | 4991 | 4731 | -27,90 | burnt bone (elk) | – | This work |
| 4 | Tainiaro | GrA-63478 | 5615 | 40 | 4537 | 4356 | -25,56 | crust | Spr2 | Nordqvist & Mökkönen 2016 |
| | | GrA-63480 | 5735 | 40 | 4691 | 4459 | -26,42 | crust | Sär1 | Nordqvist & Mökkönen 2016 |
| | | GrA-63483 | 5775 | 40 | 4721 | 4504 | -27,79 | crust | Spr1 | Nordqvist & Mökkönen 2016 |
| 5 | Latokangas | GrA-63485 | 6010 | 40 | 5002 | 4793 | -24,91 | crust | Sär1 | Nordqvist & Mökkönen 2016 |
| | | GrA-63486 | 5025 | 35 | 3946 | 3711 | -27,89 | crust | Sär1 | Nordqvist & Mökkönen 2016 |
| 6 | Kivimaa | GrA-63516 | 4905 | 35 | 3769 | 3637 | -26,75 | crust | TCW | Nordqvist 2018 |
| | | GrA-63517 | 4765 | 45 | 3641 | 3378 | -26,08 | crust | TCW | Nordqvist 2018 |
| 7 | Kierikin sorakuoppa | GrA-63488 | 4850 | 35 | 3707 | 3528 | -25,54 | crust | TCW | Mökkönen & Nordqvist 2018 |
| | | GrA-63487 | 4790 | 35 | 3645 | 3386 | -27,36 | birch bark tar on pottery | TWC | Mökkönen & Nordqvist 2018 |

| No | Site | Lab-code | BP | ± | calBC | (2 σ) | $\delta^{13}C$ | Material (type/context) | Pottery type | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Kierikinkangas (north) | Hela-408 | 4820 | 65 | 3759 | 3378 | -27,20 | birch bark tar on pottery | TCW | Pesonen 2004 |
| 9 | Kauniinmetsänniitty 1 | GrA-63544 | 5055 | 35 | 3959 | 3716 | -25,86 | crust | TWC | Nordqvist 2018 |
| | | GrA-63542 | 4935 | 35 | 3781 | 3644 | -28,49 | crust | TWC | Nordqvist 2018 |
| | | GrA-63546 | 4895 | 35 | 3769 | 3633 | -26,10 | crust | TWC | Nordqvist 2018 |
| | | Hela-1712 | 4770 | 40 | 3641 | 3381 | -29,60 | birch bark tar on pottery | TWC | Pesonen 2013a |
| | | Hela-1713 | 4730 | 40 | 3632 | 3376 | -25,40 | crust | TWC | Pesonen 2013a |
| | | Hela-1714 | 4690 | 40 | 3624 | 3368 | -19,60 | burnt bone (seal) | – | Pesonen 2013a |
| | | Hela-1711 | 3935 | 35 | 2566 | 2298 | -27.50 | birch bark tar (‘chewing resin’) | – | Pesonen 2013a |
| 10 | Kuuselankangas | GrA-63491 | 4990 | 35 | 3940 | 3652 | -25,91 | crust | TCW | Mökkönen & Nordqvist 2018 |
| | | Hela-464 | 4625 | 70 | 3627 | 3103 | -25,30 | charcoal (posthole) | – | Pesonen 2000 |
| 11 | Purkajasuo-Korvala | GrA-63504 | 4535 | 35 | 3366 | 3101 | -27,08 | birch bark (housepit, structure) | – | Mökkönen & Nordqvist 2018 |
| | | Hela-136 | 4475 | 60 | 3360 | 2935 | -28,80 | crust | Pöljä | Pesonen 2004 |
| | | GrA-63505 | 4455 | 35 | 3340 | 2937 | -27,71 | crust | Pöljä | Mökkönen & Nordqvist 2018 |
| 12 | Hangaskangas E | Ua-45449 | 3775 | 40 | 2341 | 2038 | -28,40 | bone (seal) | – | Pesonen 2013b |
| | | Ua-454450 | 3695 | 35 | 2200 | 1972 | -27,70 | bone (seal) | – | Pesonen 2013b |

## Appendix 3

Volume of the studied lithics per site. HQQ –high-quality quartz, i.e. microcrystalline variants of quartz (different colour variants of rock crystals). For abbreviations of pottery types, see Appendix 1.

| Site | Ceramics | Phase | Quartz (g/pcs) | Quartzite (g/pcs) | Slate (g/pcs) | Flint (g/pcs) | Other (g/pcs) | All (g/pcs) | High-quality quartz (% of cataloque nos) |
|---|---|---|---|---|---|---|---|---|---|
| Tervaniemi, Ahola | – | 1 | 5528/3111 | 162/14 | 128/58 | – | 93/15 | 5911/3198 | 6 |
| Vepsänkangas | Särl | 1+2 | 8944/1656 | 803/86 | 892/185 | 3/3 | – | 10 641/1930 | 2 |
| Veskankangas | – | 1+2 | 41 008/8961 | 94/22 | 18 237/2644 | 8/2 | – | 59 346/11 629 | 3 |
| Tainiaro | Spr1; Sär1; Spr2 | 2 | 19 066/3030 | 177/19 | 114 125/11 523 | 97/7 | 98/7 | 133 562/14 586 | 2 |
| Latokangas | Sär1; Spr1; EAP | 2+3 | 14 755/3537 | 1899/178 | 1481/347 | <1/1 | 9/2 | 18 144/4065 | 3 |
| Kivimaa | TCW | 3 | 33 834/7209 | 99/7 | 147/29 | 6/5 | 45/7 | 34 131/7257 | 10 |
| Kierikin sorakuoppa | TCW | 3 | 12 633/1963 | 1185/15 | 2957/177 | 106/81 | 17/3 | 16 909/2240 | 8 |
| Kierikinkangas (north) | TCW | 3 | 2533/1163 | 43/12 | 351/31 | 9/1 | – | 2936/1212 | 1 |
| Kauniinmetsänniitty 1 | TCW | 3 | 5869/1665 | 71/3 | 1009/113 | 10/4 | 597/58 | 7555/1843 | – |
| Kuuselankangas | TCW; Kierikki; SDCW | 3+4 | 41 700/21 172 | 1298/78 | 6758/570 | 32/15 | 235/14 | 50 023/21 849 | 1 |
| Purkajasuo-Korvala | Pöljä | 4 | 18 668/12 172 | 620/77 | 2903/205 | 5/6 | 12/7 | 22 209/12 467 | – |
| Hangaskangas E | – | 5 | 1113/733 | 139/7 | 826/360 | – | – | 2078/1100 | – |
| | | | | | | | | 363 445/83 376 | |

## Appendix 4

Basic metrics for the studied quartz lithics. For abbreviations of pottery types, see Appendix 1.

| Site | Ceramics | Phase | Flakes (pcs) | Tools (pcs) | Tool-to-flake ratio (pcs) | Bipolar cores (pcs) | Platform cores (pcs) | Irregular cores (pcs) | Bipolar-to-platform core ratio | Cortex (% of catalogue nos) |
|---|---|---|---|---|---|---|---|---|---|---|
| Tervaniemi, Ahola | – | 1 | 2931 | 181 | 6,2 | 55 | 4 | 6 | 13,8 | 5 |
| Vepsänkangas | Sär1 | 1+2 | 1602 | 54 | 3,4 | 18 | – | 4 | – | 11 |
| Veskankangas | – | 1+2 | 8624 | 321 | 3,7 | 73 | 9 | 24 | 8,1 | 14 |
| Tainiaro | Spr1; Sär1; Spr2 | 2 | 2961 | 69 | 2,3 | 36 | 1 | 4 | 36,0 | 18 |
| Latokangas | Sär1; Spr1; EAP | 2+3 | 3444 | 93 | 2,7 | 52 | 8 | 5 | 6,5 | 5 |
| Kivimaa | TCW | 3 | 7024 | 284 | 4,0 | 47 | 10 | 34 | 4,7 | 18 |
| Kierikin sorakuoppa | TCW | 3 | 1844 | 119 | 6,5 | 21 | 16 | 10 | 1,3 | 8 |
| Kierikinkangas (north) | TCW | 3 | 1116 | 47 | 4,2 | – | 3 | – | – | 5 |
| Kauniinmetsänniitty 1 | TCW | 3 | 1625 | 40 | 2,5 | 4 | – | – | – | 6 |
| Kuuselankangas | TCW; Kierikki; SDCW | 3+4 | 20 849 | 323 | 1,5 | 110 | 21 | 26 | 5,2 | 6 |
| Purkajasuo-Korvala | Pöljä | 4 | 12 011 | 161 | 1,3 | 36 | 16 | 9 | 2,3 | 9 |
| Hangaskangas E | – | 5 | 732 | 1 | 0,1 | – | – | – | – | 17 |