

# Quantifying the Use of Stones in the Stone Age Fireplaces of Estonia

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Fireplaces and burnt stones related to them are common features found at Stone Age settlement sites. Although information about them is present in archaeological reports and also available in publications, there has been no general research done regarding combustion features specifically. The purpose of this study was to fill the gap of relevant research and to test the hypothesis that the structural features of fireplaces reveal information on the subsistence model of settlements.

The study is based on a database of Estonian Stone Age fireplaces, which was compiled by using the available data on all excavated objects. The database includes 167 fireplaces and contains quantifiable data about stones in fireplaces.

The analysis of data revealed that the use of stones in fireplaces changed significantly in time. While most of the Mesolithic fireplaces contain them, they become scarce in the Neolithic. It can be concluded that the use of stones in fireplaces is related to the economy of settlements and changes within time reflect the changes in general subsistence strategies.

*Keywords:* fireplaces, hearths, quantitative analysis, reuse of data, Mesolithic, Neolithic.

Ugnia vietēs ir su jais susiję degę akmenys yra įprastos struktūros, randamos akmens amžiaus gyvenvietėse. Nors informacija apie šiuos objektus pateikiama archeologinėse ataskaitose ir publikacijose, iki šiol nebuvo specialaus jiems skirto tyrimo. Šio straipsnio tikslas yra užpildyti šią spragą ir patikrinti hipotezę, kad ugnia vietėjų struktūriniai bruožai atskleidžia informaciją apie pragyvenimo gyvenvietėse modelį.

Šioje studijoje remiamasi Estijos akmens amžiaus ugnia vietėjų duomenų baze, kuri sudaryta iš visų prieinamų kasinėtų objektų. Duomenų bazėje yra 167 ugnia vietės ir kiekybiniai duomenys apie akmenis jose.

Duomenų analizė atskleidė, kad akmenų naudojimas ugnia vietėse laikui bėgant smarkiai keitėsi. Daugumoje mezolito laikotarpio ugnia vietėjų akmenų yra, o neolito laikotarpio ugnia vietėse akmenys tapo retenybė. Galima daryti išvadą, kad akmenų naudojimas ugnia vietėse susijęs su gyvenviečių ekonomika ir pokyčiai laikui bėgant atspindi bendros gyvenimo strategijos pokyčius.

*Reikšminiai žodžiai:* ugnia vietė, kiekybinė analizė, pakartotinis duomenų naudojimas, mezolitas, neolitas.

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## INTRODUCTION

Fireplaces are one of the most common and informative structures found in Stone Age habitation sites. In a lot of cases, they contain fire-cracked rocks, which appear inside of the fireplace structure or close to them. For some reason, those features haven't been traditionally very attractive to archaeologists in Eastern Europe and only scarce information on excavated fireplaces has been published. Often only the presence of stones in fireplaces is being mentioned.

During the construction and use of the fireplace, those stones must have had some sort of purpose, which could provide us with insights into the function of the fireplace and the subsistence model of a settlement in general. They might have been used for lining the fireplace or building constructions that help with carrying out various activities, for example,

holding up a ceramic vessel. The use of hot stones for cooking and boiling has been widely documented in ethnographic records (Nelson, 2010, p. 243) and also researched in archaeology (Nakazawa et al., 2008). Black & Thoms (2014) have discussed that a significant number of fireplaces with stones in the archaeological material have actually been earth ovens used for cooking. Stone heaters have also been used to keep the houses warm.

All those possible functions have not been distinguished in any previous research of the Estonian Stone Age, thus leaving a gap in the interpretation of fireplaces. The purpose of this study is to explore the possibilities of classifying fireplace features by quantitative analysis of fire cracked rocks from archaeological records of Estonian Stone Age sites. Correlations between separable classes and general processes in the economy of the Stone Age are then evaluated.

## MATERIAL &amp; METHODS

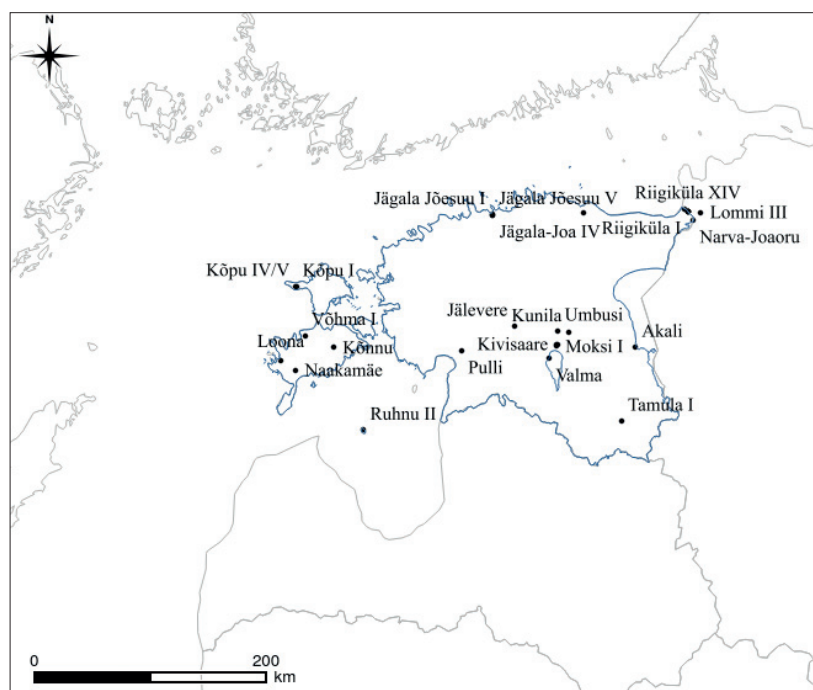
As the Stone Age fireplaces have not been a focus of many studies, source data had to be gathered from archaeological excavation reports, photos, plans, drawings and publications. Although the level of detail of the recorded notes in archaeological excavation reports and publications was uneven, it was possible to get detailed information about 167 fireplaces out of about 200 Stone Age fireplaces excavated in Estonia.

One encountered problem was the different interpretations of what a fireplace is. Therefore, for the purpose of clarity, the term *fireplace* was defined as a construction that controls fire and heat and is meant to fulfill some sort of functional purpose. In archaeology, we are talking about remnants of those constructions (Fig. 1). Typically, we analyzed the recorded information about excavations and the structure of data was modeled based on the analysis. It contains information about excavations, site and structural features. From the available records, the following features could be acquired: the presence on stones, structure of stone construction, average size of stones used, type (material) of stones, type of base, dating of fireplace, exist-

ence of pit and associated pottery complex. Based on this data, a database of all known Stone Age fireplaces in Estonia was created (Sikk, 2015).

The quantification of features of constructions brings up several issues. The presence of stones was recorded for all fireplaces, but in some cases it was observed that a fireplace with one or two natural stones nearby was also classified as a “hearth with stones” (Jaanits, 1965). For distinguishing between natural rocks and purposeful stone constructions, excavation plans had to be evaluated. If the stones inside the hearth formed a more dense or different structure than natural rocks around it, the fireplace was considered to have stones. In a couple of cases, an area seemed to be cleared of most stones (Jaanits, 1965). If the remaining rocks seemed to form some sort of structure, it was still considered as a fireplace with stones.

The structure of stone construction of fireplaces has traditionally been described in Estonian archaeological excavation reports and could be concluded from excavation plans. Based on documentation, the structure was classified into following groups: isolated stones, stone slabs, sparse stones, stone layers and stone piles.



**Fig. 1.** Stone Age settlement sites with excavated fireplaces.

*1 pāv. Akmens amžiaus gyvenvietēs su kasinētomis ugnīvietēmīs*

The average size of stones was also documented in a lot of cases and could also be verified or measured from excavation plans in case of a missing description.

The material of stones could be determined by photographs in case they were not documented in excavation reports. Materials were classified as being either sandstone, limestone or fieldstone (crystalline rock).

One of the most critical dimensions of data was the dating of the fireplaces. Some fireplaces have been directly dated by the radiocarbon method, while others could be dated by stratigraphy or related find complexes; moreover, several records had to be discarded because of a lacking information.

All fireplaces were grouped into four periods: pre-pottery Mesolithic (9000–5500 BC) with 38 fireplaces, Narva Period Mesolithic (5500–4000 BC) with 51 fireplaces, Early Neolithic (4000–2900 BC) with 64 fireplaces and Late Neolithic (2900–1800 BC) with 11 fireplaces. A traditional periodization would have not been functional because of the uneven distribution of excavated fireplaces in time.

The described data was analyzed to find correlations between described data dimensions. The results were then explained by archaeological record and parallels driven from present day experience and the domain of ethnographic knowledge are described below.

## THEORY ABOUT THE FUNCTION OF STONES

It is clear that fire making was a significantly more important activity for the people of the Stone Age than it is for the modern citizen. However, fire making is still used for various purposes and even fires lit for recreational purposes bear resemblance to ancient fire craft traditions. During our interpretation, parallels with ethnographic records and experiences from contemporary fire crafting habits were drawn, which helped deduce the possible functions of fireplaces.

In general, the purposes of fire making can be regarded as the following: warming a building or campsite, preparing food, disposing of waste and creating a focal point for social events and rituals. All of those purposes can be combined in one fireplace and even during one fire making event. For example, food is made in a stove which is also heating the house. Camping fires made for cooking often become social focal points. It is also worth noting that waste is often

burned in ritual fires, for example, in the fires lit for the Midsummer Festival in Estonia, old wood material and other wastes are usually burnt. In Southern Europe, the burning of old olive tree branches has become a ritualized event (Kostenidou *et al.*, 2013).

Stones have been used for multiple purposes in fireplace structure. They can be used for building a structure to contain fire. In contemporary campfires, it is typical that a circle of stones is made around a fireplace to limit the spread of fire. In archaeological material, a layer of stones can sometimes be seen constructed under the fireplace. In case of more complex hearths used mostly in buildings, a stove has been built by stacking stones together.

Besides limiting fire, stones can be used as a non-burning material to help various tasks that are performed close to a fireplace. Hunter-gatherers using single stones in fireplaces for holding up items are widely documented (e.g., in Binford, 2002, pp. 149–152) and experience regarding culinary practices around campfires makes it easy to understand their value as fireproof solid objects. It can be assumed that they could be used for supporting ceramic vessels while cooking. The structures have evolved to be more complex in stoves used for cooking and in houses, in which case that is a discussion beyond the scope of this paper.

Besides being a fireproof construction material, stones can also store heat, which makes it possible to keep an object or area hot for a period of time after the fire has been burnt. Stone heaters were been constructed in buildings as they are used in large stoves to keep buildings warm. A contemporary example of the usage of stone heaters is their use in saunas, where stones store energy and also tone down heat radiation. In Estonia, such stone heaters came into use during the Early Metal Age (Tõnisson, 2008, pp. 114–143). It has been assumed that the Stone Age fireplaces with stones were predecessors of those heaters (*Ibid.*).

As regards to culinary practices, the heat storing property of stones has been used for stone boiling, earth ovens and dry heat roasting on hearths and girdles. The practice of boiling liquids with stones has been widely documented in ethnography (e.g., Nakazawa *et al.*, 2008; Nelson, 2010, p. 243), but it is very hard to detect in archaeological record. The stones were to be heated in fire and, when hot, to be put into a vessel containing liquid and later discarded. As a re-



**Fig. 2.** Fire pit with stones from Kõpu IA during excavations in 1998. Photo: Aivar Kriiska.

*2 pav. Ugniavietēs su akmenimis īš Kõpu IA gyvenvietēs, 1998 m. kasinējimai. Aivaro Kriiskos nuotrauka*

sult, they are not necessarily connected to any fireplace or pit in archaeological record (Fig. 2). Earth ovens, on the other hand, are easily detectable and widely documented in archaeology. They were used for slow cooking of mostly fatty meat and inulin-rich plants (Wandsnider, 1997, p. 12) and their widespread use has been documented in archaeology of the Stone Age. The first proof of use of earth ovens comes already from the Paleolithic, at least 35000–31000 BP (Movius, 1966; Straus, 2006; Black & Thoms, 2014, p. 206). Earth ovens are still used in some places, e.g., in Polynesia and Australia (e.g. Binford, 2002, pp. 165–168; Orliac, 2003; Pautreau *et al.*, 2003). A lot of research has been done on the Neolithic fireplaces in France and it has been shown that the process of constructing and using them has been similar to Polynesian fireplaces (Orliac, 2003; Pautreau, 2003). It has also been discussed, based on the material of Edwards Plateau regarding Southern and Central North America, that most of observed fireplaces with stones have been earth ovens (Black & Thoms, 2014).

Another model of cooking involves heating up stones on fireplace coals and cooking food on the stones. One variation of this type of cooking is a prim-

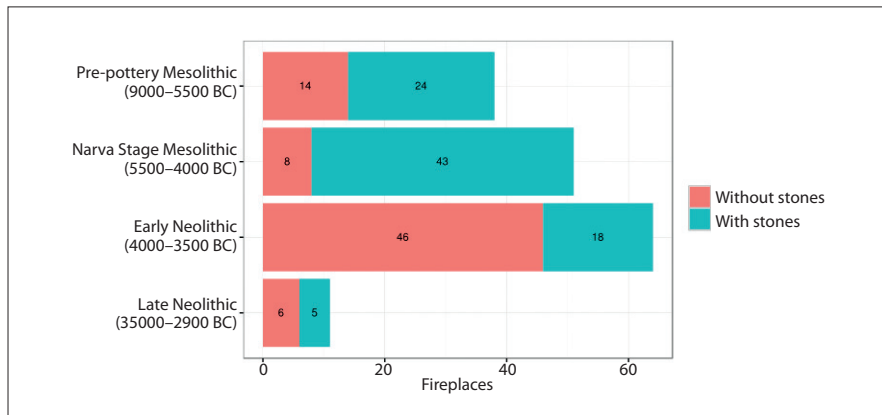
itive griddle – fire is made or coals are put under a stone slab and food is cooked on it.

All those different functions of stones could be reflected in the fireplace construction and in such a way it is possible to get insight into the use of a fireplace by analyzing the structure of its archaeological remains.

## RESULTS AND DISCUSSION

The presence of stones in archaeological fireplaces has been the best documented feature of them. Altogether, 75 documented fireplaces had stones in their structure and 91 did not, with one fireplace unspecified. In some cases, the fireplaces contain remains of burnt rocks – larger pieces could have been removed from the fireplace after usage for cleaning or reuse (Jaanits, 1965; 1979; Kriiska, 1996).

The presence of rocks does not significantly correlate with other structural features of fireplaces. Stones are present in 56% of fireplaces with dug-in pits and 63% of fireplaces built on the ground. In the cases when the existence of a pit has not been documented, the fireplace usually did not contain any stones. Solid objects help preserving the construction of archaeolog-



**Fig. 3.** The distribution of stone presence in fireplaces during different time periods.

**3 pav.** Akmeņu ugniavietēse paplitimas atskirais laikotarpiais

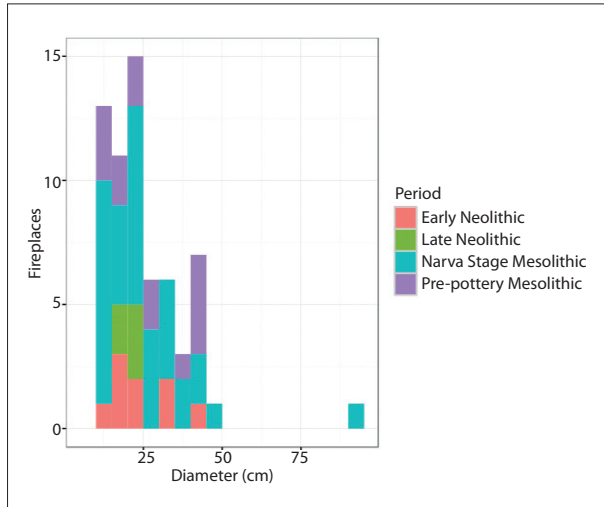
ical features so the pit could have been left undetected without stones. (Fig. 3). The principle can also be observed while analyzing the shape of fireplaces. Fireplaces with stones have more varying shapes – there are several rectangular and triangular constructions. Those would probably have been preserved as typical oval-shaped areas with dark soil if they wouldn't have contained stones. In several cases, sparse stones and the uneven shape of a fireplace reflect the later mixing of archaeological contexts.

67 of 89 documented Mesolithic fireplaces (75%) and only 23 of 75 Neolithic fireplaces contain stones. This is a statistically significant difference with a P value < 0.001 (two tailed Chi-square test). When broken down into 4 periods, it can be seen from distribution (Fig. 3) that fireplace data from the best represented Narva stage of Mesolithic and the early Neolithic most expressively show the change in time, with the statistical significance being even greater. There are also more fireplaces with stones from pre-pottery Mesolithic, but the ratio could be caused by excavation methodology and bad preservation of older fireplaces. Fireplaces from the late Neolithic are underrepresented and mostly found in the Valma settlement site (Jaanits *et al.*, 1982, pp. 68–70, 105) and thus don't give any additional information.

The change of use of stones in the fireplaces of the Narva stage of Mesolithic and early Neolithic reflect a shift in the subsistence model of settlements. During the Narva stage, certain settlements had emerged with a predominant seal hunting economy in the Estonian

islands (Kriiska, 1995; 2001; 2002; Kriiska & Lõugas, 1999); almost all of the fireplaces in those settlement sites have been built with stones. Habitation continued during the Early Neolithic and was still mostly based on seal hunting, but the fireplaces from the Neolithic lack stones (Kriiska, 2001). Similar fire pits with stones dated to the Narva stage of Mesolithic have also been documented in lake-connected sites of Akali (Янитс, 1959, p. 37; Jaanits, 1966) and Kivisaare (Kriiska *et al.*, 2003) and Riigiküla IV (Kriiska, 1996) settlement site on the northeastern seashore in Estonia. In Akali, the fireplaces dated to the Early Neolithic did not contain stones. According to the data, the fireplaces with pits and stones became virtually non-existent during the Neolithic, expressing the shift of fireplace function in time. This indicates that the decreased use of stones in fireplaces has been caused by more general developments in subsistence and that usage is not location dependent.

Another way to explore the use of stones is to quantify their selection. The material of used stones in fireplaces in Estonia doesn't reveal any patterns. People of the Stone Age had probably used the first stones they found without paying too much attention to materials resistance to fire, heat accumulation properties and other features. In case of damage, the stones were probably replaced. For example, in the site of Narva Joaorg, limestone slabs were used (Jaanits, 1960) as locally abundant material. In Kõpu sites, the stones were taken from the beach with no preference given to any particular type.



**Fig. 4.** The size distribution of stones in fireplaces.

**4 pav.** *Akmenų dydžių pasiskirstymas ugnievietėse*

What seems to have been of importance in a lot of cases was the size of the stones. It can be seen from the diagram (Fig. 4) that about  $\frac{2}{3}$  of fireplaces contained stones that were on average 10–25 cm in diameter. But in the remaining ones, there are mostly larger stones including an outlier with a diameter of 90 cm, which is a stone slab from the site at Narva Joaorg (Jaanits, 1960) (Fig. 4). It is noteworthy that starting from the Mesolithic there are several fireplaces where stones have an average diameter of only 10–15 cm, but there is only one such fireplace from the Neolithic period. The fireplaces with small stones are mostly found in seal hunting camps from the Mesolithic period on Estonian islands and the bigger than average stones come mostly from the Narva-Joaorg site, where relatively big limestone slabs were used for constructing fireplaces. In several cases, they form a layer below the fireplace and a slab had been situated on the fire forming a primitive griddle at least in two cases. In the case of those fireplaces with small stones from the Mesolithic, the stones are placed sparsely or as a dense pile or layer. Isolated stones in fireplaces were slightly bigger.

Studied fireplaces can be grouped into five classes by their stone structure: fire pits with stones, fireplaces built on the ground of stones, primitive griddles and fireplaces with isolated, bigger stones.

Fire pits with stones have been dug into the ground and filled with smaller rocks. Some of them retain a dense block of stones but some have a sparse layer

that could have resulted after opening and cleaning the fireplace. These fireplaces were predominantly created during the Mesolithic, and only one from the Riigiküla II settlement site belongs to the Neolithic (Гурина, 1967, p. 21). Yet in that case the fireplace is typologically different because of its exceptional size and dense stone layer, perhaps signifying that it had a different function. Most of the fireplaces were used during the Sindi-Lodja (7000–5500 BC) and Narva stage (5500–4000 BC) of the Mesolithic on the Estonian islands, but a couple of them have been found in the coasts on inland water bodies. In seal hunting camps, those found in sites at Võhma, Ruhnu and Kõpu, the fire pits cover large areas in settlement sites. It is probable that those fireplaces were used as earth ovens for processing food and at least some of them were related to sealing activities. Stones in them were used mostly as heat reservoirs for keeping the moderate heat in the earth oven for longer periods of time.

Fireplaces built on the ground have been found from settlement sites of all Stone Age periods. Most of them were constructed during the pre-pottery Mesolithic. According to the documentation of excavations, fire had been made on the stones as they were covered with charcoal in some cases (Jaanits, 1960). They could have been constructed as a base for making fire and could have also functioned as heat storage so that after heating them food items could have been placed on hot stones.

Several primitive griddles have also been excavated, most of them from Narva Joaorg. A limestone slab had been placed on smaller limestone pieces and fire had been made under it. About a 5 cm thick layer of coal was preserved under the stone slab (Jaanits, 1960, p. 5). A similar yet made of granite stone griddle was also found on the Siimussaare Mesolithic settlement site (Moora, 1964). The construction of those fireplaces is very similar to griddles used even nowadays for cooking food on low temperature, for example those used in baking bread (Lyons & D'Andrea, 2003).

Another type of fireplaces is distinguishable by isolated larger stones. In some cases, they are accompanied by several finds. Such fireplaces have been documented during excavations of several sites: Kunda Lammasmägi (Indreko, 1936), Kivisaare (Indreko, 1931) and Narva Joaorg (Jaanits, 1960). Their



**Fig. 5.** A fireplace (maybe reconstructed) with large stones for holding up a ceramic vessel, found during excavations in Jägala Jõesuu I in 1921. Photo: Adolf Friedenthal (Estonian History Museum AM D159:1 29).

**5 pav.** *Ugniavietē (galbūt rekonstruota) su dideliais akmenimis keramikos indams laikyti kasinėjimų Jägala Jõesuu I gyvenvietėje metu. Adolfo Friedenthalio (Estijos istorijos muziejus AM D159:1 29) nuotrauka*

description fits with ethnoarchaeological records, where it has been stated that stones have been situated close to fire for helping with various tasks and holding up items (e.g., Binford, 2002, pp. 149–152). In addition to the mentioned fireplaces, which have not been fully documented, there are two fireplaces where sherds from broken comb ware vessels have been found between such stones. One was found in the settlement site at Jägala Jõesuu I, during the excavations of 1921 (Spreckelsen, 1925) and the second one was retrieved from the Riigiküla III settlement site (Гурина, 1967, p. 12). Both fireplaces contained sherds of almost complete ceramic vessel. This is a strong indication that the stones of fireplace had been used for supporting a vessel or hot coals over fire and the pot was broken during or after use. Most of the documented fireplaces found with isolated stones were constructed during the Neolithic period in sites with a comb ware pottery complex (Fig. 5). The purposeful use of stones is also demonstrated by small stone piles prepared for use that have been found in sites at Umbusi (Jaanits, 1992), Pulli (Jaanits, 1970) and Akali (Янитс, 1959, p. 37). The last example demonstrates the value of stones because they were

not locally available near the settlement site and had to be brought from elsewhere.

No information could be found on the heaters used in buildings during the Stone Age, mostly because of only three fireplaces having been excavated from house remains in Estonia. The hearths from the settlement site at Riigiküla I (Гурина, 1967, pp. 21–30) and Narva Jõesuu IIb (Крийска *et al.*, 2015) did not contain stones. Jaanits (1982, p. 105) has speculated that fireplaces with stones in the Valma settlement site had been inside buildings, but the remnants of buildings have not been found, so the fireplaces could have been situated outdoors.

## CONCLUSIONS

An analysis of Stone Age fireplaces demonstrated a purposeful use of stones, reflected in fireplace constructions. Four different types of fireplace structures with stones were visible in archaeological record: fire pits with stones, fireplaces built on the ground of stones, primitive griddles and fireplaces with isolated, bigger stones. It can be concluded on the types and ethnoarchaeological parallels that the main functions of stones are reflected in fireplace construction and can be differentiated with a case-by-case analysis of fireplaces. Functions visible in archaeological material of Estonia are the following: limiting fire, storing heat, forming a fireplace base, maintaining a griddle function and helping to hold up items over the fire. In the two latter cases, the stones have been probably used for supporting a ceramic vessel over a fireplace. Most fireplaces probably were cooking facilities and there is currently no evidence of use of stone heaters in buildings from the Stone Age.

A quantitative analysis revealed correlations between several dimensions of fireplace structure: presence of pit, existence of stones, size of stones, date and location. Tempo-spatial patterns in the features of fireplace constructions can be seen. Most Mesolithic fireplaces contain stones, yet in the Neolithic fireplaces the presence of stones drops significantly. The difference is particularly visible between the material from the Narva stage of Mesolithic and the Early Neolithic.

During the pre-pottery stage of Mesolithic, fireplaces built on the ground with stones are most com-

mon. During the Narva stage, fire pits with stones became widespread, especially in sealing camps on the Estonian islands. Similarly, ground fireplaces have also been found in the site at Narva Joaorg, where they have been built of limestone slabs on the ground. None of those are found in later archaeological contexts, where the use of stones seems to decrease significant-

ly. Patterns of change in fireplace construction reflect the evolution of subsistence technology of settlement sites, which itself is related to wider-level processes.

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## AKMENŲ NAUDOJIMO ESTIJOS AKMENS AMŽIAUS UGNIAVIETĖSE NUSTATYMAS

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Santrauka

Ugniavietės ir su jomis susiję degę akmenys yra įprastas objektas, aptinkamas akmens amžiaus gyvenvietėse. Nors informacija apie jas yra pristatoma archeologinėse ataskaitose, taip pat aptinkama publikacijose, iki šiol nebuvo atlikta specialiai joms skirta tyrimo.

Šio straipsnio tikslas – užpildyti šią spragą ir patikrinti hipotezę, besiremiančią prielaida, kad ugniaviečių struktūriniai bruožai atskleidžia informaciją apie pragyvenimo gyvenvietėse modelį. Straipsnyje analizuojama, kokiam tikslui buvo naudoti akmenys ugniavietėse.

Ši studija remiasi sudaryta Estijos akmens amžiaus ugniaviečių duomenų baze, kurioje surinkti visų kasinėtų objektų prieinami duomenys. Į duomenų bazę įtrauktos 167 ugniavietės ir kiekybiniai duomenys apie jose esančius akmenis.

Buvo išskirti keturi skirtingi ugniaviečių su akmenimis struktūros tipai: ugniavietės duobėse su akmenimis, ugniavietės, įrengtos ant akmenų pagrindo, primityvios keptuvės

ir ugniavietės su atskirais didesniais akmenimis. Remiantis kasinėjimų duomenimis ir etnoarcheologinėmis paralelėmis bei šiuolaikiniu patyrimu, buvo iškeltos hipotezės apie jų funkcijas.

Dauguma ugniaviečių galbūt buvo naudojamos gaminant maistą, o akmenys naudoti ugnies plitimui apriboti, šilumai išlaikyti ir kaip tvirtas, ugniai atsparus objektas kitiems daiktams laikyti. Mažiausiai dviem atvejais akmenys, atrodo, buvo naudoti moliniams indams, kurie toje vietoje buvo sudužę, laikyti. Akmenų naudojimas ugniavietėse laikui bėgant gerokai pakito. Akmenų aptikta daugumoje mezolito laikotarpio ugniaviečių, o neolito ugniavietėse akmenų aptinkama retai. Išskirtiniai objektai – ugniavietės duobėse, daugiausia naudotos mezolite Narvos laikotarpiu ir neaptiktos neolito laikotarpio kontekste.

Galima daryti išvadą, kad akmenų naudojimas ugniavietėse susijęs su gyvenviečių ekonomika, o jų pokyčiai laikui bėgant atspindi bendras gyvenimo strategijas.

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