# QUARTZ AND QUARTZITE AS LITHIC RAW MATERIALS IN THE HUNGARIAN PALAEOLITHIC[•]

## KVARC ÉS KVARCIT MINT KŐ-NYERSANYAG A MAGYARORSZÁGI PALEOLITIKUMBAN

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*„A man of knowledge lives by acting, not by thinking about acting,*
*nor by thinking about what he will think when he has finished acting."*
– Carlos Castaneda, The Teachings of Don Juan: A Yaqui Way of Knowledge

## Abstract

*Due to the petrological features and the inferior knapping quality, quartz and quartzite were regarded as secondary lithic sources. Since the low morphological standardization of the products made of these raw materials cannot enable a simple, easy „technological reading", for a long time the analysis of lithic tools made of quartz and quartzite was not as intensive as of others made of better quality raw materials. Furthermore, during the analyses, an attempt was generally made to generalize the technical criteria associated with different siliceous raw materials to quartz and quartzite. This phenomenon is the so-called „flint syndrome", the use of a flint artefact typology for the analysis of quartz or quartzite assemblages without taking into consideration the raw material differences. Only in the last decades has the erroneous, inadequate aspect of this approach been realized by specialists. It is only in these recent years that specific attention has been paid to these raw materials, systematic research has begun in countries where the one or the other raw material plays a significant role in the lithic stone industries. In the research of the Hungarian Palaeolithic, the judgement of these raw materials has been always rather controversial. The primary goal of this paper is not a detailed discussion of Hungarian Palaeolithic sites, but merely to raise awareness of this problem associated with these raw materials and perhaps altering their perception. The following short overview of the archaeological sites is not exhaustive, can be regarded only as indicative.*

## Kivonat

*A kvarcot alacsonyabb rendű pattintási minősége miatt hagyományosan egy másodrangú kőeszköznyersanyagnak tekintették. Miután az ásványtani illetve kőzettani jellemzőik és a belőlük készült termékek alacsony morfológiai standardizációja megnehezíti az alkalmazott kőpattintási technológia meghatározását, így a kvarc és kvarcit eszközök vizsgálatával nagyon sokáig nem foglalkoztak olyan intenzíven, mint más, jobb minőségű nyersanyagból készült eszközökével. Rádásul a vizsgálatok során általában megpróbálták a különböző kovaféleségekkel kapcsolatos technikai kritériumokat a vizsgálandó kvarc illetve kvarcit nyersanyagokra kiterjeszteni. Ennek a megközelítésnek a hibás, elégtelen volta csak az elmúlt évtizedekben vált nyilvánvalóvá a szakemberek számára. Ekkor kezdtek megkülönböztetett figyelmet szentelni ezeknek a nyersanyagoknak, akkor indult meg a szisztematikus kutatásuk azokban az országokban, amelyek kőiparaiban jelentős szerepet játszik egyik vagy másik nyersanyag. A hazai paleolitikumban is meglehetősen ellentmondásos ezeknek a nyersanyagoknak a megítélése. A cikk elsődleges szándéka nem lelőhelyeink részletes tárgyalása, hanem csupán a nyersanyagokkal kapcsolatos probléma felvetése és ez által talán a róluk alkotott kép módosítása. Így lelőhelyeink rövid ismertetetése inkább jelzésértékűnek tekintendő.*

KEYWORDS: RAW MATERIAL UTILIZATION, QUARTZ, QUARTZITE, NORTHERN HUNGARY, PALAEOLITHIC

KULCSSZAVAK: NYERSANYAGFELHASZNÁLÁS, KVARC, KVARCIT, ÉSZAK-MAGYARORSZÁG, PALEOLITIKUM

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## Introduction

In 1990 and 1992 short excavations were carried out at Püspökhatvan–Diós and Püspökhatvan–Öregszőlők Upper Palaeolithic sites. The radiocarbon dating of the latter site (27.700 ± 300 BP (Deb-1901)) places the site in the elder, blady phylum of the Gravettian entity (Cs. Balogh & Dobosi 1995, 37-38, 57). In the course of the excavations, in the surrounding area, limnic quartzite banks were found, which served as raw material for the atelier sites. After the excavations in collaboration with the archaeologists A. Markó (Hungarian National Museum, Budapest), K. Zandler (Ferenczy Museum Center, Szentendre) and the author, systematic field surveys had begun in the area of the Cserhát Mountains. Since the above-mentioned Palaeolithic sites were the first ones located in the region, the primary goal of these field surveys was to localize new Palaeolithic sites. The secondary goal was to localize and document possible raw material sources.

The first significant results, on the utilization of nummulitic chert in the Middle Palaeolithic, were published yet (Markó & Kázmér 2004). The results on the utilization of some non-flint lithic raw materials will be published before long (Péntek, in prep. 1). This paper will try after to give a general summary of the utilization of quartz and quartzite as lithic raw materials.

Because of the low morphological standardization of the products made of these raw materials, for a long time, the technological and typological analysis of lithic tools made of quartz and quartzite was fading into the background. Furthermore, during the analyses, an attempt was generally made to generalize the technical criteria associated with different siliceous raw materials to quartz and quartzite. This phenomenon is the so-called „flint syndrome“ (after Knutsson 1998, 78, Beardsell 2013, 66). This term refers to the “automatic use of an ill-fitting flint artefact typology” in which quartz assemblages are approached in the same way as chert and flint ones while failing to take raw material differences into account (Beardsell 2013, 94). The difficulties in the analysis of the artefacts made of quartz or quartzite have among others a plain enough reason. The processing of pebbles, primarily quartz and quartzite pebbles is closely related to the bipolar-on-anvil technique. The anthropogenic origin of the individual artefacts is often unclear, and the knapping stigmas for these raw materials are slightly different from those commonly occurring for different silica-containing raw materials. The characteristics observed in the fragments are highly dependent on the type and quality of the raw material selected and the applied bipolar technique (horizontal/vertical straight or oblique). In the case of quartz and quartzite, due to the fracture properties of the raw material, the incidence of Siret fractures (Inizan et al. 1999, 156) is high (Mourre 1994, 18), and there is a high incidence of step and hinge fractures (Mourre 2004). As a result, the application of bipolar technique on quartz or quartzite results in a large variety of non-standardized by-products - large pieces of irregular shape and size, basal and parasitic flakes, irregular fragments, most of which are involuntary and uncontrolled by the knapper (Leaf 1979: 39).

In the first part of the paper, the discussed raw materials will be described briefly, focusing primarily on the flaking qualities of them. At the beginning of the second part, as a short by-pass, the results of M. Gutay (2007) and the author at the southern foothills of the Mátra Mountains, mainly the Gyöngyös area will be reviewed. At the end of this part, the archaeological sites, localized during the field surveys in Nógrád County, especially in the Cserhát Mountains, with documented utilization of quartz and quartzite will be described.

All data, stemming from previously published papers will be summed up in the Supplementary Materials.

## Quartz and quartzite as lithic raw materials

To get the sufficient geological and archaeological background to understand the characteristics of quartz and quartzite, we leaned mainly on the papers of Vincent Mourre (1994; 1996; 2004), Arturo de Lombera Hermida (2008; 2009), and the doctoral thesis of Killian Driscoll (2010).

The basis of the followings was given by K. Driscoll (2010, 5-8), with some extensions, therefore. only papers of other authors will be signed distinctively.

Quartz is silicon dioxide ($SiO_2$), a significant component of many igneous, sedimentary, and metamorphic rocks, such as sandstone, quartzite etc. (Bons 2001). Quartz is a hard but brittle mineral which makes it suitable for forming into stone tools and subsequent use. In terms of fracturing, almost all quartz does not exhibit cleavage, which means it does not have a tendency to break along structural planes in the crystal structure but is instead characterised by conchoidal fracturing. It means that its fracture surface has a curved shape. Miikka Tallavaara and colleagues noted that “the fracture surfaces are often noticeably rugged in quartz than in flint” (2010, 2442). The fracture path is more unpredictable and internal flaws set up small cracks to form on either side of the main fracture (Cotterell & Kamminga 1987, 678). Quartz flakes have a high fragmentation tendency. Probably reasons can be such properties as the relatively low tensile and compressive strength and its fairly high amount of internal flaws (Domanski et al. 1994, 197-198; Tallavaara et al. 201, 2443)

Quartz can be broadly divided into cryptocrystalline (or microcrystalline; extremely fine-grained dense and compact forms) and macrocrystalline forms (varieties that develop visible crystals or are made of large intergrown crystals). The modern classification scheme of quartz, taking into consideration the structure and physical properties creates two types: quartz (macrocrystalline quartz) and chalcedony (cryptocrystalline quartz) (e.g. Götze 2010, 166 Fig. 2). The "grainy" varieties of cryptocrystalline quartz include flint, chert, and jasper, and are described as rocks instead of minerals (as they have less SiO2 in their composition). The conchoidal fracturing of the cryptocrystalline materials happens at the micro-scale of the individual quartz crystals and the macro-scale, following a fractal pattern. Macrocrystalline forms include vein quartz and rock crystal, while the artefacts made of them will be referred to as 'lithics' and 'stone tools' in archaeological parlance, they are in fact minerals. The fracturing at the micro-scale is conchoidal, but a fractal pattern may or may not be produced depending on how the crystals have aggregated.

Quartzite is general petrological term indicating metamorphosed sandstone mainly or entirely composed of quartz, a silica mineral. Various materials and individual quartz grains are welded together by an amorphous silica filling to form quartzite. The quartz content exceeds 90 per cent in most quartzites. In other words, quartzite is an altered sandstone, "that has been recrystallized by the heat of volcanic activity occurring near the sediment or strengthened by silica filling the small spaces between grains" (Cotterell & Kamminga 1990, 129). Generally, there are two varieties of quartzites in terms of metamorphism, metaquartzite and silicified sandstone, known as orthoquartzite, although it is often difficult to distinguish them. Orthoquartzites are have not undergone metamorphosis. Quartz grains are interlocked and hardened by a cementing process in orthoquartzites, and fracture happens along the internal cement interstices between the individual quartz grains. If the grains are fine and there are few internal flaws, a more or less conchoidal fracture can be obtained. Metaquartzites represent metamorphosed sandstone in which particles of quartz were deformed and interlocked. "… the individual quartz sand grains were welded together by later heat and pressure, so that instead of breaking between grains, which prevents conchoidal fracture, it now can be knapped across grains ... " (Whittaker 1994, 72). And according to William Andrefsky, Jr., "Fine-grained quartzites tend to fracture with more control than the larger-grained quartzites and are more suitable for flintknapping" (1998, 54-55) (Seong 2004, 77).

## Quartz and quartzite utilization in the surroundings of Gyöngyös (Heves County)

M. Gutay in her unpublished thesis (Gutay 2007), reviewing the results of the field surveys performed with Gy. Kerékgyártó mentioned two quartzite artefacts with further elaboration. One of the artefacts is an unspecified, manufactured quartzite pebble at the Gyöngyöspata 5 (Dobogó) site (**Fig. 3.**, Q-7). Among the lithic artefacts, the limnic silicite waste products dominate, there are some retouched flakes, and two side-scrapers as well. Because of the lack of culture-specific tools, the cultural affiliation of the site is not clear (Gutay 2007, 70). The other artefact is a bifacially elaborated massive demi-Quina type side-scraper of big dimensions (78×53×18 mm). It is a stray find from the plateau above the diatomaceous earth quarry in Szurdokpüspöki (Western Mátra Mountains) (Gyöngyöspata 53 site (**Fig. 3.**, Q-8); Gutay 2007, 96, Table XLIX,1.). It is a Middle Palaeolithic tool, its occurrence as stray find can be explained by the presence of raw material, mainly limnic opal, in large amounts.

György Lengyel and colleagues, in their paper (Lengyel et al. 2006) described the surface collections of the Aurignacian sites Nagyréde 1 (Öreg- hill; (**Fig. 3.**, Q-11)) and Nagyréde 2 (Vájsz-lane; (**Fig. 3.**, Q-12)) near Gyöngyös, at the southern foothills of the Mátra Mountains. In Table 1, summarizing the raw material distribution of the sites, quartzite was referred to as a raw material of unknown origin. Though the percental ratio of quartzite is low (0.2%) at both sites, at Nagyréde 1 both quartzite artefacts are tools (1.8% of the 112 tools), and at Nagyréde 2 site one of the two quartzite artefacts is a tool (1.3% of the 79 tools) (Lengyel et al. 2006, 80, Table 1. and 81, Table. 3.). The typological character of the tools was not specified in further detail. The likely origin of the quartzite pebbles is a nearby gravel exposure. It is noteworthy to mention the occurrence of nummulitic chert at these sites (personal notification of A. Markó).

Between 2016 and 2019, the author of this paper initiated the complete topographic documentation of the Nagyréde 1 and 2 sites. All artefacts, regarded as archaeologically relevant, retouched tools, blades and technological markers (such as crested blades, core rejuvenation flakes, burin spalls) have been recorded with handheld GPS. With this method, on the ground of the recorded artefact distribution, in a GIS (Geographical Information System) model the estimation of the approximate extension of the sites, actually site-complexes, was possible.

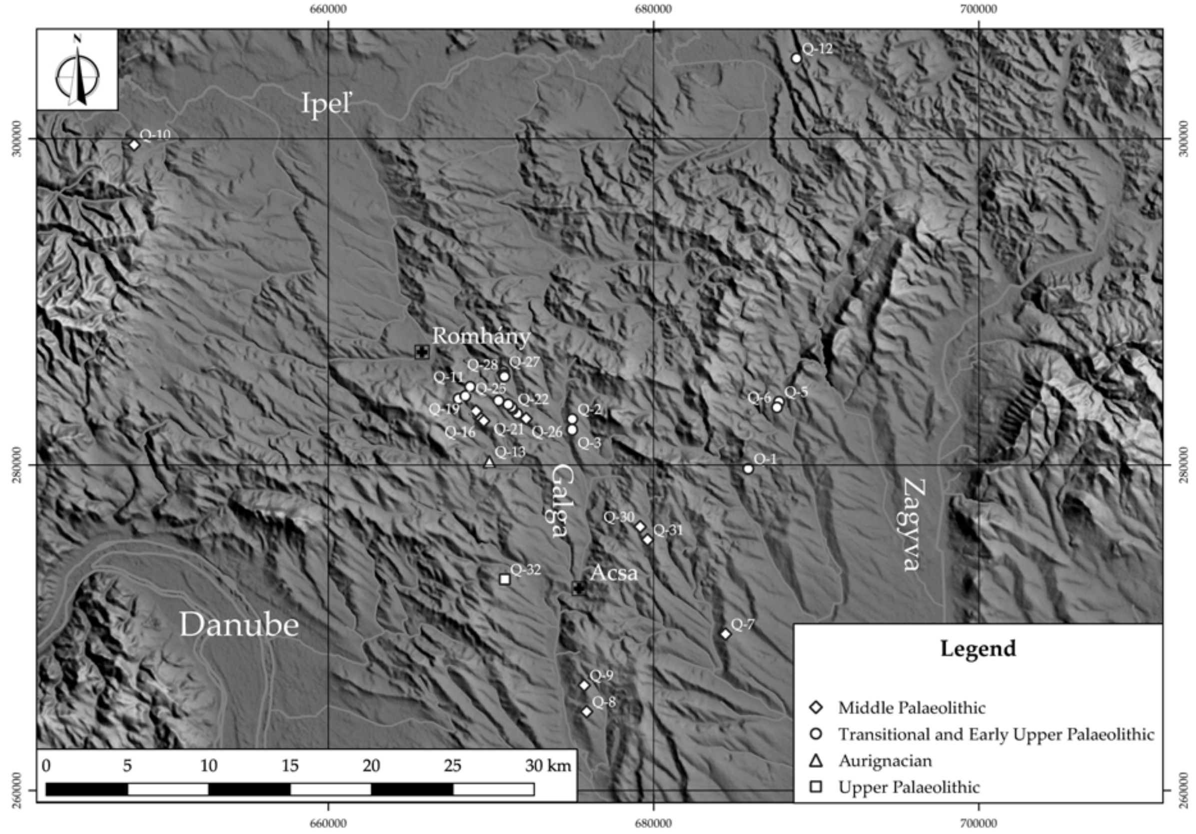


**Fig. 1.:** Archaeological sites with recorded quartzite utilization classified according to cultural affiliation in Nógrád County, especially the Cserhát Mountains.

Q1= Bér–Szár-hill 1 and 2, Q2=Bercel–Erdőben-vége 1, Q3=Bercel–Erdőben-vége 2, Q4=Bercel–Pinurka, Q5=Buják–Szente 2, Q6=Buják–Szente 2 (stray find), Q7=Erdőtarcsa–Daróci-hill, Q8=Galgagyörk–Csonkás-hill, Q9=Galgagyörk–Komárka, Q10=Hont–Csitár, Q11=Kétbodony–Halyagos-hill, Q12=Kisgéc–Fehér-hill, Q13=Legénd–Hosszú-lands, Q14=Legénd–Káldy-farm 2, Q15=Legénd–Káldy-farm 3, Q16=Legénd–Káldy- farm 5, Q17=Legénd–Káldy- farm 6 (stray find), Q18=Legénd–Rovnya 1, Q19=Legénd–Rovnya 2, Q20=Szanda–Patkányos-prairie, Q21=Szécsénke–Berecz-side 1, Q22=Szécsénke– Berecz- side 2E, Q23=Szécsénke– Berecz- side 2W, Q24=Szécsénke– Berecz- side 3, Q25=Szécsénke– Berecz- side 4, Q26=Szécsénke–Kis-Ferenc-hill, Q27=Szécsénke–Visak 1, Q28=Szécsénke–Visak 2, Q29=Szécsénke–Visak 3, Q30=Vanyarc–Szlovácka-dolina, Q31=Vanyarc–Tovi, Q32=Csővár–Arany-hill.

**1. ábra:** Kvarcit felhasználás kulturális alapon osztályozott régészeti lelőhelyeken Nógrád megyében, különös tekintettel a Cserhát hegységre.

Q1= Bér–Szár-hegy 1 and 2, Q2=Bercel–Erdőben-vége 1, Q3=Bercel–Erdőben-vége 2, Q4=Bercel–Pinurka, Q5=Buják–Szente 2, Q6=Buják–Szente 2 (stray find), Q7=Erdőtarcsa–Daróci-hegy, Q8=Galgagyörk–Csonkás-hegy, Q9=Galgagyörk–Komárka, Q10=Hont–Csitár, Q11=Kétbodony–Halyagos-hegy, Q12=Kisgéc–Fehér-hegy, Q13=Legénd–Hosszú-földek, Q14=Legénd–Káldy-tanya 2, Q15=Legénd–Káldy-farm 3, Q16=Legénd–Káldy-farm 5, Q17=Legénd–Káldy-farm 6 (stray find), Q18=Legénd–Rovnya 1, Q19=Legénd–Rovnya 2, Q20=Szanda–Patkányos-puszta, Q21=Szécsénke–Berecz-oldal 1, Q22=Szécsénke– Berecz-oldal 2E, Q23=Szécsénke– Berecz-oldal 2W, Q24=Szécsénke– Berecz-oldal 3, Q25=Szécsénke– Berecz-oldal 4, Q26=Szécsénke–Kis-Ferenc-hegy, Q27=Szécsénke–Visak 1, Q28=Szécsénke–Visak 2, Q29=Szécsénke–Visak 3, Q30=Vanyarc–Szlovácka-dolina, Q31=Vanyarc–Tovi, Q32=Csővár–Arany-hegy.

During the systematic field surveys, extraordinary attention was devoted to the occurrence of non-local raw materials as well. Among the 2,139 recorded artefacts, no quartzite artefact was present, siliceous pebble and nummulitic chert in low number were recorded. Since there are no known gravel beds in the surroundings of Nagyréde, both the siliceous pebbles (inclusive nummulitic chert) and the quartzite pebbles may have been originated from the bed of the Rédei–Nagy-streamlet.

From an archaeological point of view, the localization of a new site-complex at Nagyréde Közép-crag (**Fig. 3.**, Q-10) with Early Upper Palaeolithic characteristics can be regarded as an important by-product. The site-complex of about 600×400 metres extension is situated westward from the settlement of Nagyréde, near the settlement border to Ecséd. At the site-complex, the above-described documentation method was applied. Although, only as indicative for the utilization of these raw materials, quartzite and siliceous pebble artefacts are present. Beside a notched quartzite tool, there is a quartzite flake of large dimensions, which proves the application of the bipolar-on-anvil technique. There is also a flake core with several free-hand removals.

In 2017, in the area of Ecséd, about 6 kilometres to the west from Nagyréde, a new Palaeolithic site-complex was localized and documented by the author (**Fig. 3.**, Q-5). M. Gutay (Dobó István Castle Museum, Eger) drew the attention of the author the possible existence of Palaeolithic sites in the area of Ecséd. Unfortunately, the results of her field surveys did not have been published yet. At four joined localities, containing 11 technically defined collection zones, the site-complex has an approximate extension of 33.85 hectares (0.3385 square kilometres). The collected lithic assemblages share the same technological and typological characteristics and can be regarded as (Early) Upper Palaeolithic. In the locality of Ecséd–Mogyorós- hill, among 629 recorded artefacts, there is a single quartzite fragment. At the locality of Ecséd–Gárdony, among 1,743 recorded artefacts, there are two quartzite tools (one side-scraper and one retouched flake) and one flake too. The quartzite pebbles, and the siliceous pebbles as well, may have been likely collected in the bed of the nearby Ágói- streamlet.

### Quartzite as a raw material in Nógrád County and the Cserhát Mountains

Thanks to the intensive field surveys of the recent years', many quartzite artefacts (tools, cores and flakes) were found on the Palaeolithic sites belonging to different chronological horizons and cultural units, in such a great amount, which necessarily has to raise the attention to this raw material. The sites embrace the Late Middle Palaeolithic Micoquian-Bábonyian industry, the so-called "Vanyarc-type" industry, resembling the archaic Szeletian, the assumed Szeletian culture and based on the very recent field explorations the Upper Paleolithic Aurignacian and even the elder and younger phylum of the Gravettian entity.

Below some Palaeolithic sites will be reviewed very briefly. A detailed paper is in preparation on the subject of Palaeolithic raw material utilization of some non-flint raw materials in the Cserhát Mountains. Some of the most significant sites can be seen with an approximately chronological assignment on the map (**Fig. 1.**, Q-1–Q-32).

### Micoquian-Bábonyian industry

In the archaeological materials of the Palaeolithic sites assigned to this industry mainly unworked quartzite flakes occur. This type of lithic raw material played a subordinate role in this industry. Á. Ringer in his dissertation on the Bábonyian wrote the following: „Im Abschlagsmaterial gab es noch Feuerstein, Quarzit und Kieselstein." (1983, 59). However, for comparison, in the Micoquian layers of the Kůlna cave in South Moravia among the used raw materials, there is a definite presence of quartzite, orthoquartzite rock crystal and smoky quartz (Valoch 1988; Neruda 2005). Both at Galgagyörk–Csonkás- hill (**Fig. 1.**, Q-8) and Galgagyörk–Komárka (**Fig. 1.**, Q-9), only one flake was found. At the Legénd–Káldy-farm site complex (**Fig. 1.**, Q-14, Q-15), four flakes and two chips of small dimensions might as well be related to tool production (Markó & Péntek 2003-2004,166, Table 1.). At the recently published material of the nearby Legénd-Káldy-farm 5 site (**Fig. 1.**, Q-16), there are eight flakes (1.71% of the entire assemblage containing 467 artefacts) (Péntek & Gábriel 2018). Next to the site, a side-scraper of great dimensions was found as a stray find.

In the area of Bercel, between the valleys of the Gólya streamlet and the Galga River, there is a comb of 300 to 800 metres variable width and with an asymmetric cross-section. The Palaeolithic site of Bercel–Erdőben-vége 1 is located along the western verge of the comb sloping steeply towards Galga Valley at a length of about 3.2 km (**Fig. 1.**, Q-2). The comb is covered with loess of variable thickness of the Upper Pleistocene age. The very low artefact intensity at the site depends on the thickness of the loess cover. From the lithic assemblage containing a small number of tools, two bifacial knives ("Keilmesser") made of limnic silicite of Mátra Mountains origin should be highlighted. The lithic raw materials include quartzite and siliceous pebbles from nearby gravel beds.

Beside a siliceous pebble flake core with an irregular hierarchy, there is a discoid quartzite flake core as well.

### „Vanyarc-type" industry

In this paper dealing with the raw material utilization of the 1,949 artefacts stemming from the excavations of the Vanyarc–Szlovácka-dolina 5 Palaeolithic site (**Fig. 1.**, Q-30), the detailed raw material distribution is also given: the 14 quartzite artefacts have a percental ratio of 0.72% (Markó 2011a, 72). In his doctoral thesis, A. Markó evaluated the sites in the Szlovácka-dolina area of the settlement Vanyarc. At the same time, during this work he postulated this industry, resembling the archaic Szeletian industry. The processed material stems partly from excavations, partly from surface collections. Concerning the quartzite as raw material the author refers to its dominant role at some significant Hungarian Middle Palaeolithic sites, and thereafter states, that the occurrence of quartzite at the sites in the environment of Vanyarc can be regarded as sporadic. However, in the excavated material, the knapping on the spot can be illustrated by a refitting-group (Markó 2012, 27, 270). In the surface collections of the excavated site, several quartzite flakes and four convex side-scrapers were present (Markó 2007a, 12). At the nearby Vanyarc–Tovi site (**Fig. 1.**, Q-31) besides the flakes of different dimensions also a side-scraper was found.

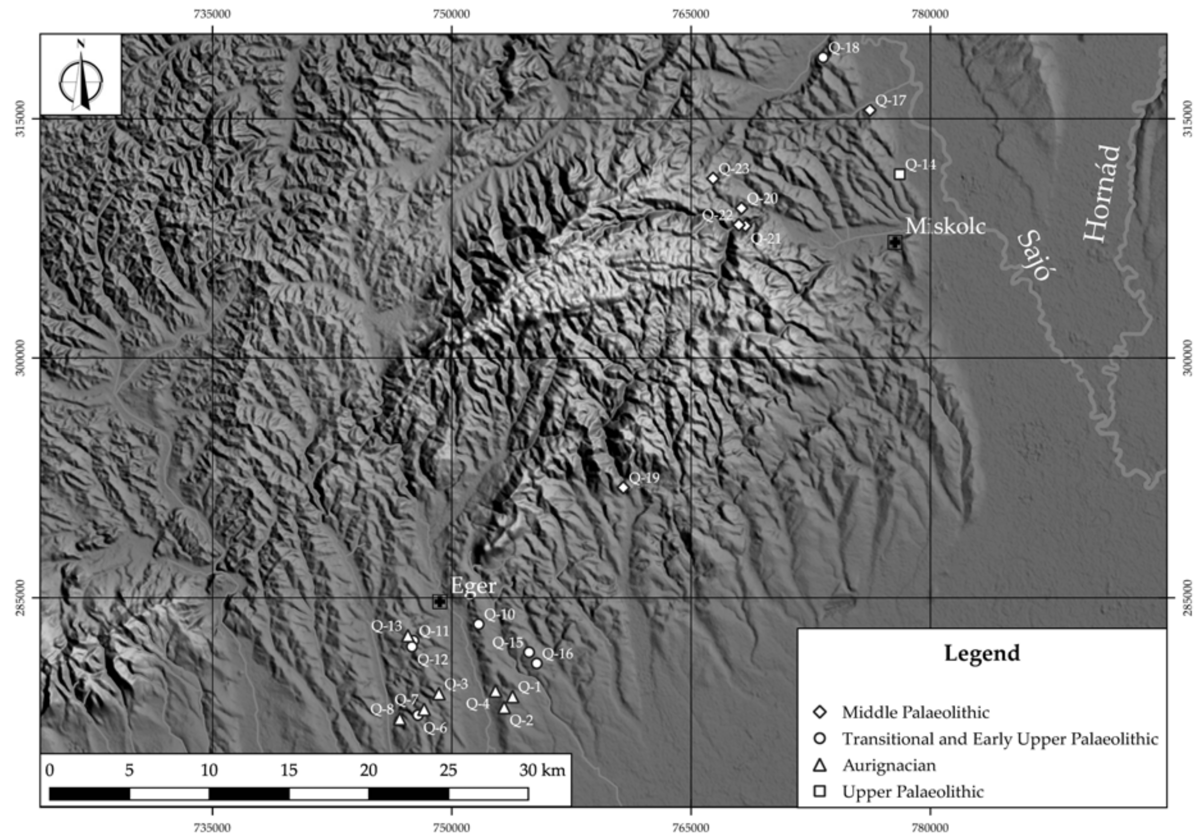


**Fig. 2.:** Archaeological sites with recorded quartzite utilization classified according to cultural affiliation in the surroundings of Miskolc (Sajó Valley) and Eger (southern foothills of the Bükk Mountains).

Q1=Andornaktálya–Gyilkos, Q2=Andornaktálya–Rózsa-hill, Q3=Andornaktálya–Szukszer-hill, Q4=Andornaktálya–Zúgó-lane, Q5=Csokvaomány–Határ-hilltop, Q6=Demjén–Hegyeskőbérc I-III, Q7=Demjén–Pünkösd-hill, Q8=Demjén–Szőlő-hill, Q9=Diósgyőr – Tapolca cave, Q10=Eger–Kőporos-hilltop, Q11=Eger–Kővágó-lane I, Q12=Eger–Kővágó-lane II, Q13=Egerszalók–Egerlátó-hilltop, Q14=Miskolc–Rózsás-hill, Q15=Ostoros–Rácpa I, Q16=Eger–Rácpa II, Q17=Sajóbábony–Méhésztető, Q18=Sajószentpéter–Margit-kapu-lane, Q19=Cserépfalu–Subalyuk cave, Q20=Miskolc–Büdöspest cave, Q21=Miskolc–Herman Ottó cave, Q22=Miskolc–Szeleta cave, Q23=Parasznya–Lambrecht Kálmán cave.

**2. ábra:** Kvarcit felhasználás kulturális alapon osztályozott régészeti lelőhelyeken Miskolc (Sajó völgy és Eger (Egri-Bükkalja) környékén.

Q1=Andornaktálya–Gyilkos, Q2=Andornaktálya–Rózsahegy, Q3=Andornaktálya–Szukszerdomb, Q4=Andornaktálya–Zúgó-dűlő, Q5=Csokvaomány–Határ-tető, Q6=Demjén–Hegyeskőbérc I-III, Q7=Demjén–Pünkösdhegy, Q8=Demjén–Szőlőhegy, Q9=Diósgyőr – Tapolca barlang, Q10=Eger–Kőporos-tető, Q11=Eger–Kővágó-dűlő I, Q12=Eger–Kővágó-dűlő II, Q13=Egerszalók–Egerlátó-tető, Q14=Miskolc–Rózsás-hegy, Q15=Ostoros–Rácpa I, Q16=Eger–Rácpa II, Q17=Sajóbábony–Méhésztető, Q18=Sajószentpéter–Margit-kapu-dűlő, Q19=Cserépfalu–Subalyuk barlang, Q20=Miskolc–Büdöspest barlang, Q21=Miskolc–Herman Ottó barlang, Q22=Miskolc–Szeleta barlang, Q23=Parasznya–Lambrecht Kálmán barlang.

### “Szeletian” culture

The traces of quartzite utilization can be observed at several sites.

On the site of Hont-Csitár, in the Ipoly Valley, Northern Hungary (**Fig. 1.**, Q-10): M. Gábori performed an excavation in 1969. Unfortunately, there is no documentation available from this fieldwork, and the assemblage was not published by him. K. Zandler processed and published the mingled lithic material belonging to various Prehistoric horizons (Zandler 2010). There are three tools made of quartzite: a leaf-point, an end-scraper made on a flake collected as a stray find (Zandler 2010, 26), and a leaf-shaped side-scraper from trench IV (Zandler 2010, 32). There are several other quartzite chunks and hammer-stones. A certain part of the assemblage, the leaf-points and leaf-shaped side-scrapers, can likely be connected to the Szeletian industry.

From the recently published assemblage from Legénd–Rovnya 2 (**Fig. 1.**, Q-19) (Péntek & Zandler 2013b) containing 972 artefacts, 19 of them (1.95%), including seven flakes, 10 raw material chunks and two side-scrapers are made of quartzite. One of the tools is a simple side-scraper made on a massive, offset (“déjeté”) flake with the dimensions of 65×46×19 mm and with a curved working edge. The curved left side-edge is bifacially worked

(Péntek 2015, 61 Fig. 15, 1; Péntek 2019, Fig. 5, 3). The second one is also a simple, side-scraper made on a massive, offset ("déjeté") flake with a straight working edge ("racloir â dos naturel"). The curved left side-edge is unworked, forming a natural back. The right side-edge is rough-and-ready „denticulated". The platform exhibits an obtuse angle to the flaking surface (105-110°). Its dimensions are 64×46×22 mm (Péntek 2015, 61 Fig. 15, 2; Péntek 2019, Fig. 5, 4). The cultural classification of the site is not obvious, while beside the tools with definite Szeletian-like character, there are some Upper Palaeolithic (Aurignacian and possibly Gravettian) artefacts too.

In the lithic assemblage, containing 1,495 artefacts, from Buják–Szente 2 (**Fig. 1.**, Q-5): (Péntek & Zandler 2014), there is only a single quartzite artefact. The find is a rough-and-ready elaborated tool, a rather atypical side-scraper with a curved working edge. The blank of the tool was a pebble-slice of great dimensions, with the original pebble cortex as a natural back. With its dimensions of 66×53×26 mm, it is the greatest tool of the assemblage. From the deep loessy dirt road, leading to the site, another stray find came to light (**Fig. 1.**, Q-6). The find is a double side-scraper or a combined tool of great dimensions. Its retouched left side-edge is a curved convex side-scraper, on the distal end of the right side-edge, there is a slightly concave notch. Its dimensions are 53×42×16 mm. The tool can be likely related to the site. The place of the finding is a dominant strategical position, controlling the valley head of a „dead-end valley". It might have probably been a hunting station.

The site of Szécsénke–Kis-Ferenc-hill (**Fig. 1.**, Q-26) together with other localities and surface find concentrations localized on both sides of the Halyagos streamlet, are regarded as parts of a Szeletian site complex. The surface collected assemblage is characterized by significant quartzite utilization (Péntek & Zandler 2013a; Péntek 2015). The likely source of the quartzite pebbles is either the Szécsénke-Kis-Ferenc-hill site itself or the gravel bed which can be found in the area of the Szécsénke-Berecz-oldal-2W site (**Fig. 1.**, Q-23) 1 km to the northwest. The geological age of these gravel beds is Upper Oligocene „Chattian" stage (Noszky 1940, 43-47), in the recent Hungarian nomenclature it belongs either to the Lower Miocene "Budafok Sand Formation" (Hámor 1985, 234), or the Upper Oligocene „Pétervására Sandstone Formation" (Hámor 1985, 230; Korpás ed. 1988, 64-66). In the constitution of the gravel beds, the quartzite pebbles dominate. At the Szécsénke–Kis-Ferenc-hill site, there are 12 quartzite artefacts; its percental ratio in the assemblage, containing 1,218 artefacts is 0.94%. Besides nine flakes, there are also three notched tools.

On the Szécsénke–Berecz-oldal 1 site (**Fig. 1.**, Q-21), being part of the same Szeletian site complex, there is a unipolar quartzite flake-core with short flaking scars (Péntek 2015, 62 Fig. 17, 1). The back-side of the core is the natural breakage surface of the rock having the dimensions of 44×53×36 mm. On the Szécsénke-Berecz-oldal 3 site (**Fig. 1.**, Q-24), there are numerous flakes, mostly discoid cores (Péntek 2015, 63 Fig. 18), a notched tool with the dimensions 48×54×25 mm of quartzite, and a retouched microlithic tool made of vein quartz (21×18×8 mm). Finally, at the Szécsénke-Berecz-oldal 4 (**Fig. 1.**, Q-25) small find-concentration, there is a notched tool on a massive pebble-slice. Dimensions are 54×33×21 mm.

## Early Upper Palaeolithic

In the area of Bercel, on the above-mentioned comb, in the south-west direction from the site Bercel–Erdőben-vége 1 (**Fig. 1.**, Q-2), there is another Palaeolithic site, Bercel–Erdőben-vége 2 (**Fig. 1.**, Q-3). The site is located also along the western verge of the comb sloping steeply towards Galga Valley, on a hilltop, at an altitude of 265 to 270 masl. The slope of the hill is steep in both the west and north-west direction. Most of the recorded artefacts were found on the slope in a secondary position. The flat hilltop has relatively uniform surface and low find intensity, because of the loessy cover. The local limnic silicite raw material dominates, but the presence of quartzite and siliceous pebble, likely from nearby gravel beds, is significant as well. Among the 109 recorded lithic finds, there are 15 siliceous pebble artefacts, and a proportionally great number of quartzite, 34 artefacts (8.31%). The quartzite artefacts include a large number of cores and core fragments and flakes. Based on the general morphology of the flakes, it is more than likely that on the site not only freehand knapping, but the bipolar-on-anvil technique was also applied. There are no retouched quartzite tools. Quartzite flakes may not have been converted into retouched tools since they were primarily required because of their sharp cutting edge. The bipolar technique is often used if the resulting flakes are to be utilized without further elaboration. However, any signs of use cannot be identified with the naked eye.

The lithic assemblage of the site does not contain any culture-specific tools. Based on the technological character of the pebble artefacts and some retouched and unretouched blades, it is quite likely that the lithic material belongs to the Early Upper Palaeolithic, having no Aurignacian relationship at all.

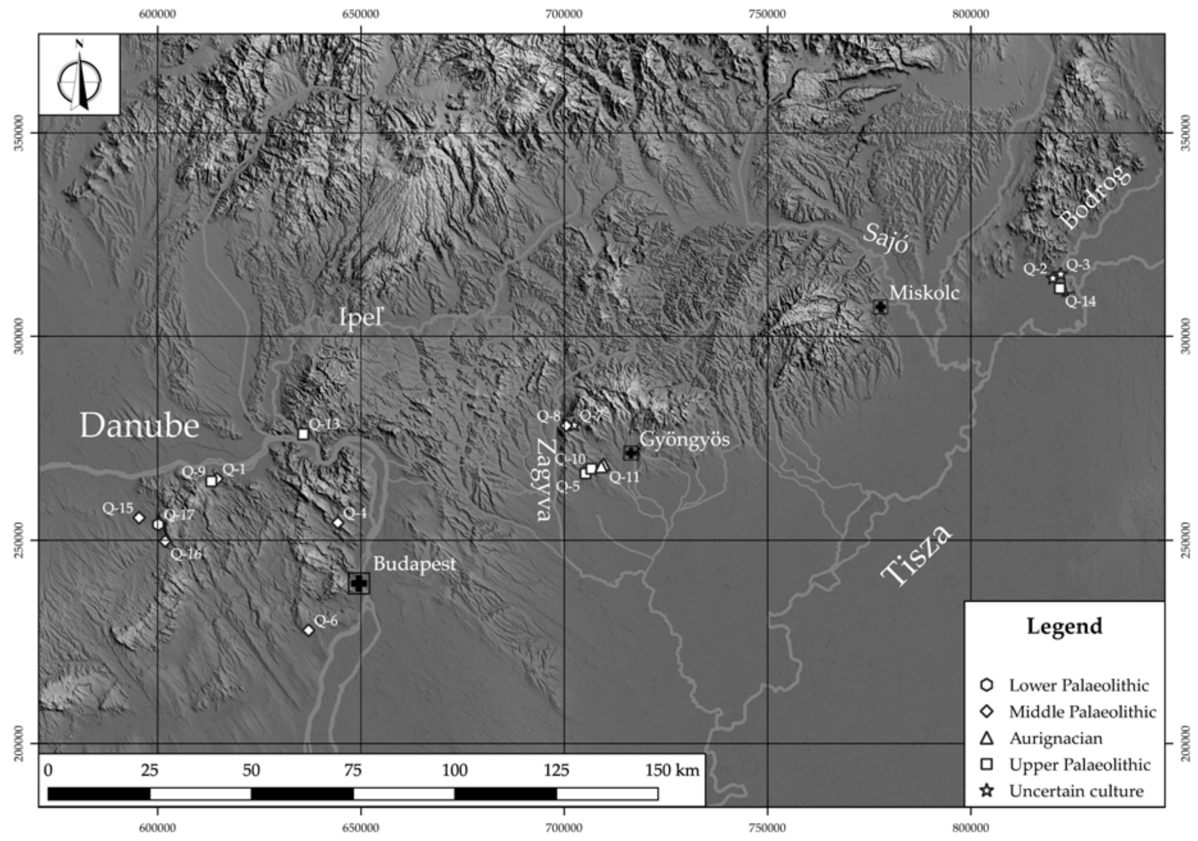


**Fig. 3.:** Diverse Hungarian archaeological sites with recorded quartzite utilization classified according to cultural affiliation.

Q1=Bajót–Jankovich cave, Q2=Bodrogkeresztúr–Dereszla (stray find), Q3=Bodrogkeresztúr–Kavicsbányadűlő- (stray find), Q4=Csobánka–Kiskevély cave, Q5=Ecséd–Gárdony, Q6=Érd–Fundoklia-valley, Q7=Gyöngyöspata 5 (Dobogó), Q8=Gyöngyöspata 53, Q9=Mogyorósbánya–Újfalusi-hills, Q10=Nagyréde–Közép-crag, Q11=Nagyréde–Öreg-hill, Q12=Nagyréde–Vájsz-lane, Q13=Szob–Ipolypart, Q14=Tarcal–Citrom-quarry, Q15=Tata–Porhanyó-quarry, Q16=Tatabánya–Szelim-cave, Q17=Vértesszőlős.

**3. ábra:** Kvarcit felhasználás kulturális alapon osztályozott magyarországi régészeti lelőhelyeken.

Q1=Bajót–Jankovich barlang, Q2=Bodrogkeresztúr–Dereszla (szórvány lelet), Q3=Bodrogkeresztúr–Kavicsbányadűlő- (szórvány lelet), Q4=Csobánka–Kiskevély barlang, Q5=Ecséd–Gárdony, Q6=Érd–Fundoklia-völgy, Q7=Gyöngyöspata 5 (Dobogó), Q8=Gyöngyöspata 53, Q9=Mogyorósbánya–Újfalusi-dombok, Q10=Nagyréde–Közép-bérc, Q11=Nagyréde–Öreg-hegy, Q12=Nagyréde–Vájsz-dűlő, Q13=Szob–Ipolypart, Q14=Tarcal–Citrom-bánya, Q15=Tata–Porhanyó-bánya, Q16=Tatabánya–Szelim-barlang, Q17=Vértesszőlős.

It is worth to mention that in the vicinity of the Bercel–Erdőben-vége 1 and 2 sites, there are at least three little lithic concentrations with quartzite artefacts (e.g. the site Pinurka, **Fig. 1.**, Q-4). The processing of the Palaeolithic sites and Palaeolithic stray find in the area of Bercel is in progress (Péntek, in prep. 2)

### Upper Palaeolithic

In the assemblage of the site Erdőtarcsa-Daróci- hill (**Fig. 1.**, Q-7):, containing 601 artefacts, there are eight quartzite artefacts (1.33%), a blade, two flakes, and four quartzite chunks (Zandler 2008). The artefact mentioned as “hammer-stone”, is a “retoucheur” of 94×40×22 mm, covered with a thick calcareous sinter layer. At one end of the stone, there are traces of beating, hammering activity. The assemblage also contains some Middle Palaeolithic tools with Micoquian-Bábonyian character. The edge of a bifacially worked tool, perhaps a leaf-point, is zigzaggy. During the elaboration, the WGK-concept (“wechselseitig gleichgerichtete Kantenbearbeitung”, Bosinski 1967, 43) was applied (Zandler 2008, 60. and Fig. 3.:2). Moreover, according to the author, Upper Palaeolithic artefacts with decisively Aurignacian character can be found in the collection. However, in a typological point of view, the dihedral burins resemble alike to those of the Gravettian industry.

The lithic assemblages of four Palaeolithic sites in the area of Bér were published recently (Péntek & Zandler 2017). The “atelier” site Bér–Egresi-lane is located on a gravel bed with a large number of siliceous and quartzite pebbles, and limnic silicite chunks as well. Despite this fact, in the lithic assemblage of 403 artefacts, only the ratio of siliceous pebble and nummulitic chert is significant

(10.67%), the quartzite is represented only by two flakes. The tool-kit proves the mingled character of the site, besides side-scrapers, morphologically similar to Middle Palaeolithic Mousterian types, there are leaf-shaped tools, and Early Upper Palaeolithic and/or Aurignacian tool types too. The presence of quartzite is more pronounced at the sites of Bér–Szár- hill 1 and 2 (**Fig. 1.**, Q-1). Besides the waste-products, there are several cores, flakes and a massive, chunky denticulated tool of great dimensions (76×41×23 mm) (Péntek & Zandler 2017, 366 Fig. 11, 2).

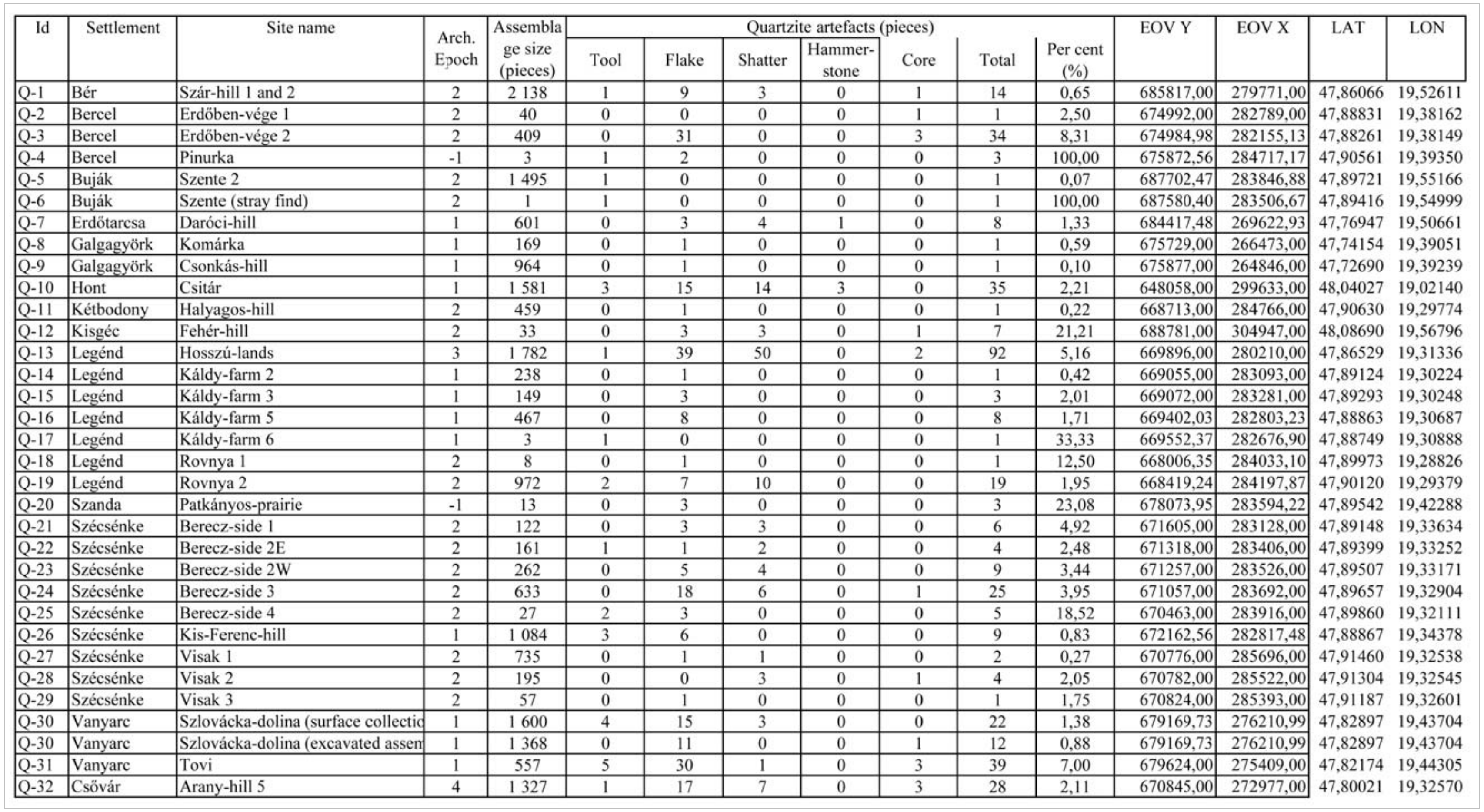
Despite the presence of a bifacial tool and some side-scrapers, the recently published lithic assemblage of the site Legénd-Hosszú-lands (**Fig. 1.**, Q-13; Péntek 2018), has both technologically and typologically an Upper Palaeolithic character. The lithic assemblage contains 1,782 artefacts, among them 146 tools (8.19%). In the tool composition, the simple and multiple burins, first of all, the carinated types ("burin caréné" and "burin busqué") dominate over the end-scrapers. The typological character of the tools justifies the assigning of the assemblage to the Aurignacian industry. In the raw material utilization, the local limnic silicite dominates (62.4%), followed by siliceous pebble (inclusive nummulitic chert) (22.45%). The ratio of 92 quartzite artefacts is 5.16%. There is also a vein quartz fragment. There is only a single quartzite tool, a bifacial knife ("Keilmesser"); the other artefacts are mainly flakes of different sizes and shapeless pieces. It is necessary to make some remarks regarding the shapeless, amorphous quartzite artefacts. According to technological observations, not only freehand knapping, but the bipolar-on-anvil technique was also applied. In connection with the bipolar-on-anvil technique, W. Andrefsky Jr. wrote that the bipolar cores are generally amorphous and are easily interchangeable with angular fragments (Andrefsky 1998, 153). Despite the great resistance to thermic effects, caused by the rigidness of the quartz mineral, as a consequence of a sudden change of temperature, quartzite pebbles tend to burst, to fracture into blocky fragments and remain in place without scattering over distances (Petraglia et al. 2002, Section 11-6.). Among the tools, there is a bifacial knife ("Keilmesser") with a natural back („couteau â dos naturel"), made on a massive quartzite flake. Its straight right side-edge is unworked. The basis and the slightly curved left side-edge are partly covered by the original pebble cortex. The dimensions are 67×37×17 mm (Péntek 2018, 65 Fig. 10, 2). The site is located along a potential migration route, linking the numerous Gravettian/Epigravettian sites in the Galga Valley with the Epigravettian site Romhány–Diós-road in the Romhány Basin (Nógrád Basin). This fact could be a possible explanation for the presence of the fragment of a backed piece in the assemblage, which may even belong to the Gravettian entity. Fragments of backed pieces can be found in the above-mentioned assemblage of the nearby Legénd–Rovnya site (Péntek & Zandler 2013b).

The surface collected homogeneous assemblage of Csővár-Arany- hill 5 (**Fig. 1.**, Q-32) containing more than 1,300 artefacts, most likely belongs to the younger blade phylum of the Gravettian entity. In the assemblage, there are many quartzite flakes and a quartzite tool of great dimensions on a massive, atypical pebble-slice. The distal end of the left side-edge is bifacially worked. Its dimensions are 82×35×13 mm. Among the artefacts of the surface collection, there are several hammer-stones, suitable for flaking and some flat quartzite pebbles with surface scars. Due to these knapping stigmata, the latter can be interpreted even as anvils. This phenomenon corresponds to the fact that probably the most efficient method of the elaboration of quartzite pebbles is the so-called bipolar-on-anvil technique. The source of the quartzite pebbles is the near Upper Oligocene „Chattian" stage gravel bed, named "Mocsolyák", located at a distance of 350-400 m from the site as the crow flies.

## *Discussion*

During field surveys between 2004 to 2006, M. Gutay (2007), localized and documented a large number of archaeological sites and small lithic concentrations in the area of the southern foothills of the Mátra Mountains. The spectrum of the collected lithic assemblages ranges from the Middle Palaeolithic to the Epipalaeolithic. All the same, among the lithic artefacts, there are only two quartzite artefacts. At the Early Upper Palaeolithic site-complexes of Ecséd–Gárdony, Ecséd–Mogyorós-hill and Nagyréde-Közép-crag, and the Aurignacian sites of Nagyréde 1 and 2, the presence of quartzite is infinitesimal. It should be noted, however, that the presence of siliceous pebble as a lithic raw material is also rare. Even though there is no available geological information on existing gravels in the region, pebbles can be collected practically in all streamlet beds. Taking into consideration the size of the collected assemblages, the reason for the subordinate role of the pebble raw materials cannot be research hiatus. By all means, for the time being, we should state only that the utilization of pebble raw materials can be considered as unremarkable in the area of the southern foothills of the Mátra Mountains.

Entirely different is the situation in Nógrád County, especially the Cserhát Mountains. There are altogether 32 archaeological sites and lithic concentrations, even some stray finds as well (listed in **Table 1.**), with the evidence of quartzite utilization.



| Id | Settlement | Site name | Arch. Epoch | Assemblage size (pieces) | Quartzite artefacts (pieces) | | | | | | | EOV Y | EOV X | LAT | LON |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Tool | Flake | Shatter | Hammer-stone | Core | Total | Per cent (%) | | | | |
| Q-1 | Bér | Szár-hill 1 and 2 | 2 | 2 138 | 1 | 9 | 3 | 0 | 1 | 14 | 0,65 | 685817,00 | 279771,00 | 47,86066 | 19,52611 |
| Q-2 | Bercel | Erdőben-vége 1 | 2 | 40 | 0 | 0 | 0 | 0 | 1 | 1 | 2,50 | 674992,00 | 282789,00 | 47,88831 | 19,38162 |
| Q-3 | Bercel | Erdőben-vége 2 | 2 | 409 | 0 | 31 | 0 | 0 | 3 | 34 | 8,31 | 674984,98 | 282155,13 | 47,88261 | 19,38149 |
| Q-4 | Bercel | Pinurka | -1 | 3 | 1 | 2 | 0 | 0 | 0 | 3 | 100,00 | 675872,56 | 284717,17 | 47,90561 | 19,39350 |
| Q-5 | Buják | Szente 2 | 2 | 1 495 | 1 | 0 | 0 | 0 | 0 | 1 | 0,07 | 687702,47 | 283846,88 | 47,89721 | 19,55166 |
| Q-6 | Buják | Szente (stray find) | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 100,00 | 687580,40 | 283506,67 | 47,89416 | 19,54999 |
| Q-7 | Erdőtarcsa | Daróci-hill | 1 | 601 | 0 | 3 | 4 | 1 | 0 | 8 | 1,33 | 684417,48 | 269622,93 | 47,76947 | 19,50661 |
| Q-8 | Galgagyörk | Komárka | 1 | 169 | 0 | 1 | 0 | 0 | 0 | 1 | 0,59 | 675729,00 | 266473,00 | 47,74154 | 19,39051 |
| Q-9 | Galgagyörk | Csonkás-hill | 1 | 964 | 0 | 1 | 0 | 0 | 0 | 1 | 0,10 | 675877,00 | 264846,00 | 47,72690 | 19,39239 |
| Q-10 | Hont | Csitár | 1 | 1 581 | 3 | 15 | 14 | 3 | 0 | 35 | 2,21 | 648058,00 | 299633,00 | 48,04027 | 19,02140 |
| Q-11 | Kétbodony | Halyagos-hill | 2 | 459 | 0 | 1 | 0 | 0 | 0 | 1 | 0,22 | 668713,00 | 284766,00 | 47,90630 | 19,29774 |
| Q-12 | Kisgéc | Fehér-hill | 2 | 33 | 0 | 3 | 3 | 0 | 1 | 7 | 21,21 | 688781,00 | 304947,00 | 48,08690 | 19,56796 |
| Q-13 | Legénd | Hosszú-lands | 3 | 1 782 | 1 | 39 | 50 | 0 | 2 | 92 | 5,16 | 669896,00 | 280210,00 | 47,86529 | 19,31336 |
| Q-14 | Legénd | Káldy-farm 2 | 1 | 238 | 0 | 1 | 0 | 0 | 0 | 1 | 0,42 | 669055,00 | 283093,00 | 47,89124 | 19,30224 |
| Q-15 | Legénd | Káldy-farm 3 | 1 | 149 | 0 | 3 | 0 | 0 | 0 | 3 | 2,01 | 669072,00 | 283281,00 | 47,89293 | 19,30248 |
| Q-16 | Legénd | Káldy-farm 5 | 1 | 467 | 0 | 8 | 0 | 0 | 0 | 8 | 1,71 | 669402,03 | 282803,23 | 47,88863 | 19,30687 |
| Q-17 | Legénd | Káldy-farm 6 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 1 | 33,33 | 669552,37 | 282676,90 | 47,88749 | 19,30888 |
| Q-18 | Legénd | Rovnya 1 | 2 | 8 | 0 | 1 | 0 | 0 | 0 | 1 | 12,50 | 668006,35 | 284033,10 | 47,89973 | 19,28826 |
| Q-19 | Legénd | Rovnya 2 | 2 | 972 | 2 | 7 | 10 | 0 | 0 | 19 | 1,95 | 668419,24 | 284197,87 | 47,90120 | 19,29379 |
| Q-20 | Szanda | Patkányos-prairie | -1 | 13 | 0 | 3 | 0 | 0 | 0 | 3 | 23,08 | 678073,95 | 283594,22 | 47,89542 | 19,42288 |
| Q-21 | Szécsénke | Berecz-side 1 | 2 | 122 | 0 | 3 | 3 | 0 | 0 | 6 | 4,92 | 671605,00 | 283128,00 | 47,89148 | 19,33634 |
| Q-22 | Szécsénke | Berecz-side 2E | 2 | 161 | 1 | 1 | 2 | 0 | 0 | 4 | 2,48 | 671318,00 | 283406,00 | 47,89399 | 19,33252 |
| Q-23 | Szécsénke | Berecz-side 2W | 2 | 262 | 0 | 5 | 4 | 0 | 0 | 9 | 3,44 | 671257,00 | 283526,00 | 47,89507 | 19,33171 |
| Q-24 | Szécsénke | Berecz-side 3 | 2 | 633 | 0 | 18 | 6 | 0 | 1 | 25 | 3,95 | 671057,00 | 283692,00 | 47,89657 | 19,32904 |
| Q-25 | Szécsénke | Berecz-side 4 | 2 | 27 | 2 | 3 | 0 | 0 | 0 | 5 | 18,52 | 670463,00 | 283916,00 | 47,89860 | 19,32111 |
| Q-26 | Szécsénke | Kis-Ferenc-hill | 1 | 1 084 | 3 | 6 | 0 | 0 | 0 | 9 | 0,83 | 672162,56 | 282817,48 | 47,88867 | 19,34378 |
| Q-27 | Szécsénke | Visak 1 | 2 | 735 | 0 | 1 | 1 | 0 | 0 | 2 | 0,27 | 670776,00 | 285696,00 | 47,91460 | 19,32538 |
| Q-28 | Szécsénke | Visak 2 | 2 | 195 | 0 | 0 | 3 | 0 | 1 | 4 | 2,05 | 670782,00 | 285522,00 | 47,91304 | 19,32545 |
| Q-29 | Szécsénke | Visak 3 | 2 | 57 | 0 | 1 | 0 | 0 | 0 | 1 | 1,75 | 670824,00 | 285393,00 | 47,91187 | 19,32601 |
| Q-30 | Vanyarc | Szlovácka-dolina (surface collecti | 1 | 1 600 | 4 | 15 | 3 | 0 | 0 | 22 | 1,38 | 679169,73 | 276210,99 | 47,82897 | 19,43704 |
| Q-30 | Vanyarc | Szlovácka-dolina (excavated assem | 1 | 1 368 | 0 | 11 | 0 | 0 | 1 | 12 | 0,88 | 679169,73 | 276210,99 | 47,82897 | 19,43704 |
| Q-31 | Vanyarc | Tovi | 1 | 557 | 5 | 30 | 1 | 0 | 3 | 39 | 7,00 | 679624,00 | 275409,00 | 47,82174 | 19,44305 |
| Q-32 | Csővár | Arany-hill 5 | 4 | 1 327 | 1 | 17 | 7 | 0 | 3 | 28 | 2,11 | 670845,00 | 272977,00 | 47,80021 | 19,32570 |

**Table 1.:** Archaeological sites in the Cserhát Mountains listed in the ascending alphabetical order of the settlement to which the site belongs administratively.

The enumeration of the attribute „Archaeological epoch” is the following: 1=Middle Palaeolithic, 2=Transitional and Early Upper Palaeolithic (sites with bifacial and leaf-shaped tools, inclusive leaf-points as well; Aurignacian tools are sometimes present), 3=Aurignacian, 4=Upper Palaeolithic/Late Upper Palaeolithic, -1=Uncertain cultural affiliation

**1. táblázat:** Régészeti lelőhelyek a Cserhát hegységben a települések növekvő sorrendjében.

Az „Archaeological epoch” (régészeti korszak) mező jelentése: 1=Középső Paleolitikum, 2=Középső Paleolitkum-Felső Paleolitikum átmeneti és korai Felső Paleolitikum (lelőhelyek bifaciális és levéleszközökkel, a levélhegyeket is beleértve; Aurignacien eszközök néha jelen vannak), 3=Aurignacien, 4=Felső Paleolitikum, Késő Felső Paleolitikum, -1=Bizonytalan kulturális besorolás.

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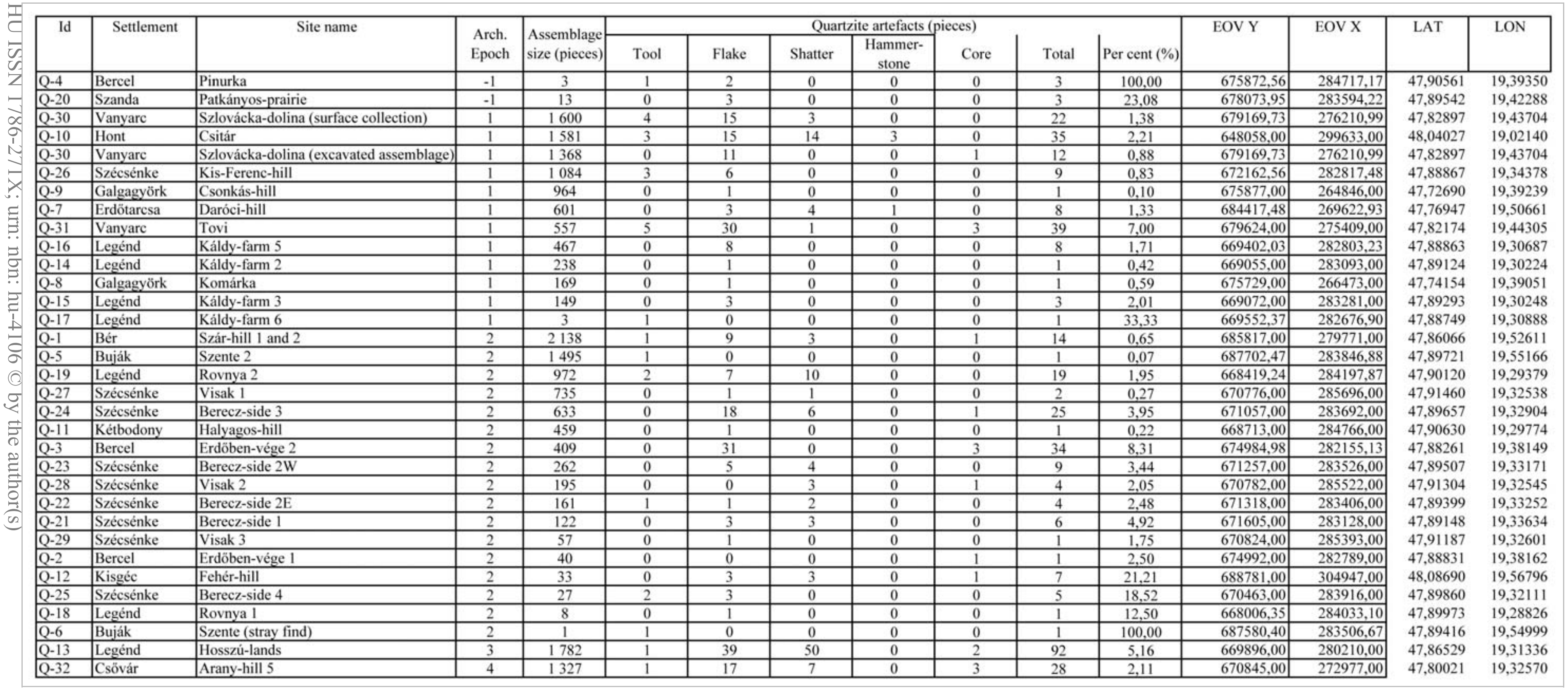

| Id | Settlement | Site name | Arch. Epoch | Assemblage size (pieces) | Quartzite artefacts (pieces) | | | | | | | EOV Y | EOV X | LAT | LON |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Tool | Flake | Shatter | Hammer-stone | Core | Total | Per cent (%) | | | | |
| Q-4 | Bercel | Pinurka | -1 | 3 | 1 | 2 | 0 | 0 | 0 | 3 | 100,00 | 675872,56 | 284717,17 | 47,90561 | 19,39350 |
| Q-20 | Szanda | Patkányos-prairie | -1 | 13 | 0 | 3 | 0 | 0 | 0 | 3 | 23,08 | 678073,95 | 283594,22 | 47,89542 | 19,42288 |
| Q-30 | Vanyarc | Szlovácka-dolina (surface collection) | 1 | 1 600 | 4 | 15 | 3 | 0 | 0 | 22 | 1,38 | 679169,73 | 276210,99 | 47,82897 | 19,43704 |
| Q-10 | Hont | Csitár | 1 | 1 581 | 3 | 15 | 14 | 3 | 0 | 35 | 2,21 | 648058,00 | 299633,00 | 48,04027 | 19,02140 |
| Q-30 | Vanyarc | Szlovácka-dolina (excavated assemblage) | 1 | 1 368 | 0 | 11 | 0 | 0 | 1 | 12 | 0,88 | 679169,73 | 276210,99 | 47,82897 | 19,43704 |
| Q-26 | Szécsénke | Kis-Ferenc-hill | 1 | 1 084 | 3 | 6 | 0 | 0 | 0 | 9 | 0,83 | 672162,56 | 282817,48 | 47,88867 | 19,34378 |
| Q-9 | Galgagyörk | Csonkás-hill | 1 | 964 | 0 | 1 | 0 | 0 | 0 | 1 | 0,10 | 675877,00 | 264846,00 | 47,72690 | 19,39239 |
| Q-7 | Erdőtarcsa | Daróci-hill | 1 | 601 | 0 | 3 | 4 | 1 | 0 | 8 | 1,33 | 684417,48 | 269622,93 | 47,76947 | 19,50661 |
| Q-31 | Vanyarc | Tovi | 1 | 557 | 5 | 30 | 1 | 0 | 3 | 39 | 7,00 | 679624,00 | 275409,00 | 47,82174 | 19,44305 |
| Q-16 | Legénd | Káldy-farm 5 | 1 | 467 | 0 | 8 | 0 | 0 | 0 | 8 | 1,71 | 669402,03 | 282803,23 | 47,88863 | 19,30687 |
| Q-14 | Legénd | Káldy-farm 2 | 1 | 238 | 0 | 1 | 0 | 0 | 0 | 1 | 0,42 | 669055,00 | 283093,00 | 47,89124 | 19,30224 |
| Q-8 | Galgagyörk | Komárka | 1 | 169 | 0 | 1 | 0 | 0 | 0 | 1 | 0,59 | 675729,00 | 266473,00 | 47,74154 | 19,39051 |
| Q-15 | Legénd | Káldy-farm 3 | 1 | 149 | 0 | 3 | 0 | 0 | 0 | 3 | 2,01 | 669072,00 | 283281,00 | 47,89293 | 19,30248 |
| Q-17 | Legénd | Káldy-farm 6 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 1 | 33,33 | 669552,37 | 282676,90 | 47,88749 | 19,30888 |
| Q-1 | Bér | Szár-hill 1 and 2 | 2 | 2 138 | 1 | 9 | 3 | 0 | 1 | 14 | 0,65 | 685817,00 | 279771,00 | 47,86066 | 19,52611 |
| Q-5 | Buják | Szente 2 | 2 | 1 495 | 1 | 0 | 0 | 0 | 0 | 1 | 0,07 | 687702,47 | 283846,88 | 47,89721 | 19,55166 |
| Q-19 | Legénd | Rovnya 2 | 2 | 972 | 2 | 7 | 10 | 0 | 0 | 19 | 1,95 | 668419,24 | 284197,87 | 47,90120 | 19,29379 |
| Q-27 | Szécsénke | Visak 1 | 2 | 735 | 0 | 1 | 1 | 0 | 0 | 2 | 0,27 | 670776,00 | 285696,00 | 47,91460 | 19,32538 |
| Q-24 | Szécsénke | Berecz-side 3 | 2 | 633 | 0 | 18 | 6 | 0 | 1 | 25 | 3,95 | 671057,00 | 283692,00 | 47,89657 | 19,32904 |
| Q-11 | Kétbodony | Halyagos-hill | 2 | 459 | 0 | 1 | 0 | 0 | 0 | 1 | 0,22 | 668713,00 | 284766,00 | 47,90630 | 19,29774 |
| Q-3 | Bercel | Erdőben-vége 2 | 2 | 409 | 0 | 31 | 0 | 0 | 3 | 34 | 8,31 | 674984,98 | 282155,13 | 47,88261 | 19,38149 |
| Q-23 | Szécsénke | Berecz-side 2W | 2 | 262 | 0 | 5 | 4 | 0 | 0 | 9 | 3,44 | 671257,00 | 283526,00 | 47,89507 | 19,33171 |
| Q-28 | Szécsénke | Visak 2 | 2 | 195 | 0 | 0 | 3 | 0 | 1 | 4 | 2,05 | 670782,00 | 285522,00 | 47,91304 | 19,32545 |
| Q-22 | Szécsénke | Berecz-side 2E | 2 | 161 | 1 | 1 | 2 | 0 | 0 | 4 | 2,48 | 671318,00 | 283406,00 | 47,89399 | 19,33252 |
| Q-21 | Szécsénke | Berecz-side 1 | 2 | 122 | 0 | 3 | 3 | 0 | 0 | 6 | 4,92 | 671605,00 | 283128,00 | 47,89148 | 19,33634 |
| Q-29 | Szécsénke | Visak 3 | 2 | 57 | 0 | 1 | 0 | 0 | 0 | 1 | 1,75 | 670824,00 | 285393,00 | 47,91187 | 19,32601 |
| Q-2 | Bercel | Erdőben-vége 1 | 2 | 40 | 0 | 0 | 0 | 0 | 1 | 1 | 2,50 | 674992,00 | 282789,00 | 47,88831 | 19,38162 |
| Q-12 | Kisgéc | Fehér-hill | 2 | 33 | 0 | 3 | 3 | 0 | 1 | 7 | 21,21 | 688781,00 | 304947,00 | 48,08690 | 19,56796 |
| Q-25 | Szécsénke | Berecz-side 4 | 2 | 27 | 2 | 3 | 0 | 0 | 0 | 5 | 18,52 | 670463,00 | 283916,00 | 47,89860 | 19,32111 |
| Q-18 | Legénd | Rovnya 1 | 2 | 8 | 0 | 1 | 0 | 0 | 0 | 1 | 12,50 | 668006,35 | 284033,10 | 47,89973 | 19,28826 |
| Q-6 | Buják | Szente (stray find) | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 100,00 | 687580,40 | 283506,67 | 47,89416 | 19,54999 |
| Q-13 | Legénd | Hosszú-lands | 3 | 1 782 | 1 | 39 | 50 | 0 | 2 | 92 | 5,16 | 669896,00 | 280210,00 | 47,86529 | 19,31336 |
| Q-32 | Csővár | Arany-hill 5 | 4 | 1 327 | 1 | 17 | 7 | 0 | 3 | 28 | 2,11 | 670845,00 | 272977,00 | 47,80021 | 19,32570 |

d **Table 2..** Archaeological sites in the Cserhát Mountains sorted ascending according to their cultural classification and the size of the lithic assemblage (in descending order).

The enumeration of the attribute „Archaeological epoch" is the following: 1=Middle Palaeolithic, 2=Transitional and Early Upper Palaeolithic (sites with bifacial and leaf-shaped tools, inclusive leaf-points as well; Aurignacian tools are sometimes present), 3=Aurignacian, 4=Upper Palaeolithic/Late Upper Palaeolithic, -1=Uncertain cultural affiliation.

**2. táblázat:** Régészeti lelőhelyek a Cserhát hegységben a kulturális besorolás növekvő sorrendjében.

Az „Archaeological epoch" (régészeti korszak) mező jelentése: 1=Középső Paleolitikum, 2=Középső Paleolitkum-Felső Paleolitikum átmeneti és korai Felső Paleolitikum (lelőhelyek bifaciális és levéleszközökkel, a levélhegyeket is beleértve; Aurignacien eszközök néha jelen vannak), 3=Aurignacien, 4=Felső Paleolitikum, Késő Felső Paleolitikum, -1=Bizonytalan kulturális besorolás.

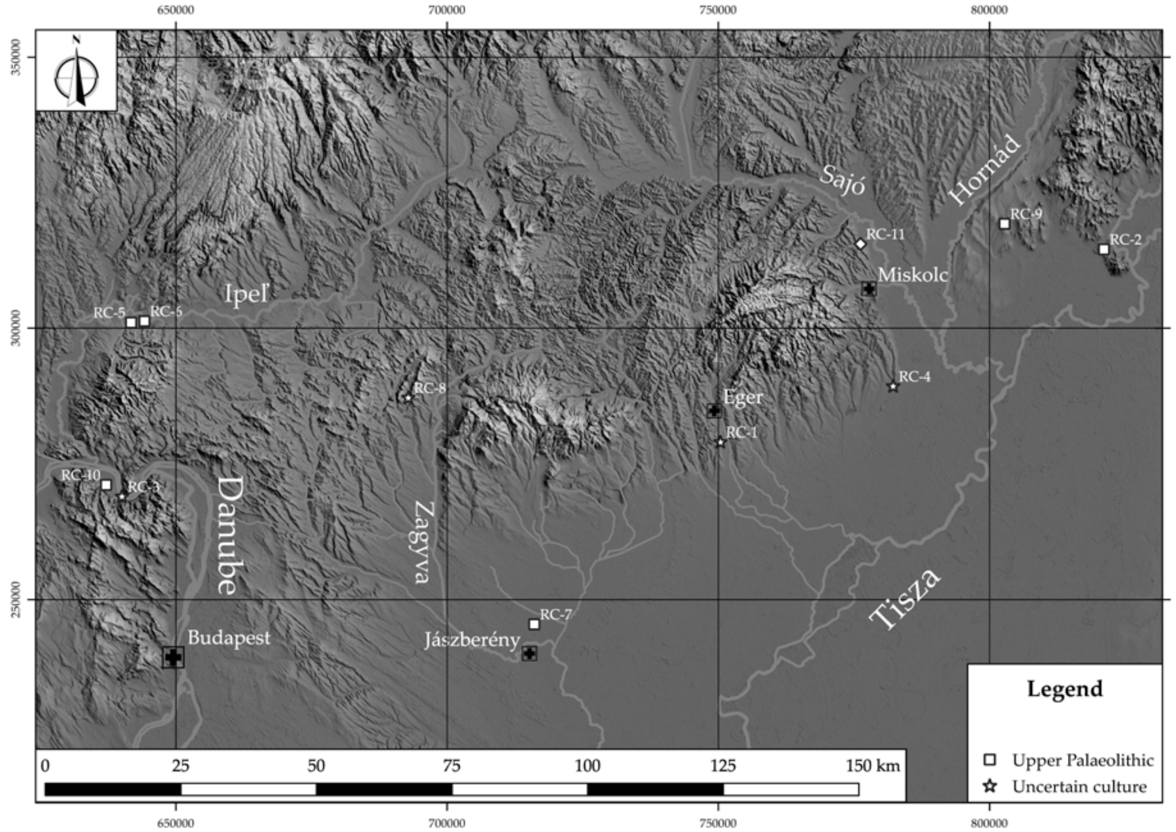

**Fig. 4.**: Hungarian archaeological sites with recorded rock crystal utilization classified according to cultural affiliation.

RC1=Andornaktálya-Alsó-hilltop, RC2=Bodrogkeresztúr-Henye, RC3=Dömös-Pattantyús, RC4=Emőd-Tehéntánc-lane, RC5=Hont-Ipoly-valley 1, RC6=Hont-Parassa III (Orgonás), RC7=Jászfelsőszentgyörgy-Székesdűlő, RC8=Kozárd-Fehér-side, RC9=Megyaszó-Szelestető, RC10=Pilismarót (Bánom, Bitóc, Pálrét, Tetves), RC11=Sajóbábony–Méhésztető.

**4. ábra:** Hegyi kristály felhasználás kulturális alapon osztályozott magyarországi régészeti lelőhelyeken.

RC1=Andornaktálya-Alsó-tető, RC2=Bodrogkeresztúr-Henye, RC3=Dömös-Pattantyús, RC4=Emőd-Tehéntánc-dűlő, RC5=Hont-Ipoly-völgy 1, RC6=Hont-Parassa III (Orgonás), RC7=Jászfelsőszentgyörgy-Székesdűlő, RC8=Kozárd-Fehér-oldal, RC9=Megyaszó-Szelestető, RC10=Pilismarót (Bánom, Bitóc, Pálrét, Tetves), RC11=Sajóbábony–Méhésztető.

The paper in preparation on some non-flint lithic raw materials contains a large number (107) of gravel beds as probable sources of pebble raw materials and archaeological sites (71) with recorded utilization of those non-flint raw materials (Péntek, in prep. 1). The reason for this abundance of evidence is firstly based on the fact that from a geological point of view this region of Northern Hungary is well researched (e.g. Noszky 1914, 1916, 1923, 1936, 1940; Peja 1937; Pávai-Vajna 1939-1940; Horusitzky 1942; Bogsch 1943; Szentes 1943; Láng 1967; Hámor 1985). Secondly, it is based likely on systematic field surveys.

In **Table 1,** the archaeological sites in the Cserhát Mountains are listed in the ascending alphabetical order of the settlement to which the site belongs administratively. The enumeration of the attribute „Archaeological epoch" is the following: 1=Middle Palaeolithic, 2=Transitional and Early Upper Palaeolithic (sites with bifacial and leaf-shaped tools, inclusive leaf-points as well; Aurignacian tools are sometimes present), 3=Aurignacian, 4=Upper Palaeolithic/Late Upper Palaeolithic, -1=Uncertain cultural affiliation. In **Table 2.**, the sites are sorted ascending according to their cultural classification and the size of the lithic assemblage (in descending order).

Concerning the 11 Middle Palaeolithic sites (at the site Vanyarc–Szlovácka-dolina, both the surface collection and the excavated assemblage contains quartzite artefacts), except for one site, the ratio of the quartzite artefacts in the assemblages is at most 2.21%. The exception is the site Vanyarc–Tovi (**Fig. 1.**, Q-31), where the ratio of quartzite is 7.00%, and among the 39 quartzite artefacts, there are five tools. Both from a technological and a typological point of view, the site belongs to the „Vanyarc-type" industry. That is why it is interesting enough that the eponymous site of the industry, at Vanyarc–Szlovácka-dolina the presence of quartzite is almost negligible.

Seventeen sites and lithic concentrations were classified as Transitional or Early Upper Palaeolithic. Among the sites with an assemblage size of some hundreds of artefacts, the highest quartzite ratio characterizes the Early Upper Palaeolithic site Bercel–Erdőben-vége 2 (**Fig. 1.**, Q-3; 8.31%). In the area of Szécsénke, almost all sites contain quartzite artefacts. At the four sites at the locality Szécsénke–Berecz-side (1, 2E, 2W, 3; **Fig. 1.**, Q-21–Q-24), the ratio of quartzite is between 2.48% and 4.92%. This ratio is somewhat higher than at the Middle Palaeolithic sites. Interestingly enough, at the sites Szécsénke–Visak (1, 2, 3; **Fig. 1.**, Q-27–Q-29), and Kétbodony–Halyagos-hill (**Fig. 1.**, Q-11), which have approximately the same technological and typological characteristics, the quartzite utilization is lower. If these sites belong to the same cultural entity or industry, these differences in quartzite utilization can be explained as stochastic, and the quartzite utilization (or in general, the utilization of pebble raw materials) in no way can be regarded as tradition. It is worth noting the two small lithic assemblages from the site Kisgéc–Fehér-hill (**Fig. 1.**, Q-12; 33 pcs.) and Szécsénke–Berecz-side 4 (**Fig. 1.** Q-25; 27 pcs.). The presence of quartzite is extraordinary high, 21.21% and 18.52% respectively. It should be emphasized the fact that the surface collections were not selective, as a general rule all artefacts were collected.

At the only Aurignacian site, the quartzite ratio is 5.16%. Comparing to other known Aurignacian assemblages in Hungary (e.g. the above-discussed Nagyréde 1 and 2 sites), it can be regarded as high.

And lastly, at the site Csővár–Arany-hill (**Fig. 1.**, Q-32), which has likely a Late Gravettian lithic assemblage, the ratio of quartzite utilization is 2.11%. Without having any comparison data, it cannot be evaluated. The evidence of the application of the bipolar technique is by all means remarkable.

To summarize very briefly, in the Cserhát Mountains during different Palaeolithic epochs, the quartzite utilization is well recorded. The quartzite - and in general the pebble raw material –utilization is always directly linked to nearby gravels. It is hardly expected that this fact would reflect only easy-going or opportunistic behaviour. At the same time, as it was mentioned above in connection with the Szécsénke–Berecz-side sites, the differences in the quartzite ratio (utilization index) are maybe random, and the quartzite utilization as such, cannot be regarded as a tradition.

It should be taken into consideration that in the Cserhát Mountains, most Palaeolithic sites are ephemeral sites, with very likely hunting functionality. If this is the case, sophisticated raw material procurement and utilization strategy are not to be expected.

The stone assemblages of the elder, classical sites with huge artefacts (Vértesszőlős (**Fig. 3.**, Q-17), Tata–Porhanyó-quarry (**Fig. 3.**, Q-15)) are partly unprocessed yet, so because of this understandable reason, the question of the quartzite artefacts could not come into view. It is true even for the large collection of the site Érd (**Fig. 3.**, Q-6), rich in artefacts, whereby only a small selected assemblage was processed. Nevertheless, in connection with this site, at least the fundamental technological analyses are forthcoming. These are essential to the analysis of any quartz or quartzite assemblage.

In the case of the Hungarian cave sites, because of the low number of the quartzite artefacts, this raw material was not given much importance. At the same time, in the cave site Diósgyőr–Tapolca cave (**Fig. 2.**, Q-9), the presence of some tools was not recognized among the artefacts. There is great uncertainty regarding the radiometric age, and excluding the site Érd, in the cultural affiliation of the quartzite artefacts. Unfortunately, the existence of the late Riss–Würm „quartzite horizon”, rendered by V. Gábori Csánk as probable, can neither be proved nor disproved. According to Á. Ringer, similarities to the Taubachian industry came to light at the site Diósgyőr–Tapolca cave, also from the 2nd layer of the Szeleta cave (**Fig. 2.**, Q-22) and the 3rd layer of the Büdöspest cave (**Fig. 2.**, Q-20) as well as from the Lambrecht Kálmán cave (**Fig. 2.**, Q-23). In the first two cases with such accompanying artefacts, which typologically can be compared mostly to the „typical Mousterian” industry of the lower layer of the Suba-lyuk cave (Ringer 2001, 81). However, this statement is in contradiction with the supposed dating of the Taubachian to the Emiliani 5d stage. Based on the candidate dissertation and the paper, dealing with the revision of the cave sites in the Bükk Mountains, of Zs. Mester, the references to the layers of the Szeleta and Büdöspest caves are inaccurate. Regarding the occurrences of the quartzite artefacts the Szeleta 2/b. and Büdöspest 8. 9. layers („F” stratigraphic unit) these references should be accepted as correct (Mester 1994, 2001).

Regarding the Hungarian open-air sites, except for the late Palaeolithic sites Mogyorósbánya–Újfalusi-hills (**Fig. 3.**, Q-9), and Szob–Ipolypart (**Fig. 3.**, Q-13) only minimal quartzite occurrence is observed in the assemblages that came to light from excavations. It seems that quartzite utilization mainly occurred on sites belonging to the „Pebble Gravettian” or „Ságvárian” industry.

For the time being, we do not have sufficient surface collected lithic material from the open-air sites Csővár–Arany- hill 5 (**Fig. 1.**, Q-32) (probably Late Gravettian) in the Galga Valley and Legénd–Hosszú-lands (**Fig. 1.**, Q-13) (Aurignacian) in the Western Cserhát Mountains, to be able to make conclusions regarding this question.

During field surveys or surface collections in the environment of Eger and the Bükk Mountains, primarily quartzite tools, elaborated quartzite artefacts were collected. The occurrence of quartzite artefacts during the processing of the assemblages, stemming either from excavations or from surface collections, did not gain much importance. The quartzite artefacts, neither from typological nor from a technological point of view, got any distinctive attention. In the below-described assemblages, the spectrum of the tools made from quartz or quartzite is relatively small. In the case of the rock crystal (macrocrystalline quartz, **Fig. 4.**), besides some burins and borers, an end-scraper of small dimensions can be found. The flakes and blades are generally unworked. Among the quartzite tools choppers, chopping-tools, cleavers, rough-and-ready elaborated side-scrapers and/or knives, denticulated and simple, unretouched (Clactonian-type) notched tools dominate, sometimes resembling Lower Palaeolithic character. End-scrapers occur in fairly small number mainly on the Eger–Kőporos-hilltop site (**Fig. 2.**, Q-10). The presence of many unworked quartzite flakes occurring in the assemblages of several sites can be explained by the fact that due to their resistance, the quartzite flakes are well suited for several functions even without further elaboration.

We can only hope that the issue of the above-discussed raw materials will take up their place in the future raw material researches.

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Supplementary material

## to the paper

# QUARTZ AND QUARTZITE AS LITHIC RAW MATERIALS IN THE HUNGARIAN PALAEOLITHIC (AM 2019//2 65-84)

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V. T. Dobosi and I. Gatter (1996) carried out the mineralogical investigation of the little archaeological collection of the Hungarian National Museum containing 14 rock crystal artefacts. The substantial advantage of fluid inclusion studies is that this method does not damage the investigated objects. The main goal of the investigation was to get information regarding the genetic conditions of mineral formation and thus indirectly of the possible source localities. The investigated artefacts are stemming from several archaeological assemblages of Palaeolithic sites. They were recovered partly from excavations, from authentic artefact-bearing layers, partly were found as stray finds. Most rock crystal artefacts can be related to the Upper Palaeolithic, more specifically to the elder and younger phyla of the Gravettian entity. The samples with fluid inclusions can be allocated most probably to "Alpine type" quartz veins, from the epithermal or mesothermal environment. In the immediate neighbourhood of Hungary, the potential geological source could be the Central or Eastern Alps.

After the publication of the above mentioned fundamental paper, some stray finds turned up and were also published; these will be listed in the following in their approximate chronological order.

In August 1988 within the framework of the cooperation between the University of Illinois at Urbana-Champaign and the University of Miskolc an excavation led by B. Adams and Á. Ringer was carried out at Sajóbábony–Méhésztető (Fig. 4, RC-11) at the eponym site of the Bábonyian industry. During the excavation, a rock crystal artefact came to light too (Adams 2000, 175). It should be noted that both the lithic assemblage from the surface collection and the excavation contains artefacts with pronounced Upper Palaeolithic, likely Aurignacian characteristics.

K. Zandler described a mesial fragment of a side-scraper with bifacially retouched straight working edge and a flake from the Andornaktálya–Alsó-hilltop site (Fig. 4., RC-1) (Zandler 2006, 41-42, 2012, 18-19). In the environment of Eger, this is the only known site where this rare but tractable raw material occurs. Unfortunately, the site cannot be identified. According to V. T. Dobosi, it can be identical to the site of Andornaktálya–Szukszer-hill (Fig. 2., Q-3) (Dobosi 2005, 61). This site has an Upper Palaeolithic (Aurignacian) surface lithic material (Zandler 2006, 22).

S. Béres described (Béres 2001) a small end-scraper made of rock crystal from the Upper Palaeolithic site Megyaszó–Szelestető (Fig. 4., RC-9), which belongs to the elder Gravettian entity containing some Aurignacian components. The radiocarbon date of the site is 27,070±680 BP (Dobosi 2000, 80). The basis of the end-scraper ("grattoir mince") of 20×24×8 mm dimensions was eliminated and the sharp fringe was retouched. The distal end was retouched in its whole width with a regular, fan-like retouch. At the right lower corner of the artefact the original crystalline surface can be seen, the wrinkle of which is perpendicular to the axis of the tool, so that the direction of the blank removals was parallel to the longitudinal axis of the crystal. As a probable source of the artefact, as in the case of the above-mentioned artefact of Sajóbábony–Méhésztető, V. T. Dobosi suggests (Dobosi 2009, 119) the sites Rousměrov and Bobrůvka in the Czech Republic, known from the paper of K. Valoch (Valoch 1989).

On the excavation in 1996 led by V. T. Dobosi and K. Simán at the Hont–Parassa III. (Orgonás) (Fig. 4., RC-6) Gravettian site, three rock crystal fragments came to light (Dobosi & Simán 2003, 27). The 14C radiocarbon analysis of the charcoal sample taken was carried out in Debrecen in the laboratory of ATOMKI. Based on this analysis, the age of the site is 27,350±610 BP. The assemblage of the site shows great typological similarity to the materials of the sites of Bodrogkeresztúr–Henye-hill and Megyaszó–Szeles-hilltop.

In May 2015, field surveys were carried out by A. Markó, K. Zandler, and the author, in the Ipoly Valley. At the site of Ipoly-völgy 1 (Fig. 4., RC-5), an unretouched rock crystal microblade was found. According to the typological characters of the other surface artefacts, the site can be attributed to the Late Gravettian entity.

Gy. Lengyel published (Lengyel 2001) a rock crystal flake stray find from Emőd–Tehéntánc-lane (Fig. 4., RC-4), which can be found in the collection of the Herman Ottó Museum in Miskolc. The Palaeolithic age of the plunging (“outrepassé”) flake is indicated by a short end-scraper found in the vicinity. The technological characteristics, described in detail by the author confirm this assumption.

In 2004, from the surface collection of the author of this paper, a burin of uncertain age got into the collection of the Hungarian National Museum. The artefacts stem from Kozárd–Fehér-oldal (Fig. 4., RC-8), from the eponym geological site of the Upper Miocene „Kozárd Formation” (Hámor 1985, 159, 1997). V. T. Dobosi determined the raw material of the artefact macroscopically as rock crystal. The artefact belonged to a small chipped stone assemblage. Among the artefacts, only one characteristic tool, a “rabot” (“grattoir épais”) can be emphasized, which is well known from the Palaeolithic (Demars & Laurent 1992, 48), but even the occurrence in the Neolithic cannot be excluded. The importance of the find is dual, on the one part till now there is no known Palaeolithic site in the vicinity, on the other part the occurrence of rock crystal as raw material is not documented in the Hungarian Neolithic (T. Biró 1998).

S. Béres in his paper dealing with the Palaeolithic of Dömös village, located on the right side of the Danube in the Danube Bend, mentioned a surface stray find, a large burin made of rock crystal from the vicinity of Dömös–Pattantyús site (Fig. 4., Q-3) (Béres 2011). In the paper there are neither details nor a drawing of the artefact, so the cultural affiliation cannot be ascertained. The Palaeolithic relation of the site is up to now unclarified, the field research aiming at the localization of the site was negative (Dobosi 2005, 66, 2006b). Unfortunately, according to the kind verbal reference of V. T. Dobosi, the raw material of the artefact is not rock crystal.

## Quartzite as a lithic raw material in the Hungarian Palaeolithic

Among the sites, foremost the classical sites will be described in the generally accepted chronological order, after which the assemblages of the caves and rock shelters will be introduced. In the end, the open-air sites will be discussed in the chronological order of the related relevant publications.

## Quartzite at the classical open-air Palaeolithic sites in Hungary

### Vértesszőlős (Fig. 3., Q-17)

The site is situated in the southern part of the Gerecse Mountains (Komárom-Esztergom County, Transdanubia). It was excavated between 1963 and 1968 with the leading of László Vértes; it is till now the single authentically excavated Lower Palaeolithic site in Hungary. The artefacts embedded partly in calcareous-tufa, partly in loess, came to light from an undisturbed settlement area. Based on the different natural scientific (faunistic, botanic) methods, the age of the site is dated in the period reaching from the Mindel interstadial of the second Central European glaciation to the end of this glaciation. Depending on the applied methods the radiometric chronology scatters within broad limits (Dobosi 2006a, 1). From the point of typological and technological characteristics of the huge assemblage the data published by L. Vértes and V. T. Dobosi are relevant (Vértes 1990; Dobosi 1990a). The latter author also dealt with the spatial distribution of the artefacts within the site (Dobosi 1990b).

Regarding the percental ratio of the quartzite the precise details are not known, but either way, it was the dominant raw material. The majority of some 8,890 diagnostic pieces were made of quartzite pebbles which likely originate from the allochthonous terraces of the Által-ér streamlet. The main characteristics of the Vértesszőlős industry are that all the tools were made of pebbles and nearly all tool types are small-sized. The largest tool has a length of 40 mm; the average length of the tools is 24.03 mm.

Among the tools 5,819 artefacts are standardized (typical) and 3,071 are non-standardized (atypical). Among the manufactured tools, L. Vértes distinguished more than 80 tool types, including unretouched artefacts and fractured ones too. When L. Vértes described the different types, the only descriptive criteria were the existence of some morphological series. Following this logic, he inserted the non-standardized tools between the tools and the debitage. He considered possible the incidental technological debitage character of a part of these non-standardized tools. Among the defined tool types the choppers and chopping tools are dominant; their number comes out to 2,145 artefacts. The technological analysis of these tools was carried out by Sz. Szőke (Szőke 2004; Farkas-Szőke 2008). The chipped stone assemblage contains different side-scrapers, even the so-called „Tata side-scrapers” are known.

C. van Riet Lowe made the first attempt to make a systematic grouping of the pebble industries of Uganda. The classification system elaborated in relation with the Kafuan industry, contains the types of hemiliths (broadways, straight splitted pebbles), ortholiths (longways, straight splitted pebbles) and plagioliths (crossways, oblique splitted pebbles) (Tieu 1991, 16, Fig. 4). The work, published in 1952 formed the base of the descriptive system of L. Vértes (Vértes 1965). In the Tata assemblage, beside the above-mentioned types, pyramidal tools, halved and quartered pebbles, hemiliths, ortholiths and plagioliths also occur. Among the tools, the so-called proto-hand axes can also be found (Tieu 1991, 63).

Regarding the stone assemblage, L. Vértes made several technological observations which, even based on our recent terms and knowledge about bipolar-on-anvil technique, can still be considered relevant. His remarks proof unambiguously, that although due to the lack of technological knowledge he could not verify, he did suspect the existence of the bipolar-on-anvil technique (Vértes 1990, 534-535).

### Tata–Porhanyó-quarry (Fig. 3., Q-15)

The site is situated in the southern part of the Gerecse Mountains (Komárom-Esztergom County, Transdanubia). It was the first open-air Palaeolithic site excavated in Hungary, in 1909-1911 by Tivadar Kormos (Kormos 1912). Thereafter László Vértes excavated the site which resulted in a monograph of international recognition (Vértes 1964). The largest part (91.3%) of the 2,318 stone artefacts stemming from the excavation of L. Vértes is made of siliceous pebble; the smaller part (7.2%) was made of quartzite pebble, the remaining 1.4% of different other raw materials (Vértes 1964, 138).

In her paper published in 1983, V. T. Dobosi dealt in detail with the technological aspects and with the possible Hungarian and international relations of the so-called „Tata industry". The majority of her statements and conclusions are till now relevant. Regarding the raw material consumption of the site, she reevaluated the 2,431 artefacts stemming partly from the excavation of L. Vértes, partly from the heritage of I. Skoflek, and established a higher quartzite ratio of 12% (Dobosi 1983, 24).

The newest excavations were carried out by the leading of V. T. Dobosi and J. Cseh in 1995-2001. The details of these excavations were published by V. T. Dobosi (Dobosi 2003). In her paper, the author mentioned that the percental ratio between chert (siliceous pebble) and quartzite changes, the quartzite ratio of 7.2% given from L. Vértes in 1964 will be higher, as she wrote it already earlier. In her paper in 2008 J. Kisné Cseh mentioned only 25,590 inventoried artefacts (Kisné Cseh 2008,35), in the paper of V. T. Dobosi in 2013 the corresponding number is 47,242 artefacts (Dobosi 2013, 20).

The essential reason for this variance is the significant difference regarding the excavations of L. Vértes in 1959. In this paper the rise of the quartzite ratio is only briefly mentioned, exact numbers are not given. Based on the Th-230/U-234 analysis of the travertine layers, the approximate chronometric age of the site is about 116-70 ka. It corresponds to the two warm interstadials (Brørup és Odderade) in the early Weichsel glaciation correlating with the oxygen isotope substages (OIS) 5a-5c. Detailed technological analysis of a part of the Tata assemblage and review of the problematic of the so-called microlithic industries can be found in diverse papers of M.-H. Moncel (Moncel 2001a, 2001b, 2003, 2004). Based on its technological characteristics and comparative studies of several microlithic industries from the OIS 11 to 4-3, such as Vértesszőlős in Hungary, Kůlna and Predmosti II in the Czech Republic or the Pontinian complex in Italy, the assemblage seems to belong to a specific tradition (Moncel 2003, 117).

### Érd (Fig. 3., Q-6)

The site is situated in the Fundoklia Valley of the village Érd (Pest County, Transdanubia). The excavation of this Middle Palaeolithic site was carried out by Veronika Gábori Csánk in 1963-1964. On the site, she could distinguish two culture-bearing layers. The upper layer could be subdivided into five occupation levels. This is a clear indication that different communities of the same cultural entity returned to the site several times. On every occupation level, there is a definitive quartzite industry, 76.2% of all the artefacts are made of quartzite. From the huge assemblage, containing some thousands of artefacts, only 808 selected tools were studied thoroughly. Three-quarters of them were made of quartzite, but the most finely elaborated tools were made of raw materials of better quality (Gábori Csánk 1967, 1968, 1984). Foremost V. Gábori Csánk dealt with the technological analysis of the tool production, which resembles the characteristic pebble-slicing method of the so-called „Pontiniano-Moustérian/Pontiniano-Charentian" industry. In her opinion, the industry of the site belongs to a cultural complex of a large range, to the „La Quina type Moustérian (Charentian)" or „South-East European Charentian" facies. As possible parallelism to the industry of Érd, besides the classical Italian Pontiniano sites, she mentioned first of all the assemblages of the Krapina cave and of the lower layer of the Veternica cave in Croatia, the C layer of the Betalov spodmol cave and the „quartzite Palaeolithic" of the lowermost layer in the Špehovka cave in Slovenia (Brodar 1938; Malez 1958). Among the sites, belonging to the so-called „Alpine Mousterian", she referred to the quartzite assemblages of the well-known cave sites in Austria, the Repolust-Höhle, the Drachenhöhle-bei-Mixnitz and the Badl-Höhle. She found it conceivable that there was a cultural connection between the Mousterian industry of the Southern Alps and the industries of Pontiniano technique (Gábori Csánk 1971, 39).

M. Mottl in her paper dealing in detail with the „Alpine Palaeolithic" as well as some other authors brought the quartzite assemblages of the Drachenhöhle bei Mixnitz and the Badl-Höhle in connection with the „Olschewian" (Central European Aurignacian II.) (Mottl 1975, 36). In the archaeological assemblage of the Repolust-Höhle, containing 1,700 chipped stone artefacts, 62% of the artefacts were made of quartz and quartzite. M. Mottl determined the assemblage as a typical flake industry belonging to the Western European Clactonian-Tayacian complex and the „Alpine Palaeolithic" (Mottl 1951, 1975). Based on several posterior studies, the industry is a specific undefinable Middle Palaeolithic industry (Brandl et al. 2011).

The fundamental technological analyses of the assemblages of Érd were attached to Zs. Mester and Marie-Hélène Moncel (Mester 2004, 2012; Mester & Moncel 2006). Based on technological investigations of 23 exhausted quartzite cores three basic debitage methods were determined: discoid debitage with bifacial modality (with two knapping surfaces), discoid debitage with unifacial modality (with one knapping surface) and lastly Quina debitage. Despite these facts, it cannot be excluded that besides the freehand knapping the bipolar-on-anvil technique was also applied. However, the excavation brought no anvils to light.

According to V. Gábori Csánk the 14C radiocarbon date of 44,300±1400 (GrN 4444), gained from a charcoal sample stemming from the „e" occupation level of the upper layer is in accordance with the geochronological situation (Gábori Csánk 1970, 6; Vogel-Waterbolk 1967, 119). Very similar 14C radiocarbon dates have been yielded from some Western European Charentian sites, for example for the two late Mousterian layers of La Quina 35,250±530 (GrN-2526), which lies directly above the „Charentian" layer (Vogel-Waterbolk 1967, 119) and for some Eastern European Moustérian sites, such as Molodova I > 44,000 (GrN-3659.), and Molodova V > 40,000 (GrN-4017.) (Gábori Csánk 1970, 6; Vogel-Waterbolk 1967, 119).

### Use of quartzite in cave sites and rock shelters

In the archaeological assemblages of caves and rock shelters discussed in the standard monography of L. Vértes (1965), there are only limited data regarding quartzite artefacts. The author had given the sites in alphabetic order as follows below. Büdöspest cave (Fig. 2., Q-20): five artefacts, Jankovich cave (Fig. 3., Q-1): two artefacts, Lambrecht Kálmán cave (Fig. 2., Q-23): seven artefacts, Puskaporos rock shelter (or Puskaporosi cave, recently known as Herman Ottó cave.) (Fig. 2, Q-21): two artefacts (The occurrence of two flakes was mentioned by P. Szolyák in his paper dealing with the Upper Palaeolithic cores of the cave (Szolyák 2008-2009, 236)), Subalyuk cave (Fig. 2., Q-19): three artefacts, Szeleta cave (Fig. 2., Q-22): three artefacts (Vértes1965, 276-346).

Excluding the Jankovich cave (Gerecse Mountains, Transdanubia), all other cave sites are located in the Bükk Mountains (North East Hungary).

### Lambrecht Kálmán cave (Fig. 2., Q-23)

In 1953, an excavation was carried out by L. Vértes and with the collaboration of Dénes Jánossy palaeontologist in the cave (Vértes 1959). The small excavated lithic assemblage contains eight artefacts, among them four artefacts, which were made of quartzite. The first quartzite artefact is a formless tool, delimited by fairly sharp breakage lines; its function is uncertain. It can be considered mostly as a high end-scraper. The working edge shows insecure splintering traces. The tool was made of greasy, having unctuous lustre, translucent white quartzite. The dimensions are 65.7×29 mm. The second quartzite artefact has an irregular triangular shape. On the thick base, there are the remains of the original pebble cortex. Both the dorsal and the ventral face are irregularly embossed; both edges are zigzaggy, meeting at a well enough defined point. The raw material is white, opaque quartzite. The dimensions are 45.7×52.5 mm. The third artefact was regarded as side-scraper, with a regular equilateral triangular shape. Its base is the slightly curved pebble surface. The left lateral side edge is blunt. The right lateral side edge is the actual scraper edge. The raw material is coarse-grained, yellowish-white quartzite. The dimensions are 63×72 mm. The fourth artefact is a flake of quadrangular shape. Its raw material is white, greasy quartzite. L. Vértes made a well-founded comparison with several lithic assemblages, mostly belonging to a "quartzite Mousterian" industry. Concerning the quartzite flakes found in the Lambrecht Kálmán cave, L. Vértes noted, that they are all atypical, made by Clactonian technique (Vértes 1965, 315).

M. Gábori (1960) dealt with the quartzite artefacts of the Lambrecht Kálmán cave, which he regarded as an industry of the cave Pre-Mousterian ("Prämoustérien"). On the bases of corresponsive palaeontological evidence and sedimentary analyses, he suggested a possible date of the industry to the Riss-Würm interglacial (Gábori 1960, 58).

### Kiskevély cave (Fig. 3., Q-4)

From the lower, the „Mousterian" layer of the Kiskevély cave (Pilis Mountains, Transdanubia) Vértes reported side-scrapers made of quartzite and siliceous pebble. In his opinion, these tools, together with the artefacts of the Szelim cave should be regarded as the same as of the Tata industry (Vértes 1965, 112). At the same time, in the part of the monography, dealing with the natural scientific and archaeological data of the cave sites, one can find only the following information about the cave: „elaborated flakes, made mainly of pebbles … 60 (pcs. PA)". In the enumeration of the several tools, he did not refer to the quartzite raw material (Vértes 1965, 313). V. Gábor

Csánk in the appendix of her doctoral thesis dealing with the Jankovichian industry described the archaeological assemblage of the „Mousterian" layer of the cave. In this layer, besides the numerous quartzite flakes, a simple side-scraper with a curved working edge made of quartzite occurs as well (Accession number: 70-51-24) (Gábori Csánk 1986, Table XI.:11). In her opinion, the rough-and-ready elaborated artefacts made of quartzite pebbles of this layer are near to the industry of the lower layer of Érd.

**Büdöspest cave (Fig. 2., Q-20)**

In his candidate (PhD degree) dissertation, Zs. Mester made some important statements concerning the archaeological assemblage of the cave (Mester 1994, 75-76. and Table XV.). He described the occurrence of three tools made of quartzite, a massive, triangular, pic-like, pointed flake with triangular cross-section (Accession number: Pb/961 9/V., it was inventoried as inverse chopper), a side-scraper with finely elaborated curved working edge made on an elongated pebble-slice (Pb/962 12/V), furthermore a fragment of the point of a perfect, classical biface (Pb/1066 12/V.). The assemblage of the lowermost layer, the F stratigraphic unit is composed dominantly of quartzite flakes (Mester 1994, Fig. 3.2.2.5), there are numerous artefacts of small or middle-sized dimensions. This fact refers to significant tool production. For the F stratigraphic unit containing 145 artefacts, a quartzite ratio > 40% had given. The same fact was mentioned by Zs. Mester in his paper dealing with the revision of the Palaeolithic sites of the Bükk Mountains (Mester 2001, 30). Here the author strengthens again the markedly high percental ratio of the quartzite raw material in the lowermost stratigraphical unit. He refers to the existence of similar stone assemblages in a 2/b layer of the Szeleta Cave (Mester1994, 83) and the 5th layer of the Lambrecht-Kálmán cave (Vértes 1953). At the same time V. Gábori Csánk mentioned the existence of an old Middle Palaeolithic industry with quartzite tools in the lowermost layers of the Kiskevély and Szelim caves, and in this connection suggested the thought of the existence of an elder "quartzite horizon", datable to the late Riss/Würm (Gábori Csánk 1994, 87). Regarding the radiometric age of the Büdöspest cave, there is only one, uncertain 14C radiocarbon date gained on a charcoal sample> 37,000 (GXO 198) (Kretzoi & Vértes 1965: 138; Gábori Csánk 1970, 4).

**Diósgyőr-Tapolca cave (Fig. 2., Q-9)**

A. Saád carried out excavations in the cave in 1932-1934. On an area of 4 m$^2$ in the middle of the cave, he found waste products and tools in large quantities. The quartzite tools that came to light from the lower, brownish layer were interpreted by A. Saád to belong to the Szeletian industry, and he assumed the presence of the Mousterian industry too. The two layers of the cave, containing leaf-shaped points were associated by L. Vértes with the late, evolved phase of the Szeletian industry. The site was regarded as a workshop (Vértes 1965, 143-144) by him. He did not mention the quartzite tools found under the Szeletian layer, following the report on the excavations.

In 1973 a rescue excavation was carried out by M. Hellebrand with the contribution of A. Saád (Saád & Hellebrandt 1974). In the interior part of the cave, there were no undisturbed layers, so they opened up two trenches on both sides of the cave entrance. Quartzite artefacts came to light in both tranches, mainly from the lower layers. Besides some flakes showing traces of elaboration, and retouching, the assemblage also contains typical tools, side-scrapers, borers and burins. The layers excavated in 1973 belong in faunistic point of view to the Varbó and Subalyuk phase (the second half of the Riss-Würm interglacial), climatically they represent a cooler phase (Hellebrandt et al. 1976). The archaeological material of the II/5. layer was classified by the authors as belonging to the „Mousterian" in a wider sense, which is analogous to the „quartzite Mousterian" material brought to light from the Lambrecht Kálmán cave (Vértes 1959). That little assemblage, however, did not support technological or typological analyses. The quartzite Mousterian material of the I. and J. layers of the Veternica cave in Croatia may be regarded as a possible analogy to the industry as it contains quartzite tools that are from the typological and technological point of view similar to those of the Diósgyőr–Tapolca cave (Malez 1974).

The material of the II/5. layer was also compared to the material of Taubach–Ehringsdorf industry that belongs to the Eemian interglacial. The porphyrite tools are technologically most comparable to the Taubachian porphyrite tools (Hellebrandt et al. 1976, 33). Thereafter Á. Ringer excavated the cave in 1988. He opened up an area of 3.0×2.0 m to a depth of 4.5 m at a distance of 18 m from the entrance. He found loessy strata, which was articulated with buried open-air soils, well comparable with the filling of the cave. According to the expectations, the lowermost Taubachian layers were found at a depth of 4.1 m to-4.3 m. According to Á. Ringer the archaeological material belongs to the Taubachian industry, which chronologically corresponds to the Emiliani 5d stage (Recently generally accepted to be correlated to the MIS 5e stage (Moncel & Rivals 2011)) (Ringer 1993, 2001, 80). From the technological point of view the industry is similar to the Taubachian industry of the 11th layer of the Kůlna cave (Valoch 1995; Moncel & Neruda 2000) and to the materials of the Slovakian sites Gánovce, Bojnice and Hôrka–Ondrej (Valoch 1984; Bánesz 1991; Kaminská et al. 1993). During the analysis of the complete assemblage of the cave, Á. Ringer and M.-H. Moncel described in detail the Taubachian character of the assemblage (Ringer & Moncel 2002, 2003). The lithic raw materials included "hyalin quartz and quartz-quartzite" (Ringer & Moncel 2003, 162), a part of those artefacts are tools made on a flake (Ringer & Moncel 2003, 163. Table 2.). The quartz and quartzite flakes covered by cortex indicate stone knapping on the spot.

It should be noted, however, that the terms used by authors are inaccurate, and cannot be interpreted unambiguously.

### Szeleta cave (Fig. 2., Q-22)

In his candidate (PhD degree) dissertation Zs. Mester mentioned nine white quartzite flakes (five with original pebble cortex) among the artefacts of the upper clastic layer of the dark-brown strata. Based on the flakes brought to light in the upper layer (2/b.), the industry could not be defined, but it resembles the industry of the lower layer at the Büdöspest cave. The composition of the industry of the 5th layer of the Lambrecht-Kálmán cave is also similar: five quartzite flakes, two felsitic porphyry flakes and a hornstone flake (Vértes 1953). Following V. Gábori Csánk, the author also mentioned the possible existence of a „quartzite horizon" in Transdanubia (Mester 1994, 84).

### Szelim cave (Fig. 3., Q-16)

The cave is situated on the Kő-hill near Tatabánya (Komárom-Esztergom County, Transdanubia). The excavation of the cave had started in 1932 by the palaeontologist I. Gaál, and after the initial successes, had continued by him in 1934. Despite numerous publications, the archaeological material was not studied systematically. At the end of the 1950s, L. Vértes analysed the stone assemblage of the cave and the results were published (Vértes 1958). In his opinion, the excavation of the cave was not professional, and therefore some artefacts were lost during the excavations, the assignment of the remaining artefacts to the layers is problematic. From the D layer, two shapeless quartzite fragments were mentioned. In the material of the E layer, there are several hundreds of quartzite flakes, partly unworked, partly transformed into tools. Among the artefacts, there is a narrow, elongated blade (Vértes 1958, 10. and Taf. I. Fig. 1.), and there are also typical tools, mainly side-scrapers. Two of the latter were described in detail and their drawings were published too (Vértes 1958, 10. and Taf. I. Fig. 4-5.). L. Vértes regarded the industry as Middle Palaeolithic and brought it concerning the so-called „Alpine Palaeolithic" (Or otherwise „Alpine Mousterian", „Pebble-Mousterian"). As possible parallelism of Érd, the quartzite assemblages of the cave sites in the Austrian Alps (Repolust, Mixnitz) were also discussed by V. Gábori Csánk (Gábori Csánk 1971, 39).

In his paper dealing with the Mousterian industries of Hungary, L. Vértes discussed the artefacts of the Szelim cave again and the drawings of two artefacts, a blade („primitive Handspitze") and a side-scraper („Spaltenschaber"), were published (Vértes 1959, 36., Abb. 2, Fig. 1., Abb. 2, Fig, 3.).

In his standard monography, L. Vértes mentioned again the presence of two quartzite fragments from the D layer of the cave, and many quartzite fragments and pebbles, choppers and chopping-tools from the material of the layer, assigned as E5 (Vértes 1965, 346). In relation with the E1 layer he did not mention quartzite tools, but a part of the listed side-scrapers certainly refers to the artefacts published in 1958, however this time without the denomination of the raw material. According to L. Vértes, concerning their elaboration and raw material, these tools completely correspond to the tools of Tata (Vértes 1965, 110-111). In her monography, V. Gábori Csánk mentioned significant similarities between the assemblage of this site and that of Érd (Gábori Csánk 1968, 250-251).

In her doctoral thesis dealing with the Jankovichian industry, V. Gábori Csánk describes an old, pebble/quartzite Mousterian industry from the E strata of the Szelim cave, mostly from the E5 layer, which corresponds partly to the material of Érd and partly that of Tata. In the appendix, in the description of the material of the E layer, there are two massive backed knives (couteau â dos), one side-scraper with Érd and Tata character, a side-scraper with a straight working edge and some flakes. Several flakes are mentioned with E1 layer designation (Gábori Csánk 1986).

The absolute age of the cave is not known; the leaf-shaped side-scraper or a bifacial Volgograd-knife (Königsaue-knife) (Gábori Csánk 1986) found probably in the B2 layer, listed in the Transdanubian Szeletian or Jankovichian industry (Vértes 1965, 159; Gábori Csánk 1984, 18) could be a terminus ante quem in this relation.

## Quartzite as a raw material in the assemblages of some Hungarian open-air sites

### The Bükk Mountains (Borsod-Abaúj-Zemplén County)

K. Zandler and S. Béres performed the revision of the archaeological assemblages of three open-air Palaeolithic sites located in the Bükk Mountains (Zandler & Béres 2011). In connection with the finds collected by J. Korek at the site, Csokvaomány-Határ-hilltop (Fig. 2., Q-5) L. Vértes mentioned quartzite tools, among others also a

„rostro-carinated" tool. This uncommon term designates objects that are both beaked (rostrate) and keeled (carinate). This tool type occurs in the assemblage of Vértesszőlős (Dobosi 2013) and also in the Tata assemblage (personal notification of A. Markó).

L. Vértes qualified the quartzite tools as finely worked. Unfortunately, in the collection of the Hungarian National Museum at the time being only the finds stemming from the field survey of L. Vértes in 1952 can be found. In the collection from the I. terrace, there is a quartzite blade and two flakes, a quartzite flake and a waste piece stem from the II. terrace, and two quartzite flakes and a chunk stem from the III. terrace. In these assemblages, no quartzite tools can be found. According to the authors of the paper the common characteristic of the assemblages that both Middle Palaeolithic and Upper Paleolithic types are present. The bifacially worked leaf-shaped tools which are asymmetric to the longitudinal axe, with rounded or obliquely truncated basis are typical forms characteristic to the Micoquian industry, which occur on Bábonyian sites both in the Bükk Mountains and the Cserhát Mountains (Ringer 1982; Markó & Péntek 2003-2004). Among the Upper Palaeolithic tool types carinated and nosed end-scrapers, Aurignacian blades, other worked or unworked blades can be found, which also occur in the material of different Szeletian sites.

**The Sajó Valley and Bodrog Valley (Borsod-Abaúj-Zemplén County)**

In 2001, Á. Ringer and Zs. Holló published the results of rescue excavations at Sajószentpéter– Margit-kapu-lane (Fig. 2., Q-18), near Miskolc, which was carried out in 1990-1993 (Ringer & Holló 2001). During the excavations, several artefacts came to light from five vertical layers that have Upper Palaeolithic, Middle to Upper Palaeolithic transitional and Middle Palaeolithic character. The material of the Gravettian settlement, found in a depth of 0.6-0.8 m under the recent surface turned out to be the richest. According to the authors, based on the preliminary analysis of the artefacts, the Palaeolithic industry laying in the greyish forest soil, parallelable to the Arcy-Stillfried B interstadial (ca. 32,200–28,300 BP), belongs to the Pavlovian, prevalent in Central and Eastern Europe. Two finds can be considered as significant: a blunted blade made of felsitic porphyry and a characteristically elaborated Gravettian-point. Based on these finds Á. Ringer correlates the first and second layers of the site with the 4th to 6th layers of the Szeleta cave („evolved Szeletian"). He suggests also that in the 1. layer an industry was found which is identical to the Gravettian industry of the Arcy-Stillfried B palaeosoil laying beneath. In their Table 1, reviewing on the raw material utilization of the archaeological material containing 320 artefacts, there are 21 flakes made of quartzite listed, with a percental ratio of 6.56% (Ringer & Holló 2001, 64).

In 1988, Á. Ringer collected stray finds and thereafter excavated the Miskolc–Rózsás-hill site (Fig. 2., Q-14). The surface collection contains 441 chipped stone artefacts, whereas the excavation resulted in 60 artefacts. In 2001 another excavation was carried out, which yielded further 173 artefacts. In the publication of the archaeological material, in Table 2, discussing the raw material distribution, quartzite raw material is mentioned from both the excavation and the surface stray finds. In the table, there are 28 quartzite artefacts listed from the excavation assemblage containing 222 artefacts, and 17 artefacts from the surface collection of stray finds, containing 368 artefacts. There is no information about the character of the quartzite artefacts. However, there is a reference to the fact, that during the free-hand knapping quartzite hammer-stones were applied. Based on typological and technological considerations, the authors listed the archaeological material of the site into the Late Glacial period, during which period Magdalenian-Epimagdalenian and Gravettian-Epigravettian industries were present in Hungary (Ringer & Lengyel 2001).

In her paper dealing with the Palaeolithic of the Bodrog river valley, V. T. Dobosi mentioned the Palaeolithic finds derived from field surveys of L. Vértes in 1963 in the environment of Tarcal-Bodrogkeresztúr near the Tokaj Mountains (Northeast Hungary). Among these artefacts there is a surface stray find from the vicinity of the benchmark of Bodrogkeresztúr–Kavicsbánya-lane (Fig. 3., Q-3).: it is a weakly elaborated flat flake of 42×34×9 mm dimensions made of fine-grained quartzite. Between Bodrogkeresztúr–Kavicsbánya-lane and Bodrogkeresztúr–Dereszla localities (Fig. 3., Q-2)., there was another stray find, with an atypical chopper-like elaboration on a splitted quartzite pebble of 36×24×10 mm dimensions (Dobosi 1974, 24). The age and the cultural affiliation of the stray finds are unknown.

In the raw material distribution of the assemblage that came to light during the corroborant excavation in 1970 at the site Tarcal–Citrom-quarry (Fig. 3., Q-14)., the quartzite artefacts were referred in the „others" raw material category. In the description of the tools, there is an artefact with N° 6. serial number, which is a double side-scraper, a pointed "gigantolith" tool, the edges elaborated with abrupt chopper-retouch are curved, at the point, there is bifacial elaboration. Its raw material is fine-grained quartz; its dimensions are 122×75×54 mm (Dobosi 1974, 12). The description of the reconstruction of the tool production was reviewed in connection with the technological observations regarding the chipped stone assemblage (Dobosi 1974, 19. ff.). By all means, it is necessary to emphasize that this reconstruction of tool production should be regarded anyway as the very first refitting study in Hungary.

A. Markó, based on technological consequences deducted from refitting exercises, processed the stone assemblage, containing 410 artefacts, of the Upper Palaeolithic site Tarcal–Citrom-quarry (Fig. 3., Q-14). (Markó 2011c). The site is located on the Fekete-hill, situated on the western side of the Kopasz-hill (Tokaj Mountains). During the corroborant excavation carried out by V. T. Dobosi in 1970, a relatively small stone assemblage came to light. Based on Table 1, concerning the raw material types of the site, 11 quartzite artefacts came to light (2.68%) during the excavation from the flake concentration III. of the segment A. In Table 2, containing the refit groups performed by A. Markó, there is an entry with the serial number 12, flake concentration III (Accession number: Pb. 71/103 ), which is characterized by „8 removals of flakes (flaking), transversal fragment" (Markó 2011c, 85, Table 2.). It is the most important refit group, supplying the most information, which came to light as a closed assemblage during the excavation. According to the author, the detachment served for the shaping of a pre-core. The initial piece might have been an oval, loaf of bread like, coarse-grained quartzite pebble, which is characterized by the presence of quartz veins and breakage surfaces. This very characteristic raw material occurs only in this artefact concentration. Based on the refittings, it was concluded, that some detachments are missing from the excavated material.

In the series of the deducted consequences, made partly based on the refittings, important common characteristics and differing peculiarities were recognized concerning the relation of the assemblages of the sites Tarcal and Szob-Ipoly-part. A common feature is the utilization of andesite and quartzite. At the same time, on the Tarcal site the shaping, the formation of the pre-cores alludes to a stoneworking technology demanding more planning. In the assemblage of Szob, the refit-series is longer. In one case, it was possible to reconstruct the whole processing of the core, from the decortication of the pebble to the abandonment of the core. At the same time, at Tarcal the refit groups containing only a few artefacts are characteristic, generally, there are no blades or flakes fittable to any core and in effect, there are few traces of the knapping on the spot.

### The surroundings of Eger (Heves County)

The investigation of the raw materials of stone tool production has a tradition of decades in the Hungarian Palaeolithic research. The paper of V. T. Dobosi published in 1978 can be regarded as the first significant milestone. Samples were taken from assemblages of open-air Palaeolithic and Mesolithic sites published earlier. The published paper summarizes and reviews the results of microscopic investigations of thin sections made from the taken samples (Dobosi 1978). The paper also describes the raw material distribution of 14 sites based on earlier publications.

Quartzite as raw material occurs at the following sites: Demjén–Hegyeskő-crag (Fig. 2/Q-6): 18 artefacts (7.5%) (Dobosi 1976), Demjén–Pünkösdtető (Fig. 2., Q-7): 10 artefacts (10.0%, Dobosi 1976), Eger–Kőporos-hilltop (Fig. 2., Q-10): 44 artefacts (Vértes 1951), Ostoros–Rácpa I and II (Fig. 2., Q-15, Q-16): 12 artefacts (9%, Dobosi 1972, 58), Sajóbábony (Fig. 2/Q-17): five artefacts. The numbers in brackets represent the percental ratios in the total assemblages.

The assemblages of the Demjén–Hegyeskő-crag, Eger–Kőporos-hilltop és Ostoros–Rácpa I and II sites were classified based on the standard monography of L. Vértes to the so-called "Eger-industry", a Mesolithic industry containing rough tools of large dimensions ("grobgerätiges Mesolithikum", Vértes 1954, 1965, 216-221).

On the Demjén–Pünkösdtető site, in the referenced paper under the name Demjén–Pünkösd-hill, a small sondage was opened up by V. T. Dobosi in 1975, but no culture-bearing layer was found.

However, on the near Demjén–Hegyeskő-crag site during a rescue excavation, a part of a Neolithic settlement was unearthed.

In the 1990s, V. T. Dobosi revised the material of the Eger–Kőporos-hilltop site and based on typology and raw material usage she correlated it mainly with the lower and upper culture-bearing layers of the Suba-lyuk cave and with the Bábonyian industry. In the revised material she did not mention quartz or quartzite. According to her observations, the leaf-points and side-scrapers are of Middle Palaeolithic character, but the high end-scrapers and nosed end-scrapers reflect some Aurignacian influence. She regarded the industry as a unified, homogeneous part of the Middle to Upper Palaeolithic transition (Dobosi 1995, 51-54).

Based on our recent knowledge, the interpretation and the cultural labelling of the above-mentioned sites is somewhat different: in the assemblages of the sites Eger–Kőporos-hilltop and Ostoros–Rácpa, Szeletian leaf-points and numerous Upper Palaeolithic, Aurignacian and/or Gravettian artefacts can be found along with the Middle Palaeolithic tools of Micoquian-Bábonyian character. Furthermore, Neolithic or Chalcolithic chipped stone artefacts occur in all assemblages. Nowadays these sites are rather interpreted to be heterogeneous than transitional.

Contrary to the usual character of Palaeolithic sites in the environment of Eger, the archaeological assemblage of the Andornaktálya–Zúgó-lane site (Fig. 2., Q-4) contained a large amount of obsidian and erratic flint artefacts.

To clarify the suggested connection with Polish archaeological sites and/or geological sources, excavations were carried out in the summer of 2002 and 2004 by the University of Miskolc and the Jagello University in Cracow, by the leading of Á. Ringer and Janusz K. Kozłowski. The lithic assemblage was analysed and published (Kozłowski-Mester 2003-2004). The raw materials from the site are quite variable. The raw materials were analysed macroscopically and set apart in ten different raw material groups. Among these, there is raw material, a very characteristic in the Palaeolithic of the southern foothill region of the Bükk Mountains. It is fine-grained and its colour is generally light grey or light brown, in the patinated state it is white. O. Kadić (Kadić 1938, 153) after the determination of A. Vendl called it quartz with chalcedony binder and regarded it as silicified sandstone. After the recent classification of K. T. Biró, this raw material will be called as Mátraháza-Felnémet type opal (also known as menilite or liver opal). The primary geological source is located on the Tó-hill near the settlement of Egerbakta. Among the so-called „other" raw materials, there are the quartz and quartzite also. In the assemblage of the site, there is a splintered piece (pièce esquillée) made of fine-grained quartzite (Kozłowski-Mester 2003-2004, 126 and Fig. 11:45). There is some uncertainty regarding the raw material of this artefact since the liver opal/menilite (Egerbakta type rock is also referred to as quartzite (Kozłowski-Mester 2003-2004, 120). It is also questionable whether the statements made in relation with the operational sequence (chaîne opératoire) of quartzite, refer to the raw material orthoquartzite or quartzite in the "other raw materials" group (Kozłowski-Mester 2003-2004, 118).

K. Zandler in his thesis dealing with the archaeological assemblages of the Palaeolithic sites in the vicinity of the town Eger reviews in much detail and partly refines the earlier published data (Zandler 2006). In Table XIX., comparing the raw materials of the sites with leaf-shaped tools, quartzite is mentioned in the lithic assemblages of the following sites:

1) Eger–Kőporos-hilltop (Fig. 2., Q-10) (14 artefacts, 0.63%): two hammer-stones, 55×51×39 mm (Accession number: Pb 48/204.) and (78)×61×35 mm (Accession number: Pb 48/303.); five quartzite flakes without elaboration; a raw material chunk (from the excavation of L. Vértes in 1948); two flakes (collected by F. Legányi in 1952 and 1954); a flake (in the collection of the Dobó István Museum in Eger with a dating of 1955. VIII.); a flake (with a date of 1957.07.08 in the Dobó István Museum in Eger); a side-scraper with curved working-edge, its left edge is retouched, on the dorsal face cortex can be observed, the butt is plain, hard hammer-stone was applied, the dimensions are 83×55×24 mm; a hammer-stone, both ends were used, 81×61×36 mm (from the collection of S. Béres).

2) Egerszalók–Kővágó-lane I. (Fig. 2., Q-11) (four artefacts, 0.64%): a retouched flake, its left edge is retouched, the butt is plain, it was detached with hard hammer-stone, 62×70×17 mm (from the surface collection of S. Béres Sándor and K. Zandler); a chopper, its dimensions are 42×32×20 mm; a broken hammer-stone, 111×71×50 mm (from the collection of S. Béres); a quartzite pebble chunk.

3) Ostoros–Rácpa I. (Hálás-hilltop) (Fig. 2., Q-15) (seven artefacts, 0.48%): a splintered piece, 34×33×9 mm; a hammer-stone, 75×58×37 mm (from the collection of S. Béres); three hammer-stones, 57×50×35 mm (Accession number: Pb 68/83.), 64x66x35 mm (Accession number: Pb 68/88.) and 67×51×38 mm (Accession number: Pb 68/89.); a quartzite flake.

4) Ostoros–Rácpa II. (Fig. 2., Q-16) (one artefact, 2.38%): bifacially worked knife with a straight natural back ("couteaux â dos naturel"), the edge is curved,76×43×23 mm (from the collection of S. Béres).

5) Csokvaomány–Határ-hilltop (Fig. 2., Q-5) (the surface collection of L. Vértes): eight quartzite flakes.

In the appendix further data regarding the occurrence of quartzite at sites without leaf-shaped tools can be found:

1) Andornaktálya–Gyilkos (Fig. 2., Q-1) (From the collection of S. Béres.): flake core, 48×73×60 mm; a quartzite flake.

2) Andornaktálya–Rózsa-hill (Fig. 2 Q-2) (District II. terület, collected by L. Fodor in 1967, partly in the collection of the Dobó István Museum in Eger.): four flakes without further elaboration; two hammer-stones.

3) Andornaktálya–Rózsa-hill (Fig. 2., Q-2) (From the field survey of V. T. Dobosi on 15.05.1973-): a quartzite flake.

4) Andornaktálya–Szukszer-hill (Fig. 2., Q-3) (Andornak I. B area, collected by L. Fodor in 1967.): two quartzite flakes.

5) Andornaktálya–Szukszer hill (Fig. 2., Q-3) (G-H area, collected by L. Fodor in 1967.): two quartzite flakes.

6) Andornaktálya–Szukszer hill (Fig. 2., Q-3) (Collected by L. Fodor in 1968.): a quartzite flake.

7) Demjén–Hegyeskő-crag III. (Fig. 1/Q-6) (From the excavation of V. T. Dobosi in June 1974.): two quartzite flakes.

8) Demjén–Pünkösd-hill (Fig. 2., Q-7) (From the excavation of V. T. Dobosi in 1973.): a hammer-stone, 52×37×27 mm. Accession number: Pb 74/89.; four flakes.

9) Demjén–Pünkösd-hill I. (Fig. 2., Q-7) (Stray find from the field survey of V. T. Dobosi on 05-6.06.1973.): a flake.

10) Demjén–Pünkösd-hill II. (Fig. 2., Q-7) (Stray finds from the field survey of V. T. Dobosi on 06.06.1973.): three quartzite flakes.

11) Demjén–Pünkösd-hill II. (Fig. 2., Q-7) (Stray find from the tranch A, from the field survey of V. T. Dobosi on 06.06.1973.): a quartzite flake.

12) Demjén–Pünkösd-hill II. (Fig. 2., Q-7) (Trench C, from the excavation of V. T. Dobosi in June 1973.): a quartzite flake.

13) Demjén–Pünkösd-hill (Fig. 2., Q-7) (Eger-Pünkösd-hill, from the collection of S. Béres.): a flake; a hammer-stone, 72x53x32 mm.

In the case of the sites Eger–Kőporos-hilltop, Ostoros–Rácpa (in the thesis of K. Zandler its name is Ostoros–Rácpa I. (Hálás-hilltop)) the given data are in slight contradiction to the somewhat higher number of quartzite artefacts published earlier (Vértes 1951; Dobosi 1972, 1978). Although it is not easy to explain the variances, it seems most likely, that the Mátraháza-Felnémet type opal (the geological source is Egerbakta – Baktai-lake), not occurring in the earlier publications at all (Felnémet type opal in the thesis of K. Zandler) are also referred to as quartzite. Due to its similar texture, it is easy to mistake this Mátraháza-Felnémet type opal for orthoquartzite. As-it was mentioned above, orthoquartzites have not undergone metamorphosis, it is composed of usually well-rounded quartz grains cemented by silica.

The chronological classification of the quartzite artefacts occurring on these sites with several Palaeolithic and even the Neolithic industries, cannot be ascertained. The frequently mentioned term „hammer-stone” is too ambiguous, not a culture-specific term at all, and their function is not clear, not interpreted.

K. Zandler in his thesis dealing with the archaeological assemblages of the Palaeolithic sites in the environment of the town Eger reviewed the Palaeolithic sites located at Egerszalók-Kővágó-lane (I and II) (Fig. 2., Q-11, Q-12) along with their research history (Zandler 2006). In the framework of the Polish-Hungarian research program, an excavation was carried out in 2006 at the site of Egerszalók-Kővágó-lane II. The main target of the excavation was to clarify with stratigraphical observations whether the surface material, showing the characteristics of various stone industries, produces a single homogeneous unit (Mester 2010, 41). In the archaeological material of the site, the quartzite plays an unimportant role (Kozłowski et al. 2009, 418). A core edge flake („éclat débordant”) made of fine-grained quartzite stems from the recurrent centripetal Levallois-debitage (Kozłowski et al. 2009, 418). Among the artefacts listed in the Szeletian industry, there is a partially bifacial elaborated pointed side-scraper („racloir convergent (ou pointe)”) made on a sub-triangular quartzite flake (Kozłowski et al. 2009, 437 and Planche 14, Fig. 2.).

In the framework of the above referenced Polish-Hungarian research program, an excavation was carried out in 2009 at Eger-Kőporos-hilltop (Fig. 2., Q-10). The main goal of the excavation was to try and solve the stratigraphical and chronological problems of the site (Mester 2010, 41). They wished to gain sedimentological and micromorphological data regarding the stratigraphy of the site, which was set up by L. Vértes, who excavated the site in 1948, and Á. Ringer who performed a rescue excavation in 2003 near to the site, on the slope above the vitric tuff mine (Mester 2010, 50).

Regarding quartzite as a lithic raw material, the publication presenting the site and the results of the excavation serve with some valuable information. In the Initial Upper Paleolithic assemblage with macroblades, there were 139 artefacts listed altogether: 12 cores, 49 blades and blade fragments, 21 blade-like flakes („éclats laminaires”), 49 retouched tools and 8 flakes. In this assemblage there is a flake-core with two knapping surfaces and posterolateral preparation („avec préparation postérolatérale”) (Kozłowski et al. 2012, 435), a steep retouched convex end-scraper with one retouched side-edge (Kozłowski et al. 2012, 437. and Planche 8, Fig. 2.), a simple end-scraper made on blade of middle-sized dimension, with convex, symmetric working edge (Kozłowski et al. 2012, 437. and Planche 8, Fig. 8.) and another piece with oblique working edge (Kozłowski et al. 2012, 439. and Planche 8, Fig. 15.). Furthermore, there is a simple end-scraper with retouched side-edge (Kozłowski et al. 2012, 439. and Planche 9, Fig. 7.). In the assemblages of the site belonging to other chronological horizons, there is no occurrence of quartzite.

### The Danube Bend (Komárom-Esztergom County)

Mogyorósbánya is one of the most important Upper Paleolithic sites in Hungary (Fig. 3., Q-9). Between 1984 and 2009 nine excavations were performed by the leading of V. T. Dobosi during which the till now biggest, continuous, undisturbed Upper Palaeolithic settlement surface was excavated. The surface area of the connected trenches reaches 400 m$^2$ The number of artefacts that came to light is approaching 7,000, out of which 8% are classifiable tools. Among the raw materials used in the 4,771 macroscopically analysed artefacts, the siliceous pebble is dominant (3,493 artefacts, 73%). Quite high is the quartzite ratio (325 artefacts, 7%), which is the second most frequent raw material. A rock crystal flake came also to light.

According to V. T. Dobosi, the material of the site belongs to the „Ságvárian" culture. Its main characteristic is the intensive usage of the pebble as raw material. The 14C radiocarbon age of the site is: Deb-1169: 19,930±300 and similarly Deb-9673: 19,000±250 (cal. 21,050–20 140) (Dobosi 2011).

The study of the archaeological material from the Upper Palaeolithic Szob site (Danube Bend) (Fig. 3., Q-13) was performed by A. Markó (Markó 2007b). On the site, discovered by A. J. Horváth, S. Gallus, the archaeologist of the Hungarian National Museum and M. Mottl, an assistant of the Hungarian Royal Geological Institute excavated in 1936. Among the artefacts that came to light from the „lower layer", there is a quartzite blade, flakes, chips and raw material chunks. Thereafter M. Gábori performed excavations on the site in 1962 and 1964-1965, but only preliminary reports were published regarding the stone assemblage. During the excavations altogether 554 stone artefacts came to light. The most frequent raw material is quartzite with 188 pieces (33.94%). Based on the refittings, some 15-20 cm long, oval or hemispheric (dome-shaped) pebbles were used. The largest technological category of artefacts is the flakes of small dimensions, flakes and raw material chunks, the only retouched artefact is a notched blade. Beside these artefacts four pebble-slices, a blade with natural back and a geometric fragment can be regarded as tools. The paper reviews also the raw material distribution (Markó 2007b, 16, Table 5.). Based on typological analyses, the author regards the site as the fourth occurrence of the so-called „Pebble Gravettian" or „Ságvárian" beside the other sites Ságvár, Madaras, Mogyorósbánya, and chronologically connects it to the upper layer of Ságvár. In the assemblage 31 refitting-groups, containing 136 artefacts were found by the author, which is 24.55% of the total material of 554 artefacts (Markó 2011b, 10 and 21-22, Table 1.). Among quartzite, there are 11 refitting groups (that is 35.48% of all refitting-groups), which contain 44 artefacts (32.35% of all refitted artefacts). These numbers correlate well with the occurrence of quartzite in the assemblage (33.94%). Among the quartzite refit groups, the refitting-scheme of a core made of an oval quartzite pebble with six refitted flakes (15. refitting-group) represents the classical pebble-slicing method (Markó 2011b, 15, Fig.4.).

# THE CHIPPED STONE TOOLS PRODUCTION ACTIVITY OF THE LATE NEOLITHIC LENGYEL CULTURE'S SOUTH-EASTERN TRANSDANUBIAN GROUP[•]

## A KÉSŐ NEOLITIKUS LENGYELI KULTÚRA DÉLKELET-DUNÁNTÚLI CSOPORTJÁNAK PATTINTOTT KŐESZKÖZKÉSZÍTŐ TEVÉKENYSÉGE

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## *Abstract*

*This article summarizes the dissertation which was defended in 2019. The basis of this doctoral thesis is the nearly 6200 pieces of chipped stone material from the site Alsónyék-Bátaszék, Hungary, and compares them with a similar quantity of lithic materials from the assemblages of the other published Late Neolithic sites from south-eastern Transdanubia. The first topic presented is a characterization of the local lithic raw materials usage in the different lithic assemblages. This has been assessed through field surveys to locate the primary raw material sources and reconstruct the method of the procurement activity. The second topic is an analysis of the stone tool making procedure and artefacts usage patterns. Upon this basis, a view at the entire chaîne opératoire of the lithic assemblages is taken focusing on the operational sequence of lithics production involving processes beginning from the finding of the original lithic raw material sources in their specific environmental setting, the selection of preparing and tool making procedure taking place within the settlement, and it lasts until it is deposited in the graves. This gives us a better understanding of the significance of the environmental surroundings, the knowledge of the raw material and the lithic procurement methods based on the raw material selection strategy of the particular communities, in this case the South-eastern Transdanubian Late Neolithic Lengyel culture. In the settlement, the technological system of the community, the possible activity zones and patterns of tool-use can be reconstructed by studying the lithic artefacts. In the case of those stone tools deposited in burials, a transformation from an average utilitarian/everyday stone tool into a definite symbol with in the burial context takes place, which can again be related back to the environmental surroundings ("the physical world").*

## *Kivonat*

*A cikk a 2019-ben megvédett doktori disszertációm összefoglalása. A doktori dolgozat alapját az Alsónyék-Bátaszék lelőhelyről előkerült közel 6200 darabos pattintott kőeszköz leletegyüttes képezi, amely eddig publikált délkelet-dunántúli késő neolitikus lelőhelyek közel azonos mennyiségű kőeszköz leletanyagával került összehasonlításra. A kőanyagokra elsősorban a helyi nyersanyag felhasználása jellemző, így a nyersanyagforrások felkutatása mellett, a begyűjtés módja jelenti az egyik elsődleges kutatási témát. Emellett a kőeszközkészítő tevékenység és az eszközhasználat képezte a vizsgálat tárgyát, – jelen esetben a délkelet-dunántúli késő újkőkori közösség – nyersanyag-kiválasztási stratégiáján keresztül a környezettel történő kapcsolat, a nyersanyagismeret és a kőzet beszerzésének módja ismerhető meg, a környezet-közösség relációjában. A településen belül a kőeszközkészítési tevékenység rekonstrukciójával a közösség technológiai rendszere, esetlegesen a tevékenységi zónák és a használati mód válik megismerhetővé. Amennyiben a sírba helyezték a kőeszközöket, fény derülhet arra, hogy válik az egyszerű használati/hétköznapi kőeszköz jelentésen túl a sír kontextusában egy határozott jellé, amely a környezetet szimbolizálja (a „fizikai" világot).*

KEYWORDS: KÉSŐ NEOLITIKUM, LENGYELI KULTÚRA, DÉLKELET-DUNÁNTÚL, PATTINTOTT KŐESZKÖZÖK, NYERSANYAGKUTATÁS, KŐESZKÖZKÉSZÍTŐ TEVÉKENYSÉG

KULCSSZAVAK: LATE NEOLITHIC, LENGYEL CULTURE, SOUTH-EASTERN TRANSDANUBIA, CHIPPED STONE TOOLS, RAW MATERIAL PROVENANCE ANALYSIS, STONE TOOLS PRODUCTION ACTIVITY

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## *Introduction: the aims of the dissertation summarized in this paper*

The Late Neolithic Lengyel culture can be localized in the territory of recent Hungary, Austria, Slovakia, the Czech Republic, Poland, Slovenia, and Croatia. Considering the enormous geographical extension of the culture, many regional sub-groups have been defined by the archaeological research of Hungary and the neighboring countries. The Lengyel culture was divided into several groups not only on a territorial basis but on a chronological basis also, which caused many terminological difficulties in the research (Bánffy 1991, 1994, 1995, 2007; Regenye 2000, 2011; Zalai-Gaál 1980, 1993; Raczky 1974, 1998, 2002).

The South-eastern Transdanubian group may be considered to be the most "classical" unit in the research of our country because Mór Wosinsky determined the Lengyel culture as an independent archaeological unit on the basis of the Neolithic settlement which was discovered on the border of the Lengyel settlement in Tolna county between 1882–1886. The next hallmark was János Dombay's excavation at Zengővárkony, followed by the publication of the site and the whole archaeological material, which shed a completely new light on how the culture was viewed (Dombay 1939, 1958, 1960). Later, István Zalai-Gaál, whose professional work in particular concentrated on the burial activities of this Late Neolithic community, was dealing with the South-eastern Transdanubian group of the Lengyel culture (Zalai-Gaál 1982, 1986, 1988). The site Mórágy–Tűzkődomb, excavated by István Zalai-Gaál, constituted a large impulse for the research of this culture, as the hundreds of burials found there provided a breakthrough not only in quantity but also concerning the quality of information (Zalai-Gaál 2002). In the 2000s, the large-scale archaeological excavations related to the highway construction also affected the territory of Southern-Transdanubia, which led to the discovery of the site Alsónyék-Bátaszék (Zalai-Gaál & Osztás 2009, 245)The excavation was made necessary by the motorway construction that initiated a large-scale surface investigation activity, opening the possibility to investigate an area of 25 hectares exhibiting one of the largest Neolithic sites in Central Europe (Serlegi et al. 2013, 5; Osztás et al. 2012, 377–378). Thanks to the large excavation area, a big number of buildings and burials could be added to what was known so far. This means that, in relation to the research history of the Lengyel culture, we are now able to open upa new dimension of empirical knowledge (Osztás et al. 2013a, Osztás et al. 2013b)(**Fig. 1**.).

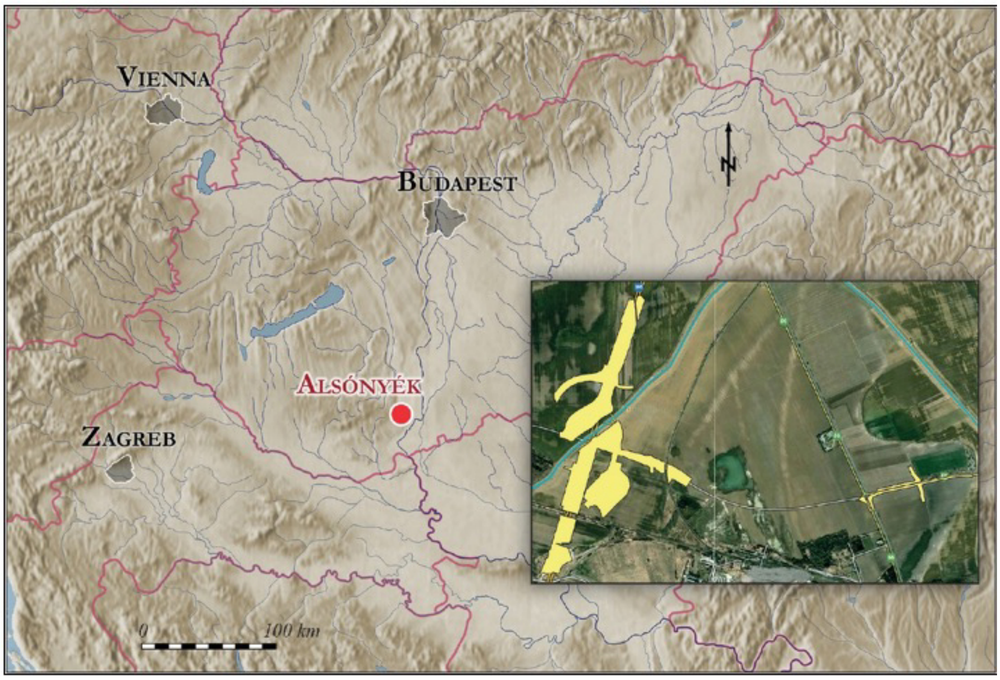

**Fig. 1.:** Location of the Alsónyék–Bátaszék site and outline plan of the excavation (Osztás et al., 2013a, 9, Fig. 1.).

**1. ábra:** Alsónyék–Bátaszék lelőhely elhelyezkedése és az ásatás átnézeti térképe (Osztás et al., 2013a, 9, Fig. 1.).

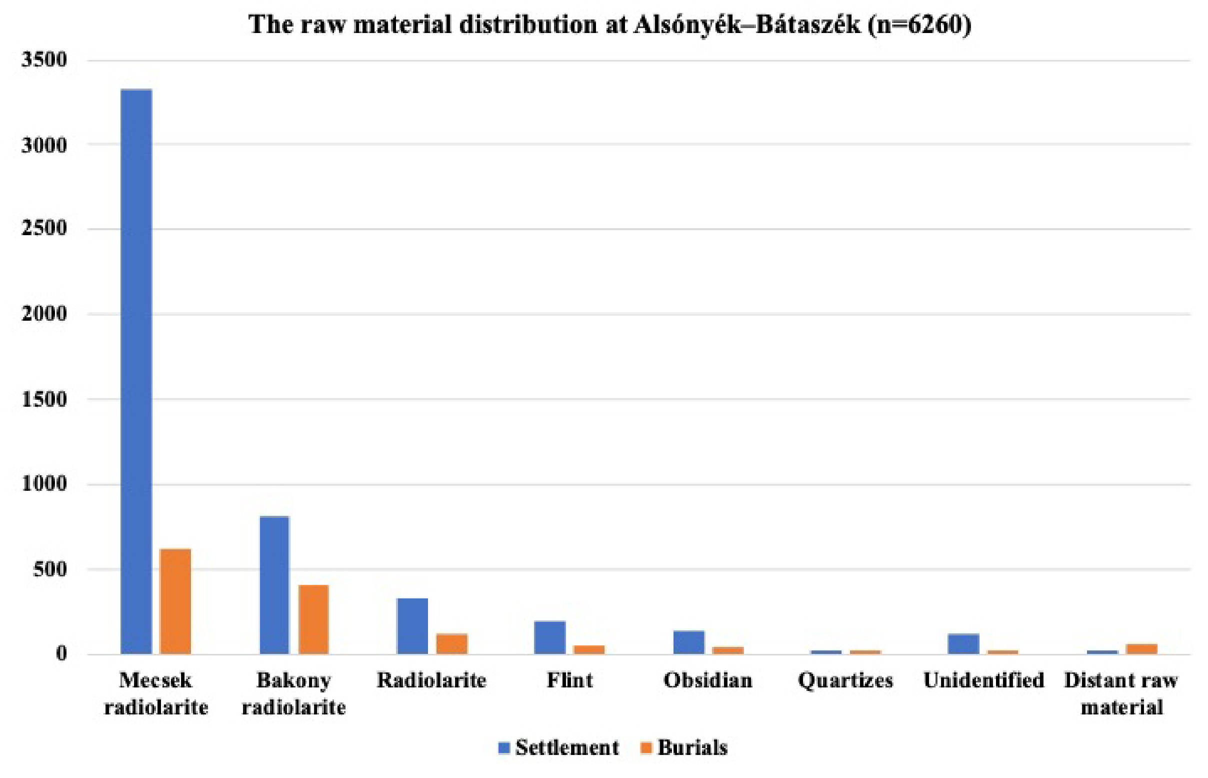

**Fig. 2.:** Raw material distribution in the settlement and burial's assemblages at Alsónyék-Bátaszék.

**2. ábra:** A nyersanyag megoszlása Alsónyék-Bátaszék település- és síranyagában.

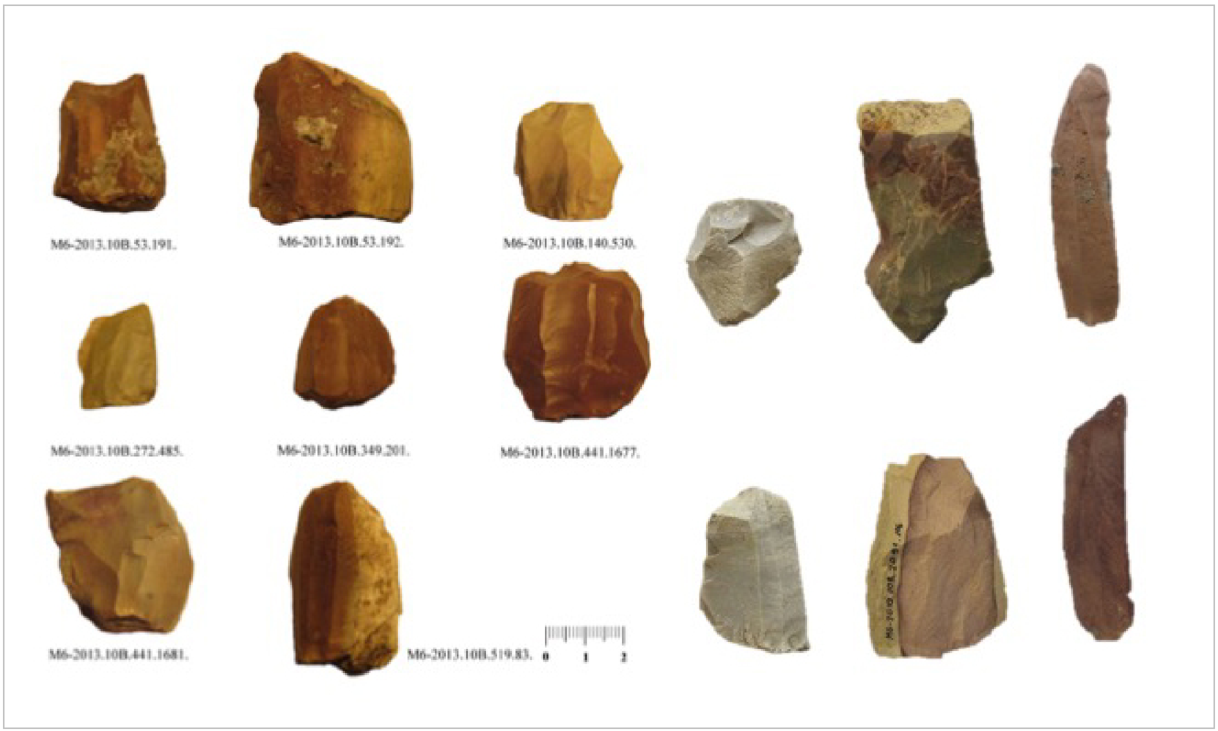

**Fig. 3.:** Stone tools from Mecsek radiolarite (Alsónyék-Bátaszék).

**3. ábra:** Mecseki radiolaritból készült kőeszközök (Alsónyék-Bátaszék).

The basis of this doctoral thesis is the nearly 6200 pieces of chipped stone material from the site Alsónyék-Bátaszék. In the dissertation, the examination of the stone tools is restricted to the artefacts deriving from the settlement objects and burials of the Late Neolithic Lengyel culture (**Fig. 2.**). Specifically, the process of chipped stone tools production, a technological approach plays a decisive role, as it is becoming more common today also for other types of artifacts: "chaîne opératoire"is used as the suitable method for reconstructing the process of production (Inizan et al. 1999, 13–17; Odell 2006, 1–12; Andrefsky 2008, 3–13). The stages of the raw material procurement, production, and use can be distinguished in the stone tool making activity, followed by its disposal or deposition – all of these stages belong to the biography of artefacts (Andrefsky 2009, 66–70; Holló et al. 2001, 2002, 2004). The basic structure of the dissertation reflects this approach.

One of the pillars of my research was to clarify the location and position of raw material sources, which was carried out using a geoarchaeological approach (Szilágyi 2018a, 1–9). The primary goal was to detect and document the spectrum of the knappable raw material in the territory of the East-Mecsek Mountain. Moreover, I aimed to create a collection of the available geological samples, which enables a comparison between the archaeological stone tools and the geological samples. The Mecsek radiolarite is dominant in the Alsónyék lithic material, its geological source located 30–50 km far from the site in the territory of the East-Mecsek (**Fig. 3**.). I investigated the topic of raw material procurement more precisely through a field survey. The goal was to understand the raw material selection strategy, the collecting and/or exploitation activity of the Late Neolithic communities (Szilágyi 2018b, 130–132).

Next, my approach is to examine the whole process of lithic material production, all phases of stone tool preparation and production activity that is the practical process of stone tool making – made up of small gestures. The primary analytical and comparative units were applied to the lithic materials from the settlement objects and burials. I compared the primary features – the raw materials, technological characteristics of artefacts and their spatial distribution – to create the comprehensive overview over the whole lithic material. Using this method, it is possible to reconstruct the tool making activity inside the settlement, revealing the intensive nature of stone production in the Late Neolithic settlement (Szilágyi 2017b).

Approaching smaller-scaled analytical units of the lithic materials of the settlement and the burials required a different methodological approach: here the investigation focused on the spatial distribution of quantities of artefacts in relation to the original archaeological features connected to buildings in the settlement. This refers to household archaeology, and the basic point was to understand and identify the pits that belonged to one or more houses forming a household unit (Szilágyi 2017a). Where and how did tool production take place? In summary, this is a complex question which guided and constituted the research and the processing and interpretation of the lithic assemblage from the settlement.

As the stone tools which appeared as grave goods represent an intentionally selected sample, governed by systems of values and meaning, we have to research and interpret these assemblages with a different method than those from settlements. At the site Alsónyék, the main part of the excavated 2236 burials belonged to specific grave groups, which represent a transformation of the social and cognitive systems in the Late Neolithic period, because in the previous period the burials were located haphazardly and sporadically between houses and different places in the settlement (Zalai-Gaál et al. 2012). We can understand the grave groups at Alsónyék, as representing pattern of converging burial practice, because we can find a more regular pattern in the orientation of the graves, the position of the buried individuals and the features of the grave goods. In this light, the main question is to understand how the lithic materials are significant as a grave good and what they mean within the burial context. The raw material, artefact type, and the exact position are concrete signs, which represent symbols beyond the mere materiality of the artefacts. I tried to uncover the possible interpretions by drawing in the available anthropological data, and to look for correlation of object patterns in relation to biological sex and age of death (Köhler 2012, 2013) (**Fig. 4.**).

Finally, in a wider perspective, I compared the stone chipped material of Alsónyék with the published and unpublished lithic assemblages of the South-eastern Transdanubian group of the Lengyel culture (Zengővárkony, Mórágy-Tűzkődomb, Pécsvárad-Aranyhegy, Lengyel-Sánc, Villánykövesd) (Biró & Bácskay 1984, Bácskay 1989, 1990; Biró 1989, 1990). My goal was to understand and interpret the Late Neolithic community's stone tool making activity, because the mentioned sites' lithic assemblages are very similar in raw materials and technological categories. For this reason, I would like to investigate the tool making strategies, the overall technological systems and the value and significance of the local raw material in the wider Lengyel cultural unit.

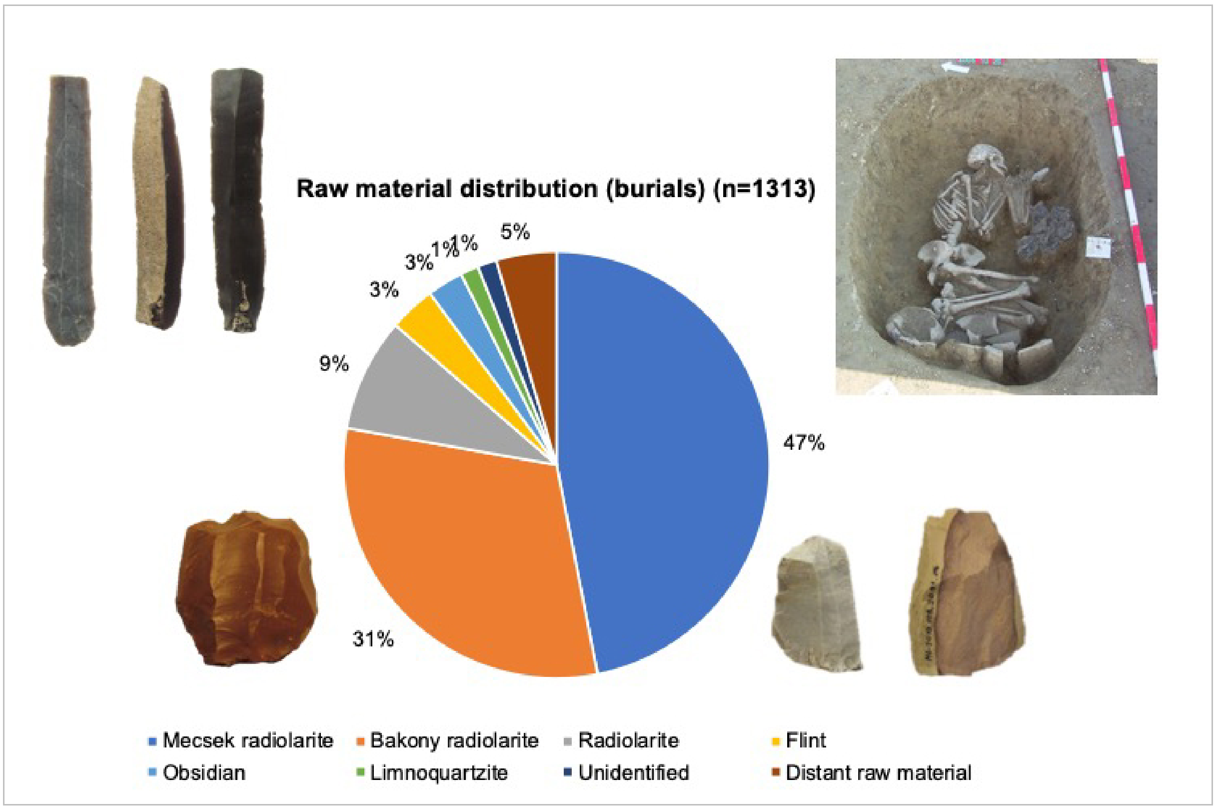

**Fig. 4.:** Raw material distribution in the burial assemblage.

**4. ábra:** A síranyag nyersanyag megoszlása.

In summary, three basic, yet all in all very complex points summarize the topics of the dissertation:

- What kinds of tool making procedure and production activity were specifically used at Alsónyék and in the South-eastern Transdanubian group of the Lengyel culture?

- What kind of significance and symbolic value did – especially local – raw materials represent in the life of this Late Neolithic community?

- How can we understand the new burials practices which were observed at Alsónyék? What did the location, the raw material and technological / typological features of the stone tools symbolize in the burial context?

## *The methods and the sources of the research*

Since the 1970s, the technological approach became more and more important in the Hungarian/interior prehistoric research, a fact that is particularly noticeable in the research of chipped stone tools. The French prehistoric research has a long and important tradition using the technological approach and understanding, which is very well visible in the exact terminological definitions and systematic dealings with the tool making procedure known from the French tradition (Inizan et al. 1999). The technological point of view and the processing method crystallized mainly with a focus on the Palaeolithic lithic materials. Yet the overall success of this method clearly shows that this is a commonly applicable method, which is now widely used in almost all archaeological periods. The technological approach to the study of the different periods and types of artefactsenabled continuous methodological developments, that lead to a new perspective not only on new materials but also on the already published find materials. This can fuel a new discussion, which offers an opportunity to see these new findings in new ways.

The recently published site of Alsónyék,provides the possibility to gain completely new insights by using this technological approach, not only regarding the South-eastern Transdanubian group of the Lengyel culture, but also relating to the whole Late Neolithic period. This is the case because the quantity of the chipped stone tools and the archaeological features in Alsónyékheavily outnumber those previously known from all other Lengyel culture sites. At Alsónyék alone more stone tools were found than in all the other published lithic assemblages from South-eastern Transdanubia combined.

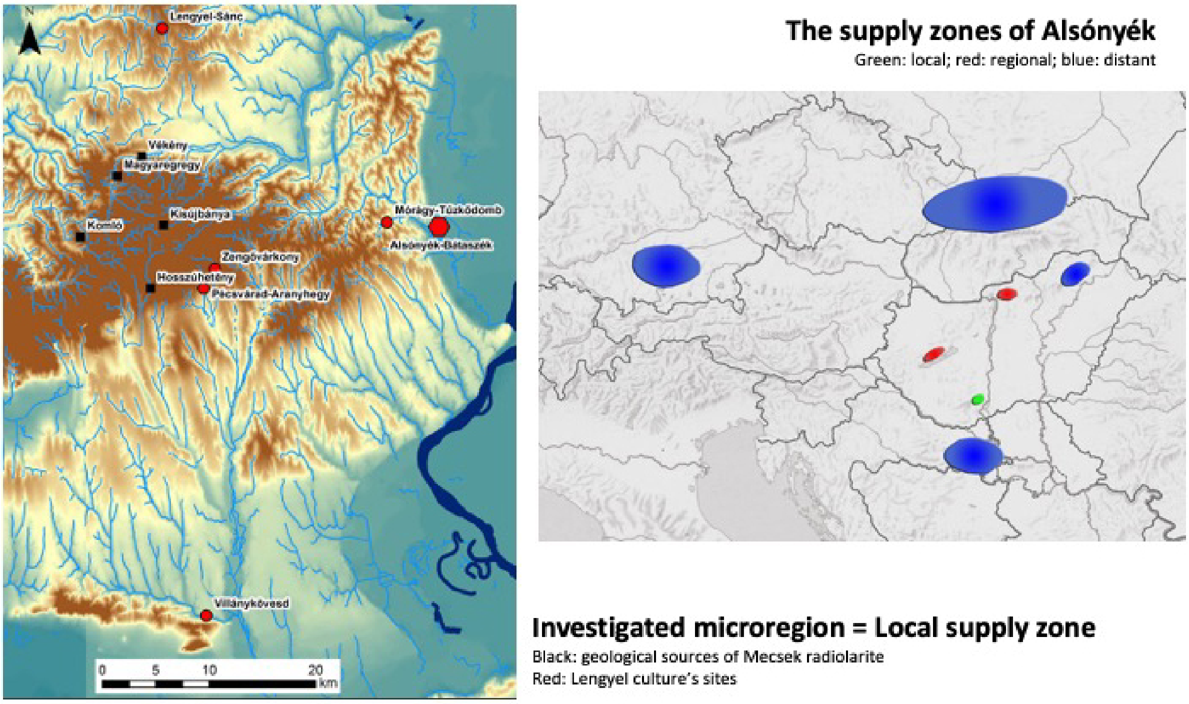

**Fig. 5.:** The raw material supply zones of Alsónyék and the map of the investigated local microregion

**5. ábra:** Alsónyék nyersanyagbeszerzési zónái és a helyi mikrorégiós kutatás térképe

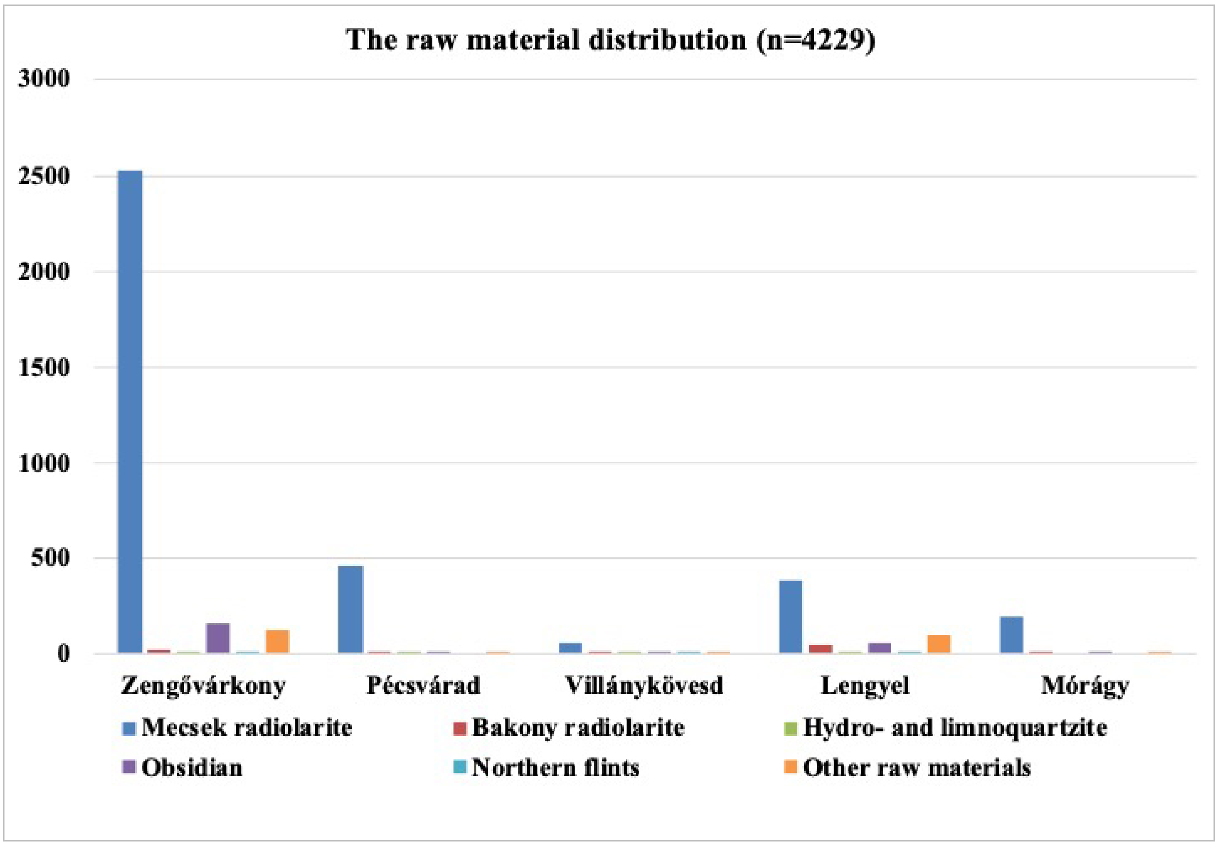

**Fig. 6.:** The raw material distribution of the compared South-eastern Transdanubian sites' lithic assemlages

**6. ábra:** Az összehasonlított délkelet-dunántúli lelőhelyek kőanyagainak nyersanyag megoszlása

Since the archaeological context is well-known at Alsónyék, this provides a fundamentally improved opportunity to shed new light Late Neolithic tool making activities (**Fig. 5.**).

Most of the previously known lithic assemblages have been studied and published by Erzsébet Bácskay and Katalin T. Biró, from whose works we know many details of these Late Neolithic communities raw material procurement and production activity (Bácskay & Biró 1984; Bácskay 1989, 1990; Biró 1989a, 1990). On this basis, we know that the local Mecsek radiolarite was the most important raw material. Yet although being spatially close to this type of radiolarite, people also used other knappable radiolarite and flint varieties (Biró 1984, 1988, 1998). Blades and retouched tools on blades dominate the lithic assemblages, based on this the Lengyel culture was determined as a "blade-culture" (**Fig. 6.**).

The Alsónyék lithic assemblage provides an excellent opportunity to rethink and understand the whole tool making procedure of the South-eastern Transdanubian group of the Lengyel culture from a new perspective, because our exact knowledge of the archaeological contexts at Alsónyék allows for a much more detailed contextual analysis.

The comparison of the lithic assemblages from the settlement and burials forms the core of the dissertation, and is interpreted in the context of the wider South-eastern Transdanubian group. I interpret the entire lithic material as representing a fundamental transformation in the Late Neolithic period, which is visible in the unique features of the site and does not show any similarities with the previous middle Neolithic and following Early Copper Age sites in Transdanubia (Bánffy 1991, 23–33; Bánffy et al. 2013, Bánffy et al. 2014). For this reason, I concentrate on investigating on assessing the nature of this transformation and the underlying reasons, arguing for a serious social and mental transformation. The entire site – with its enormous extension and excessive number of buildings and burials, its unique archaeological material – stand out not only from the other South-eastern Transdanubian Late Neolithic sites, but also constitutes an exceptional case in the whole territory of Transdanubia. The site chronology indicates a surprisingly short time period in the light of the very intensive concentration of settlement structures and burial activity: Based on the highest probability estimates, the settlement was used for 200–500 years, while the burial activity encompasses 250–350 years. This period was even shorter in the most intensively used part of the settlement, where the lifespan is, with a 95% probability, estimated to 45 years, while the burial activities took place for 95 years (Osztás et al. 2013b, 280, Tab. 6.; 282. Tab. 8.).

Regarding the entire site, I investigate the very important historical question, how to understand and interpret the origin and the short duration of this Late Neolithic phenomenon which was reflected by an extraordinarily intensive and concentrated activity for a limited number of generations. From this observation, we can infer a relatively „sudden" transformation, a rapid growth of population necessitating the establishment of the extensive settlement, changes in food production and the development of craft activities. We have to investigate the possible spatial and temporal dimensions of the transformation to understand the Alsónyék "phenomenon". Regarding the spatial dimension, Alsónyék differs from the other known sites of the Lengyel culture, in the sense that Alsónyék is an extraordinarily large flat settlement. Regarding temporal dimension, this period demonstrates an extraordinary dynamic of change, a marked social and mental transformation at the end of the Neolithic and the beginning of the Copper Age. These dynamic changes are very well represented by the grave goods and burial practices. They can be interpreted in relation to the larger regional transformation visible in the neighbouring Great Hungarian Plan. In that area, at this time, the tell-settlements ceased to be used and new communities with absolutely different material culture and new settlement forms appeared. Replacing intra-mural burials, now the dead are buried in extra-mural cemeteries, separated from the settlements (Siklósi 2010; 2013; Raczky & Anders 2009; 2010; Raczky et al. 2014, 328–332; Salisbury 2012; Schier 2014, 428). In Transdanubia, the transition period between these two periods (the Late Neolithic and the Early Copper Age) was of a continuous nature, and the new Copper Age period here started in the context of the same Lengyel culture. In this period the "Alsónyék" community was probably the agent of this transformation, while the pottery material suggests that they were a recipient of southern impulses (Zalai-Gaál 1980, 1982, 1993, 2008; Bánffy 1991, 1994, 1995, 2007).

For this reason, in the dissertation, I focus on a further examination of this transformation. This I do by investigating three major topics, namely the environmental background, the activities in the settlement and those connected to the burials. Within each of these topics, different phenomena are studied, at different spatial scales, using different methods. While in the study of the environmental background the interrelation between landscape, human actions and cultural patterns is central, the study of the settlement features will concentrate on chaîne opératoire and spatial distribution analyses to detect activity areas. The study of the burials uses methods of social and cognitive archaeology to reconstruct meaningful social practices (Müller 2018).

## *Scientific results achieved*

During the last few years I processed the whole Late Neolithic lithic material from the site Alsónyék. The basic features of the chipped stone material were analysed with regards to the research topics discussed above. In light of this, the most important results are:

- We now understand the typical raw material procurement strategy, its methods and the possible trade routes used by the Late Neolithic communities of Alsónyék and the whole South-eastern Transdanubian group of the Lengyel culture.

- We can understand the raw material selection activity, the technological background of the community in Alsónyék and the tool production inside the settlement from the aspect of the stone tool making activity.

- A better understanding of many new elements of the burial practice, starting from the basic point of stone tools deposited in the graves. The raw material, types of tool and their position inside the grave signify specific meanings. These features point to and are part of the fundamental transformation taking place at the transition from the Late Neolithic to the Early Copper Age periods.

The method of the raw material collecting activity shows more about the use of the environment in the context of the Lengyel culture. The original question was: how was the raw material procurement organised and was there cooperation or possibly a division of labour between the contemporaneous settlements? Based on the field survey and the processed lithic assemblages we can suggest that the local raw material procurement activity did not require very sophisticated or highly specialised exploitation activities, but instead very good raw material knowledge. We can assume that the people involved in these activities knew the raw material sources in the East-Mecsek Mountains very well. During the field survey we found that the bigger part of the valley and the stream were potential raw material sources, from which the knapping specialist could choose and collect the good quality knappable raw materials in a very easy way. However, concerning the Alsónyék lithic material, the big-sized radiolarite blades used as grave goods had to be retrieved from the outcrops/bedrocks, not from the stream valley. These bedrocks are potential suitable raw material sources for these blades and in these thin bedded structures many radiolarite intercalations are located (Barabás 1986; Konda 1986; Raucsik 2012a, 2012b, 2012c, 2012d). This observation suggests, that, again, the prociduous bedded (raw material) blocks could be collected without any special exploitation activity or specialized tools. The bigger-sized radiolarite blocks – concluding from the recent features – were suitable to create the cores which were needed for the big-sized blades. All this suggests, that the raw material collecting activities were most likely carried out by those people, who had the stone tools making skills, the lithic-local environment of knowledge and who knew the exact places of the stream valley, and the outcrops of suitable raw materials for the big blades (**Fig. 7.**).

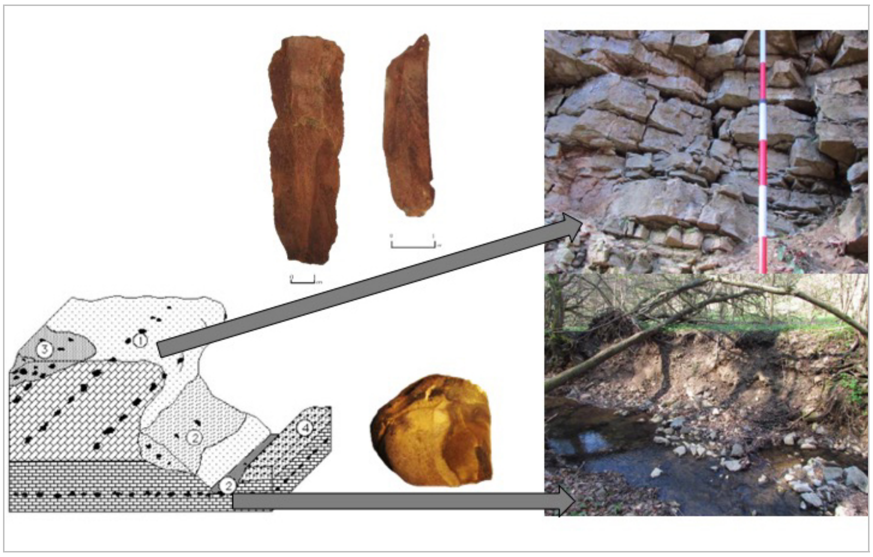

**Fig. 7.:** The sources of different kind of raw material. The two possible raw material procurement strategies: 1 – primary autochthonous source – bedrocks – large blade from the burial; 2 – secondary autochthonous source – stream bed – average sized core from the settlement. Created by Kata Szilágyi.

**7. ábra:** A különböző fajta kőzetek nyersanyagforrásai. A két lehetséges nyersanyagbeszerzési stratégia: 1 – elsődleges helyzetű nyersanyagforrás – szálkőzet – nagyméretű pengék a sírokban; 2 – másodlagos helyzetű nyersanyagforrás – átlagos méretű magkő a településről. Készítette Szilágyi Kata.

In the settlement assemblages, there is not a large amount of decortication flakes, which would prove the preparation of the core within the settlement. For this reason, we can assume that the local raw material arrived in the settlement in the form of cores, pre-cores or raw material blocks, all of these forms that did not have a significant amount of cortex. There are two possible explanations for this. One possibility is that, in some cases many stone tools made from the less "pure" radiolarite or parts of the whole were silicified, thus it was not necessary to remove the whole cortex. The other possible explanation for the lack of corticated flakes on the site is, based on the observation of the field survey that it was necessary to break the nodules and the bigger raw material blocks to check if it was suitable for knapping. This often leads to the creation of very sharp fracture surfaces and edges, which would cause a problem for the collector, since they could easily cause injuries during transport or simply cut through what bag they were stored in. This constitutes an important practical aspect in the Late Neolithic, given the conditions for the transport of the raw material either by living animals or carried by humans. In the case of Alsónyék this would mean transport over 20–30 km distance, considering the field features of the Mecsek. Thus, transporting unprocessed or freshly broken up rock, raw material of which a significant part would be useless for stone tool making would be a waste of energy.It would therefore have been seen as more rational to create the pre-form or even the cores in the surroundings of the collecting area.

The study of the different technological categories of the stone tool production activity enables us to assess the cultural tradition of the Lengyel culture that is reflected by the stone tools. Based on the technological features studied, the South-eastern Transdanubian group of the Lengyel culture was a „blade culture", as in every lithic assemblage blades and tools made on blades heavily dominate. The highest proportion of blades is found on the part of the lithic assemblage that comes from the burials. Most of the burials appeared at the Alsónyék and Mórágy sites, and the numbers of blades are outstandingly high in both of their stone collections. In general, in the settlement lithic assemblages (Zengővárkony, Pécsvárad, Villánykövesd, Alsónyék), blades and flakes are most frequent, while cores and tools are less abundant (Biró 1998). By contrast, in the burial assemblages' blade-tools appear in the highest quantity. The new data from Alsónyék can shed new light on the reason why the blade was the most important type.

High-intensity burial activities similar to those of Alsónyék or similar amounts of chipped stone assemblages were not found in any other place within the South-eastern Transdanubian group of the Lengyel culture. This phenomenon, the co-occurrence of high-intensity burial activities and large amounts of chipped stone materials, in itself sheds new light on the mentioned group and the Lengyel culture. The vast majority of the identified 2236 burials at this site had the traditional oval-shaped pit. In addition, a total of 130 rectangular-shaped burials were documented by the excavating archaeologists, which until now was an unknown grave type in the Lengyel culture (Zalai-Gaál et al. 2011, 2012). The distribution of burials and grave groups show a large difference in the entire site because, like the intensity of the settlement structure, the burial activity is also the densest in the northern part of the site, where there are 41 grave groups in this area out of a total of 92 grave groups (Gallina 2009; Gallina et al. 2010; Köhler 2013).The grave groups also show huge differences concerning the number of burials, which is manifested in several aspects (**Fig. 8**.).

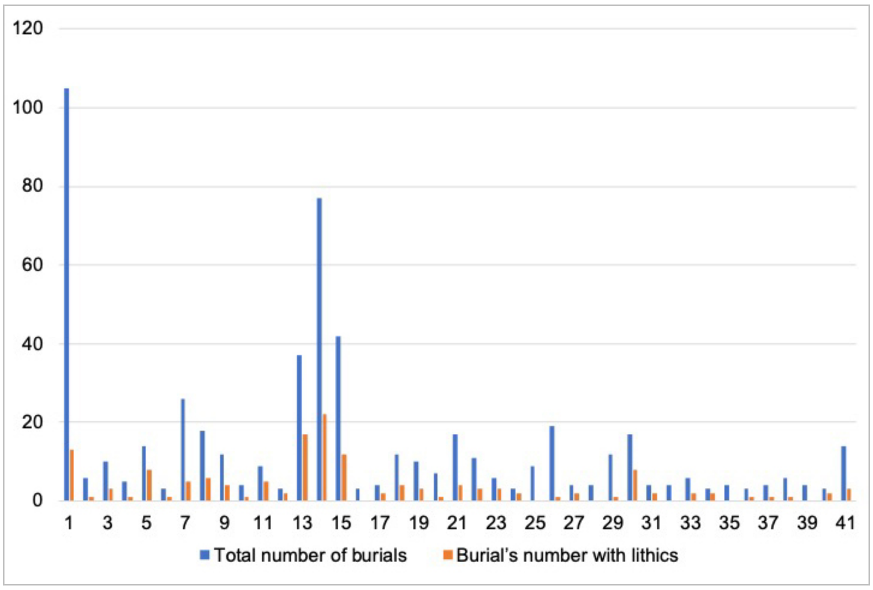

**Fig. 8.:**
The comparison of the total burial number and burials with lithic grave good.

**8. ábra:**
A összes sír mennyiség és a kőeszköz melléklettel rendelkező sírok számának összehasonlítása.

The creation of the grave groups is part of a process of mental transformation, the emergence and consolidation of a new burial rite involving the artefacts and people (in this case the dead/buried persons), a dead community, the funeral as a social act, embedded in a regular ritual process. It also represents a socio-mental argument, as a result of which the new concept of cemetery (the community of the dead) develops separately from the settlement (the community of the living). The spatial separation is a very important element in this transformation since the listed items are physically displaced from each other. The search and decision for a location was performed in the mental map of the community which first needed to crystallize before the physical location of the graves and the artefacts could be carried out. In my opinion, at the case of Alsónyék, we can interpret the burials which are organized in grave groups and the constant places of the artefacts/grave goods inside the grave as the nonverbal print-out of this mental map (Dzbyński 2008).

The number of burials in each grave group did not determine the frequency of stone equipment attached to them, indeed nearly half of the chipped stone assemblage came from burials not belonging to any grave group. The grave groups show very large differences in the number of burials, their location, structure, the form of graves and the frequency of the stone tools as grave goods (**Fig. 9.**). The orientation and position of the deceased's posture show definite regularity, that is, a kind of system can be recognized. By contrast, there is a number of "irregularities" in group structure, both in quantity and quality of burials and grave goods. Presumably, regularity and the rule itself are manifested in space at this time, that is, the definite place of the tombs and the positions of grave goods within the grave speak to the ongoing social-mental transformation unfolding in the period and in that Late Neolithic community. Within such a transformation the mentioned "irregularities" can be well explained as deviations from the slowly crystallizing new standard, in which the forming burial rite concerning the individuals and the artefacts would only gradually have found their place. However, the relationship between any individual burial and the specific artefacts placed next to him/her, the system of relationships is now beginning to take a definite and regular form. Incidentally, the relationship between the deceased individual or the burial community and the artefacts placed in the grave may develop during this period and become a more definite sign.

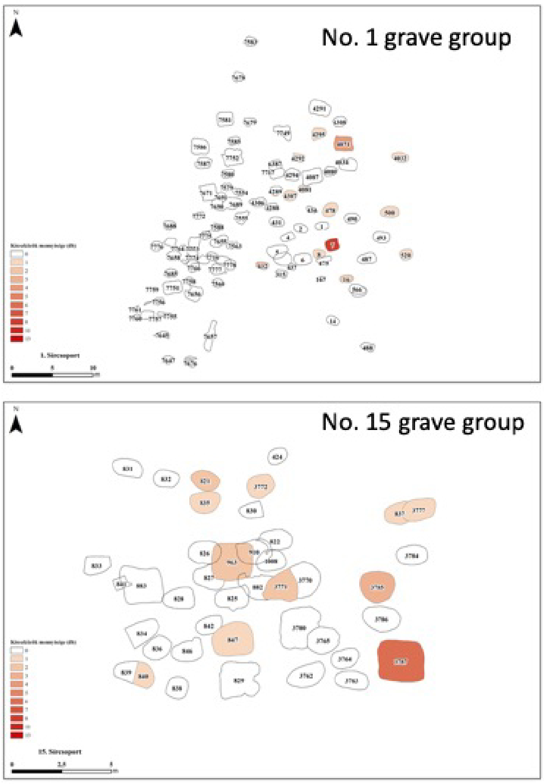

**Fig. 9.:** The frequency of the lithic grave goods in the No. 1. and No. 15. grave groups. Created by Péter Czukor.

**9. ábra:** Kőeszköz mellékletek gyakorisága az 1. és 15. számú sírcsoportban. Készítette Czukor Péter.

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# ARCHAEOMETRIC INVESTIGATION OF AN ALKALI BASALT NEOLITHIC POLISHED STONE TOOL FROM NAGY-FERTŐ LOCALITY, NEAR MEZŐKÖVESD (BORSOD-ABAÚJ-ZEMPLÉN COUNTY, NE HUNGARY) •

## ALKÁLI BAZALT NEOLIT CSISZOLT KŐESZKÖZ ARCHEOMETRIAI VIZSGÁLATI EREDMÉNYEI MEZŐKÖVESD, NAGY-FERTŐ LELŐHELYRŐL (BORSOD-ABAÚJ-ZEMPLÉN MEGYE, MAGYARORSZÁG)

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## *Abstract*

*A Neolithic alkali basalt polished stone tool originated from Nagy-Fertő locality, near Mezőkövesd, was studied from archaeometric aspect. Its mineral association was detected by EDS/SEM and XRD. The decisive mineral components of the stone axe are olivine, clinopyroxene, labradorite, sodalite, natrolite and spinel. Data of bulk chemistry WDXRF analyses were compared with previously published data on similar raw materials and it shows a good match with the stone axe and the alkali basalts from Bulhary, Ceres Mountains. As other sodalite-bearing basalts are not known from the Carpathian basin and its surroundings and according to the similar mineralogical assemblage of the stone axe and the alkali basalt raw material, in addition the bulk chemistry data confirmed the presumption of the possible provenance field is Bulhary in the Ceres Mountains (Slovakia).*

## *Kivonat*

*Egy alkáli bazalt nyersanyagú neolit csiszolt kőeszköz archeometriai vizsgálati eredményeit mutatjuk be Mezőkövesd, Nagy-Fertő lelőhelyről. A kőeszköz fő kőzetalkotó ásványai: olivin, klinopiroxén, labradorit, szodalit, nátrolit és spinell. Az EDS/SEM és XRD vizsgálatok eredményei nagy hasonlóságot mutattak a Cseres-hegységben (Szlovákia) előforduló szodalit-tartalmú alkáli bazaltokkal. Elvégeztük a bolgáromi kőbányából származó kőzetminta EDS/SEM, XRD elemzését is, továbbá kőzetkémiai (WDXRF) vizsgálatok is történtek mindkét mintán, amelyek megerősítették a hasonlóságot. A Kárpát-medence környékéről más szodalit-tartalmú alkáli bazalt nem ismert. Ez a tény, illetve az ásvány- és kőzetkémiai azonosságok is alátámasztják a kőbalta nyersanyagának cseres-hegységi eredetét.*

KEYWORDS: ALKALI BASALT, SODALITE, PROVENANCE, HERMAN OTTÓ MUSEUM

KULCSSZAVAK: ALKÁLI BAZALT, SZODALIT, FORRÁSTERÜLET, HERMAN OTTÓ MÚZEUM

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**Fig. 1.:** Excavation area is signed with green circle in the Borsod-Abaúj-Zemplén county map

**1. ábra:** A kőeszköz régészeti lelőhelye zöld körrel jelölve a térképen

**Fig. 2.:** Alkali basalt stone axe (D19 sample) from Mezőkövesd, Nagy-Fertő excavation area

**2. ábra:** Alkáli bazalt kőbalta (D19 minta) Mezőkövesd, Nagy-Fertő lelőhelyről

## *Introduction*

The archaeological collection of the Herman Ottó Museum contains approximately 500 Neolithic polished stone tools. Most of the axes are metabasites, mainly different types of amphibolites and contact metabasites (Kereskényi et al. 2017). 36 polished stone tools proved to be blueschists (Kereskényi et al. 2018). Lithology of the quarter of the collection has eruptive origin and roughly 50 pieces of stone artefacts are of sedimentary origin. A few axes are determined to be hornfels and some metaultrabasite polished stone tools also occur in the archaeological collection.

There is one piece made from alkali basalt among the eruptive stone tools. In this paper mineralogical and petrological investigations of this alkali basalt polished stone tool are presented and the results are compared to the possible provenance field of the raw material.

Mineral abbrevations applied in the paper: Ol: olivine, Di: diopside, Aug: augite, Lab: labradorite, Ano: anorthoclase, San: sanidine, Nep: nepheline, Ntr: natrolite, Sdl: sodalite, Sme: smectite, Ca: calcite, Usp: ulvospinel, Mgt: magnetite, Ilm: ilmenite, Ap: apatite, Ze: zeolite.

## *Archaeological background*

The archaeological locality of the polished stone tool is Nagy-Fertő excavation area near Mezőkövesd, on the track of M3 motorway, locality No. 76 (**Fig. 1.**). It came to surface with Spondylus findings and Middle Neolithic ceramic fragments belonging to the Szakálhát culture (Csengeri 2013, Gál 2018). The broken implement must have had shoe-last form (**Fig. 2.**). There has not been published archaeometrical work about Szakálhát cultured polished stone implements yet.

## *Samples and methods*

The stone axe is a non-catalogized artefact and belongs to the collection of the Department of Archaeology, Herman Ottó Museum. The alkali basalt sample of Bulhary (Bolgárom) belongs to the collection of the Department of Mineralogy, Herman Ottó Museum (Inventory number: 2011.167, Locality: Bulhary quarry, Collectors: Ferenc Kristály and Sándor Szakáll, Year: 2011).

Analyses were carried out at the Institute of Mineralogy and Petrology, Miskolc University. Macroscopic and microscopic description were made on the stone axe using Zeiss Stemi DV4 stereo microscope. Polished sections were made from the stone tool and the raw material. EDS/SEM analyses were prepared using a JEOL JXA-8600 Superprobe electron-microprobe in energy-dispersive mode. The accelerating voltage was 20 kV and beam current was 20 nA.

Non-destructive X-ray diffraction (XRD) analyses were carried out both on the stone implement and the alkali basalt with Bruker D8 Advance X-ray diffractometer. Parameters of XRD analyses: CuKα source, 40 kV and 20 mA generator settings, parallel beam geometry (Göbel-mirror) Vantec1 position detector (1° window opening degree), 0.1 mm collimator. The exact method of the analyse is resumed in the earlier published papers (Kristály 2014, Kristály & Kereskényi 2016).

Bulk chemistry determined by wavelength dispersive X-ray fluorescence (WDXRF) Rigaku Supermini spectrometer. Parameters of the WDXRF: 200 W air-cooled Pd cathode-tube, 50 kV accelerating voltage, 4.0 mA current, 1.2-1.6 Pa vacuum pressure. In basic circumstances the required sample quantity is 3 g for WDXRF, but due to the unique aspect of stone implement only 0.6 g was available.

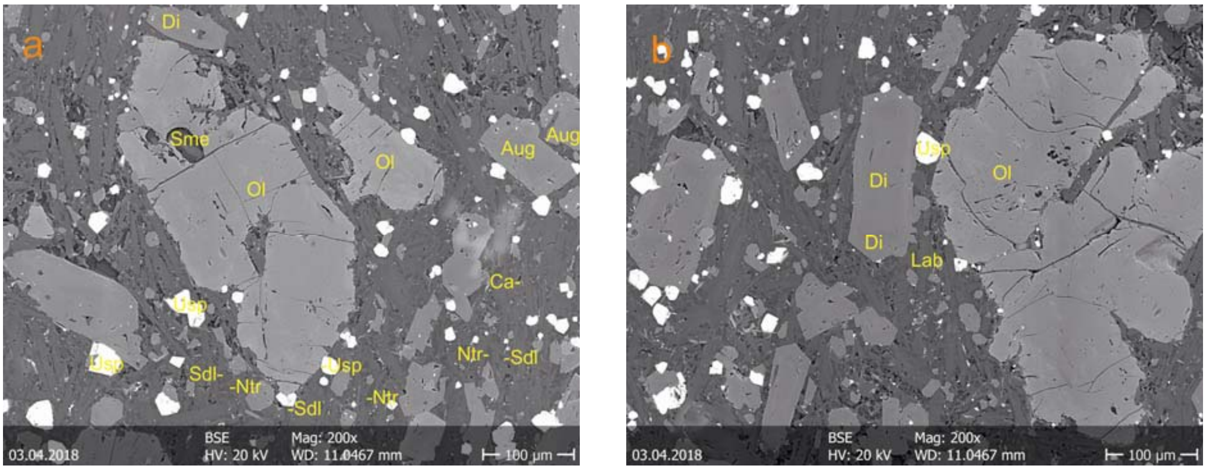
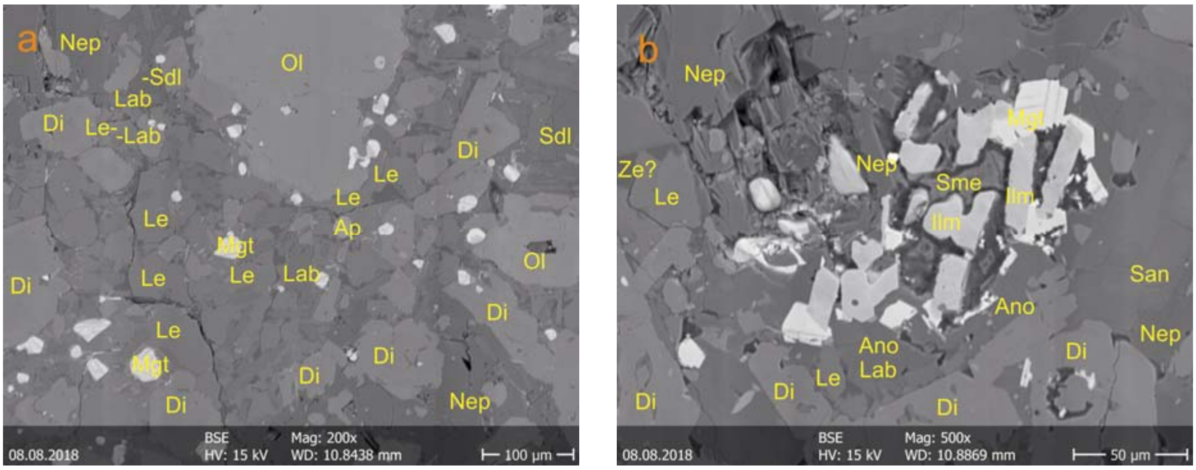


**Fig. 3:** BSE images of the stone axe

**3. ábra:** A kőbalta BSE képe



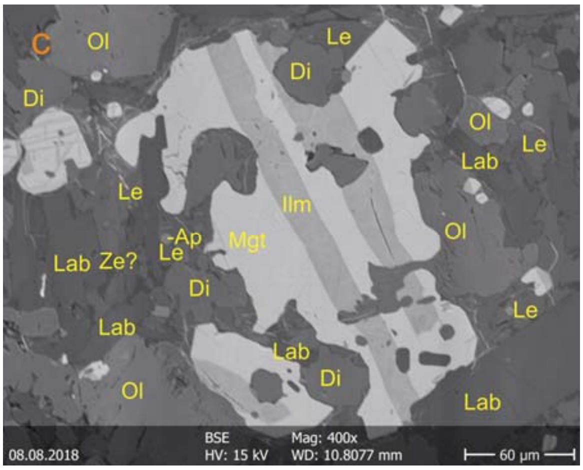


**Fig. 4.:** BSE images of alkali basalt from Bulhary

**4. ábra:** Bolgáromi alkáli bazalt BSE képe

Hence 0.6 g sample amount was mixed with 2.4 g analytical purity glass sand in both cases of analysing of the stone implement and the possible source material. In the case of controlled analyses 3 g of alkali basalt was measured.

## *Geological setting of the provenance field*

Alkali basaltic fields located in Cerová Highlands in southeastern of Slovakia. The southern border of Ceres Mountains is the Slovakian-Hungarian state border. In Hungary the Ceres mountain ranges in Karancs, Medves and Heves-Borsod hills (Konečný et al. 2004). The alkaline basaltic volcanism have developed Ceres Basalt Formation in 5 episodes since 5.5-4 million years forming maars, lava streams, cinder cones, dykes and tuffs (Forgáč 1970, Farsang et al. 2014). The comparison sample was collected from one of the largest quarry, the Bulhary volcanic complex is situated next to Bulhary village.

## *Results*

### Macroscopic and microscopic description

The dimensions of the polished stone tool are 3.7 cm x 1.8 cm x 1.5 cm. Macroscopically the stone tool is dark grey and max. 5 mm off-white rounded spots can be recognized in even distribution on its surface and inside the tool (**Fig. 2.**). Along the spots the axe falls apart to blocks, showing the phenomenon of sunburning (Zagożdżon 2003). Due to burial, sporadical light yellow coating can be studied on the surface of the axe.

Microscopically porphyric texture with red and green olivine and black pyroxene phenocrysts can be recognized in the dark, homogenous matrix.

### EDS/SEM analyses of the stone axe

EDS/SEM investigation has shown that the size of subhedral olivines can reach the 700 µm. The composition of the olivines varies continuously representing Fe-content increase from core to rim, while the Mg-content decreases and enriches in the core of olivines. From core to rim the fayalite content is 25-34%. Formation of smectites can be observed inside of some olivine crystals (**Fig. 3a**). Zoned euhedral and subhedral pyroxenes are identified and have diopside and augite composition (**Fig. 5.**). Among the feldspars only plagioclase was recognized. Composition of plagioclase corresponds to labradorite ($An_{52-58}$) (**Fig. 6.**), its size can reach 500 µm. The equant crystals of ulvospinel crystals are up to 40 µm and distributes in the sample equally. Ulvospinel xenoliths can be observed in pyroxenes and olivines. The groundmass contains interstitial sodalite and natrolite crystals sporadically, and sporadical calcite needles. Glass component is not observed in the sample (**Fig. 3a-b**).

### EDS/SEM analyses of the Bulhary basalt

Since there is no knowledge of sodalite-bearing basalt in the surroundings of the Carpathian Basin, except is at Bulhary in South Slovakia (Farsang et al. 2014, Fehér et al. 2016), mineral chemistry of alkali basalt from Bulhary quarry was studied for comparison.

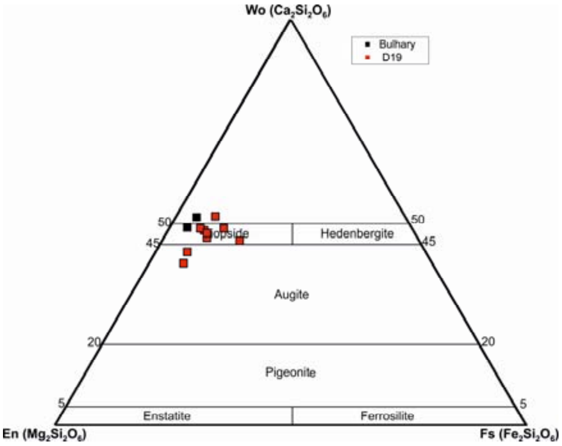


**Fig. 5.:** Chemical compositions of clinopyroxenes of D19 stone axe and the alkali basalt from Bulhary plotted in the En-Fs-Wo ternary diagram (Morimoto 1989)

**5. ábra:** Klinopiroxének kémiai összetétele a D19 jelű kőbaltából és a bolgáromi alkáli bazaltból az En-Fs-Wo háromszög diagramon ábrázolva (Morimoto 1989)

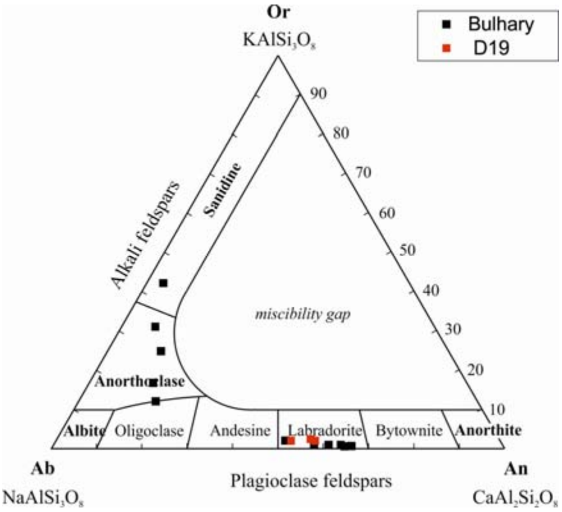


**Fig. 6.:** Chemical compositions of feldspars of D19 stone axe and the alkali basalt from Bulhary plotted in the Or-Ab-An ternary diagram

**6. ábra:** Földpátok kémiai összetétele a D19 jelű kőbaltából és a bolgáromi alkali bazaltból az Or-Ab-An háromszög diagramon ábrázolva

The subhedral zoned olivines can reach the 700 µm (**Fig. 4a**). The fayalite-content varies between 24-33% from core to rim. Inside of some olivine crystals formation of smectites can be observed (**Fig. 4b**). The slightly zoned subhedral pyroxenes have diopside composition (**Fig. 5.**). Plagioclases correspond to labradorite ($An_{51-67}$) composition (**Fig. 6.**), their size is under 100 µm. Alkali feldspars can be observed in the raw material sample (**Fig. 4b**) and according to chemical analyses they fall in anorthoclase and sanidine fields (**Fig. 6.**). The equally distributing Ti-rich magnetite ($TiO_2$: 10-14 wt%) forms equant crystals up to 200 µm. Magnetite xenoliths can be observed in pyroxenes and olivines. Ilmenite exsolution can be observed in some magnetites (**Fig. 4c**). Feldspathoids are present as nepheline, leucite and sodalite: nepheline is up to 150 µm, leucite reaches 100 µm (**Fig. 4a**). The largest sodalites occur up to 70 µm and fill the spaces between other crystals (**Fig. 4a**). Apatite has been determined from the sample as an accessory phase (**Fig. 4c**).

### XRD analyses

Non-destructive XRD analyses were accomplished both on D19 polished stone tool and the Bulhary basalt. Olivine, diopside, feldspar, sodalite and nepheline were recorded in the D19 stone axe (**Fig. 7.**).Olivine, diopside, feldspar, sodalite, nepheline, leucite and analcime were detected from the alkali basalt (**Fig. 8.**).

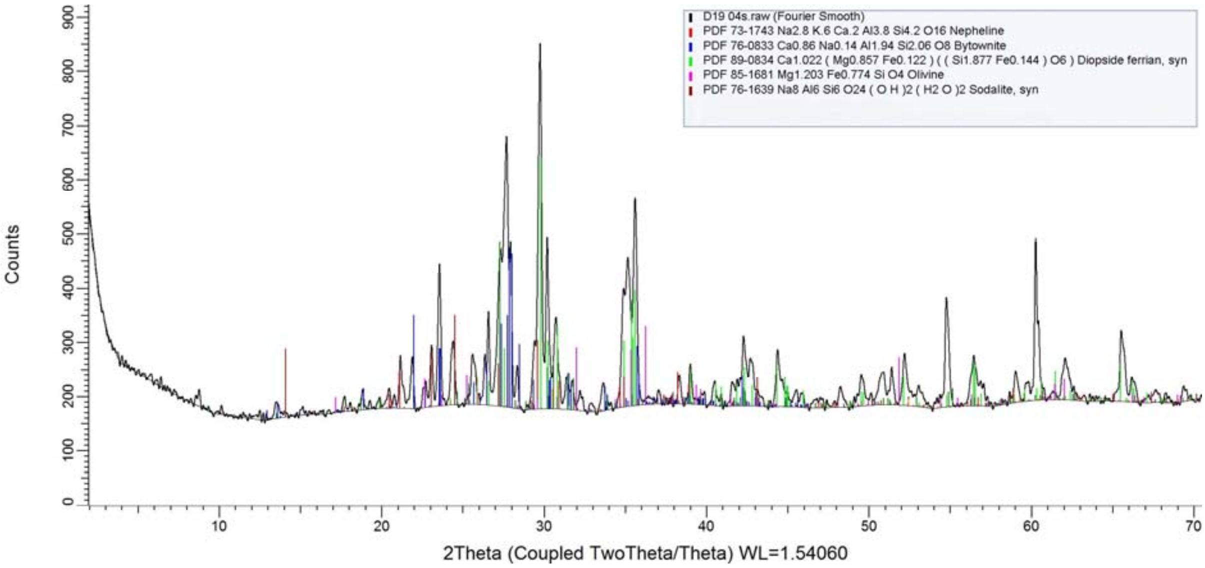


**Fig. 7:** XRD pattern of D19 stone axe

**7. ábra:** D19 jelű kőbalta XRD felvétele

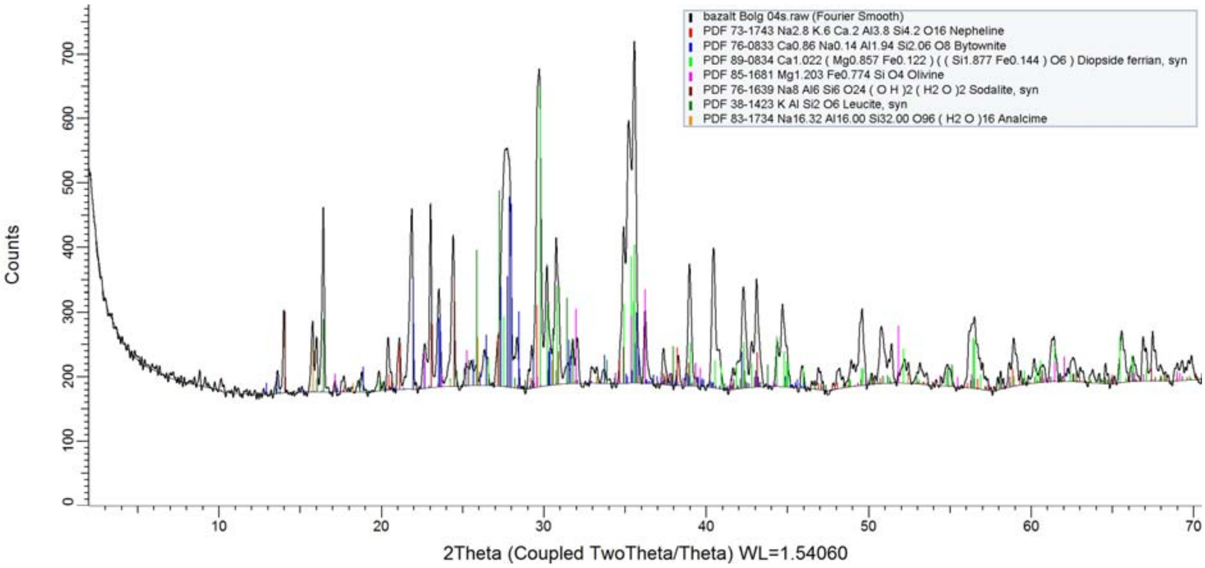


**Fig. 8:** XRD pattern of Bulhary alkali basalt

**8. ábra:** Bolgáromi alkali bazalt XRD felvétele

**Table 1.:** Bulk chemistry results. The major components are given in wt%. The amount of oxides is calculated from the elemental concentration, based on the oxidation numbers

1. D19 stone axe (mixed with glass sand); 2. Bulhary quarry: alkali basalt (mixed with glass sand); 3. Bulhary quarry: alkali basalt; 4. Bulhary: limburgitoide basanite (Forgáč 1970); 5. Konradovce: nepheline basanite (Forgáč 1970) 6. Filakovo: nepheline basanite (Forgáč 1970); 7. Belina: nepheline basanite (Forgáč 1970) 8. Badzovce: nepheline basanite (Forgáč 1970); 9. Borkul-Bagac: nepheline basanite (Forgáč 1970). 10. Average bulk chemistry of basalt fields from North Hungary (Jugovics 1974); 11. Bulhary quarry: basanite (Hakulinová et al. 2011.) 12. Bulhary abandoned quarry: basanite (Hakulinová et al. 2011.)

**1. táblázat:** Kőzetkémiai eredmények. A főelemek wt%-ban megadva. Az oxidok mennyiségét az elemi koncentrációból számoltuk az oxidációs számok alapján

| **Sample** | **1.** | **2.** | **3.** | **4.** | **5.** | **6.** | **7.** | **8.** | **9.** | **10.** | **11.** | **12.** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | no data | no data | 46.2 | 45.53 | 44.92 | 44.23 | 48.53 | 46.53 | 42.75 | 46.62 | 45.60 | 46.04 |
| $TiO_2$ | 2.25 | 2.12 | 1.80 | 2.70 | 1.88 | 2.66 | 1.88 | 1.71 | 1.93 | 1.75 | 2.24 | 2.25 |
| $Al_2O_3$ | no data | no data | 15.3 | 10.76 | 16.59 | 15.87 | 16.03 | 18.21 | 14.42 | 17.53 | 16.73 | 16.47 |
| $Fe_2O_3^*$ | 10.55 | 9.35 | 7.36 | 14.15 | 10.45 | 11.44 | 11.62 | 8.93 | 9.82 | 9.62 | 9.43 | 9.05 |
| MnO | 0.22 | 0.21 | 0.16 | 0.20 | 0.24 | 0.17 | 0.26 | 0.32 | 0.32 | no data | 0.18 | 0.17 |
| MgO | 5.3 | 6.85 | 5.03 | 8.60 | 9.03 | 7.21 | 7.32 | 6.34 | 7.86 | 5.50 | 8.55 | 8.62 |
| CaO | 8.75 | 10.4 | 9.06 | 11.07 | 10.70 | 11.01 | 9.04 | 8.69 | 12.79 | 9.51 | 9.72 | 9.93 |
| $Na_2O$ | 5.75 | 5.95 | 5.05 | 3.27 | 3.56 | 3.15 | 3.64 | 5.09 | 2.51 | 4.14 | 4.05 | 4.08 |
| $K_2O$ | 2.95 | 3.25 | 2.23 | 1.83 | 2.10 | 1.30 | 1.36 | 2.90 | 1.57 | 2.19 | 2.42 | 2.30 |
| $P_2O_5$ | 0.51 | 0.57 | 0.53 | 0.00 | 0.12 | 0.00 | 0.17 | 0.51 | 0.26 | no data | 0.60 | 0.56 |
| S | 0.08 | 0.05 | 0.01 | no data | no data | no data | no data | no data | no data | no data | 0.01 | 0.04 |

* Total Fe as $Fe_2O_3$.

### Bulk chemistry of the rock samples

WDXRF analyses were carried out both on polished stone tool and Bulhary sample. As 2.4 g analytical purity glass sand was mixed to 0.6 g sample in both cases, the 1:4 ratio is noticed at the evaluation of results. Because of the high content of Si and Al elements of glass sand, those data were ignored from the interpretation. In a controlled analysis the alkali basalt represented results for Si and Al. Regarding the $TiO_2$, MgO, CaO, $Na_2O$, $K_2O$ and $P_2O_5$ content, the stone axe and the alkali basalt show a very good match (**Table 1.**, **Fig. 9.**).

## *Discussion*

The EDS/SEM determined mineral association of the stone implement accords with the alkali basalt from Ceres Mountains (Farsang et al. 2014).

EDS/SEM of alkali basalt from Bulhary was accomplished also, because there is no other known occurrence of sodalite-bearing basalt in the Carpathian Basin or its surroundings (Farsang et al. 2014, Fehér et al. 2016). The subhedral olivines can reach 700 µm in both samples, their chemical composition vary very similar from core to rim.

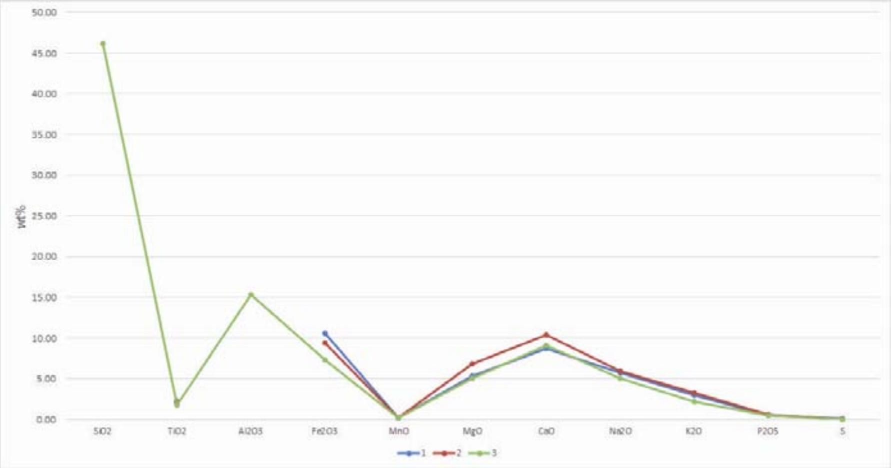


**Fig. 9.** Bulk chemistry data of D19 stone axe and the alkali basalt from Bulhary.

1. D19 stone axe (mixed with glass sand); 2. Bulhary quarry: alkali basalt (mixed with glass sand); 3. Bulhary quarry: alkali basalt

**9. ábra:** A D19 jelű kőbalta és a bolgáromi alkáli bazalt kőzetkémiai eredményei.

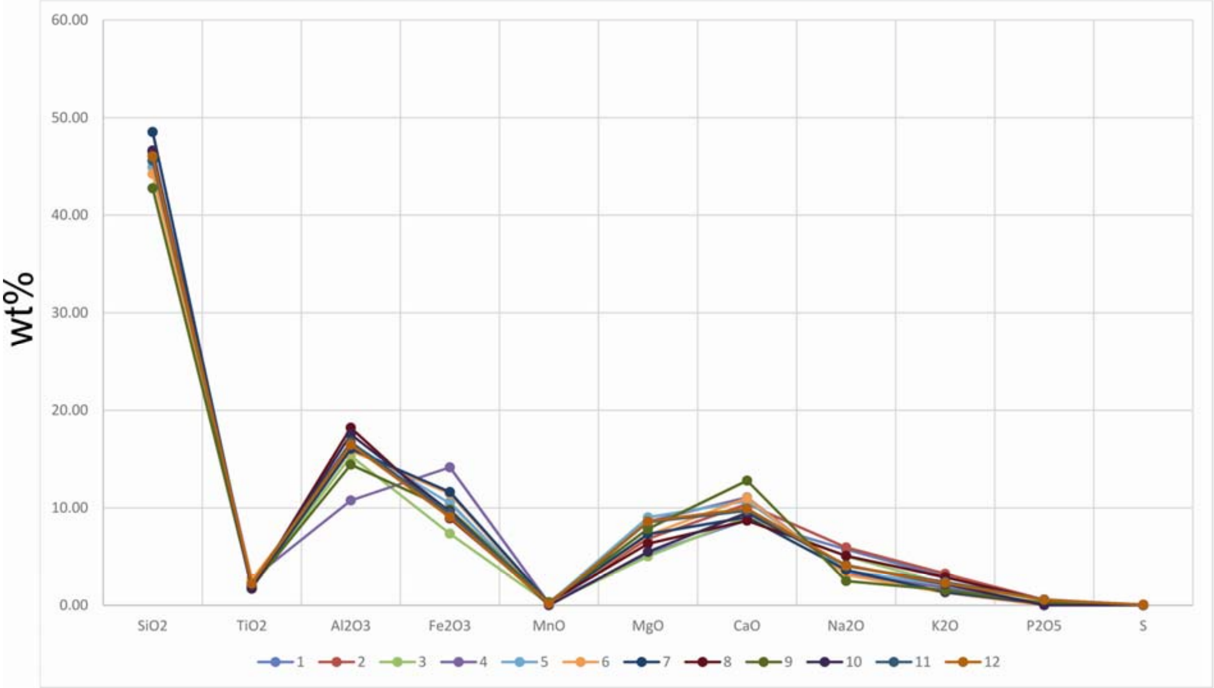


**Fig. 10:** Bulk chemistry results compared with previously published data

1. D19 stone axe mixed with glass sand; 2. Bulhary quarry-alkali basalt mixed with glass sand; 3. Bulhary quarry-alkali basalt; 4. Bulhary limburgitoide basanite (Forgáč 1970); 5. Konradovce nepheline basanite (Forgáč 1970) 6. Filakovo nepheline basanite (Forgáč 1970); 7. Belina nepheline basanite (Forgáč 1970) 8. Badzovce nepheline basanite (Forgáč 1970); 9. Borkul-Bagac nepheline basanite (Forgáč 1970). 10. Average bulk chemistry of basalt fields from North Hungary (Jugovics 1974); 11. Bulhary quarry basanite (Hakulinová et al. 2011.) 12. Bulhary abandoned quarry basanite (Hakulinová et al. 2011.)

**10. ábra:** Kőzetkémiai eredményeink összehasonlítva a korábban publikált adatokkal

Fayalite-content overlaps: in the stone implement is 25-34% and in the alkali basalt is 24-33%. In both samples a few olivine crystals contain smectitic alteration zones inside (Figs. 3 and 4). Zoned clinopyroxenes are present both in the stone axe and the alkali basalt. In the stone axe diopside and augite are determined, from the alkali basalt only diopside is described (**Fig. 5.**). Chemical composition of plagioclases corresponds to labradorite, anorthite content of the stone implement and the alkali basalt overlaps (Fig. 6). The size of labradorite can reach 500 µm in the stone axe, but it is smaller (up to 100 µm) in the alkali basalt (**Figs. 3.** and **4.**). Farsang et al. (2014) described plagioclase megacrystals from more locations in the basalt of Ceres Mountains.

Equant spinel-group crystals distribute in each sample evenly (**Figs. 3.** and **4.**). In the case of stone axe ulvospinel up to 40 µm represents the spinel group, however Ti-rich magnetite is observed in the alkali basalt where the largest crystal reached 200 µm. Spinel xenoliths were recorded in olivines and pyroxenes from both samples (Figs. 3, 4)

Feldspathoids are also noticed in both samples, though the mineral species are slightly different. Sodalites fill the spaces between other minerals in both samples. The size of the sodalite crystals are larger in the Bulhary alkali basalt than in the stone axe: 70 µm and 10 µm, respectively (**Figs. 3** and **4.**).

Natrolite is observed in the stone axe. In the Bulhary basalt a zeolite-like mineral is also detected, however, it cannot be specified on the basis of the chemical composition. Nepheline and leucite are present in the Bulhary basalt, but in the stone axe these two minerals are not proved by EDS/SEM, although nepheline is confirmed by XRD.

Alkali feldspars, namely anorthoclase and sanidine, occur in the alkali basalt, however these minerals were not recognized in the stone axe.

The XRD pattern of Bulhary sample shows several similarities with the stone axe, except some accessories (**Figs. 7- 8.**). Glass phase is not detected one of the samples.

Earlier published data from Ceres Mountains and our bulk chemical data are shown in Table 1 and plotted on **Fig. 10.** as confirmation of the Bulhary sodalite-bearing basalt as the possible provenance of D19 Neolithic polished stone tool. Regarding the major elements, the best matching with our data have the Badzovze nepheline basanite (Ceres

Mountains) (Forgáč 1970) and Bulhary-basanite quarry and abandoned pit (Hakulinová et al. 2011).

The stone implement and the Bulhary alkali basalt show several good matches in mineralogical association according to EDS/SEM and XRD. Sodalite was identifed as rock-forming mineral in both samples. According to Farsang et al. (2014), sodalite is originated from high temperature fluids and described as cavity filling mineral. In the stone implement sodalite is defined as rock-forming mineral among the previously crystallized minerals. It could form from residual melt enriched in incompatible elements (Cl) instead of feldspars or by hydrothermal alteration process from feldspars or glass.

## Conclusions

Considering the mineralogical assemblage, the textures, and the bulk chemistry of the stone axe, the alkali basalt and noting the previously published data (Forgáč 1970, Hakulinová et al. 2011), the D19 stone axe is very similar to the basanites of Ceres Mountains. Primary sodalite-bearing basalt is only described from Bulhary quarry and its surroundings in the Carpathian Basin (Farsang et al.2014, Fehér et al. 2016). According to this fact, the provenance field of D19 stone axe could be Bulhary or its surroundings (Slovakia) (**Fig. 11.**).

Alkali basalt as stone raw material is known in the Neolithic (Szakmány 2009) although detailed studies have not been published yet. Concluding sodalite-bearing alkali basalt as lithic raw material has not been described from the earlier studied polished stone implements yet.

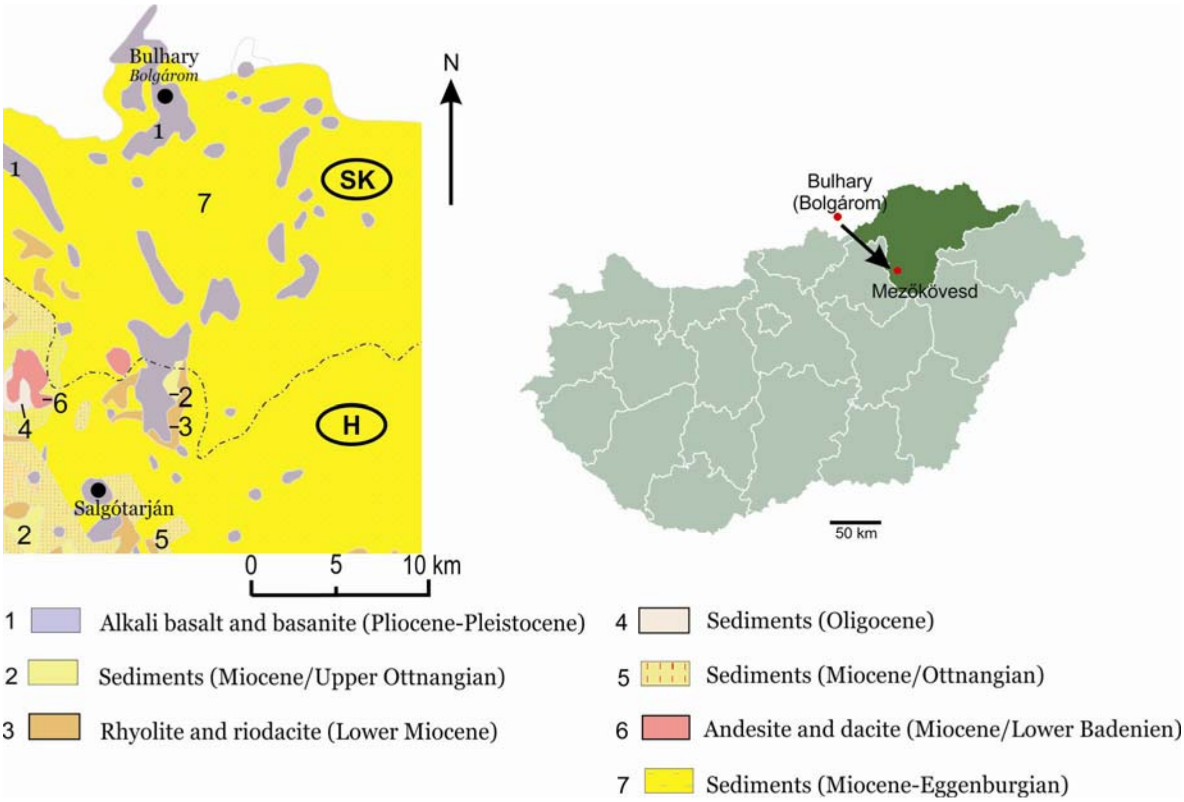


**Fig. 11:** Archaeological locality and presumed raw material source of the D19 stone axe

**11. ábra:** A D19 jelű kőbalta régészeti lelőhelye és feltételezett forrásterülete

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# BASALT UTILIZATION IN THE ARCHAIC PERIOD OF BOLIVIA GEOLOGICAL AND ARCHAEOLOGICAL BACKGROUND•

## BAZALT FELHASZNÁLÁS BOLÍVIÁBAN AZ ARCHAIKUS PERIÓDUSBAN GEOLÓGIAI ÉS RÉGÉSZETI HÁTTÉR

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*"In theory, there is no difference between theory and practice, while in practice there is."*

Benjamin Brewster (1860-1941)

## Abstract

*The motivation of this paper was given by some basalt artefacts found at Pueblo Sajama (Department of Oruro, Bolivia). This small assemblage consists mainly of flakes and does not contain culture-specific artefacts at all. In the absence of the latter, it is unreasoning to focus on the possible cultural affiliation of the assemblage. However, there are some typological characteristics, which suggest rather an elder origin of the artefacts. The detailed review of the lithic assemblage is in progress. Since, according to the available archaeological information on the study area, the environment of the Nevado Sajama is little-known, this attempt of the authors should be regarded as a sort of awareness-raising. Apart from the utilization of various types of obsidians, very little is known about the basalt utilization in the Archaic Period of this territory. This fact is especially surprising as there seems to be numerous evidence of the use of basalt as a lithic raw material. In this summary, the authors try to gather the available facts on the basalt utilization concerning this period. The authors would like to emphasize the fact that this paper does not contain any new results either in a geological or an archaeological point of view. It reflects only the results of the performed data collection.*

## Kivonat

*Ennek a tanulmánynak az indíttatását néhány Pueblo Sajama-ban (Oruro, Bolívia) talált bazalt lelet adta. Ez a kis leletegyüttes főleg szilánkokból áll, és egyáltalán nem tartalmaz kultúra-specifikus leleteket. Ez utóbbiak hiányában indokolatlan, hogy a leletegyüttes lehetséges kulturális kapcsolataira összpontosítsunk. Vannak azonban olyan tipológiai jellemzők, amelyek a leletek idősebb származását sugallják. A leletegyüttes részletes feldolgozása folyamatban van. Mivel a tanulmányozott területről rendelkezésre álló információk alapján a Nevado Sajama környezete régészeti szempontból kevéssé ismert, a szerzőknek ezt a kísérletét egyfajta figyelemfelkeltésnek kell tekinteni. A különböző típusú obszidiánok felhasználása mellett nagyon keveset tudunk a bazaltnak és általában a vulkanikus kőzeteknek, mint kőeszköz-nyersanyagoknak a használatáról a vizsgált terület archaikus időszakában. Ez a tény különösen meglepő, mivel úgy tűnik, hogy számos bizonyíték áll rendelkezésre a bazalt nyersanyagként való felhasználására. Ebben a rövid összefoglalóban a szerzők megpróbálják összegyűjteni a bazaltfelhasználásról rendelkezésre álló tényeket ezen időszakra vonatkozóan. A szerzők hangsúlyozni szeretnék, hogy jelen írás sem geológiai, sem régészeti szempontból nem tartalmaz új eredményeket. Csupán az elvégzett adatgyűjtés eredményeit tükrözi.*

KEYWORDS: BOLIVIAN ALTIPLANO, ARCHAIC PERIOD, RAW MATERIAL PROCUREMENT, BASALT

KULCSSZAVAK: BOLÍVIAI-MAGASFÖLD, ARCHAIKUS PERIÓDUS, NYERSANYAGBESZERZÉS, BAZALT

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## *Introduction*

Several chronologies in the archaeology of the Americas include an Archaic Period. Following Aldenderfer's (2009, Fig. 5.1) chronological scheme for the South Central Andes, the term "Archaic Period" refers to human occupations chronologically situated between, approximately, 10,950 and 3,900 cal BP. Geologically, this period ranges from the Late Pleistocene to the beginning of the Late Holocene. The end of the Archaic Period is associated with the consolidation of agricultural, pastoral, and ceramic technologies, sedentary ways of life, and the emergence of socio-political complexity. Aldenderfer's (2009) general sequence divides the Archaic Period into four sub-chronological periods: Early Archaic (9,500-8,000 BP or 10,950-8,950 cal BP), Middle Archaic (8,000-6,000 BP or 8,950-6,950 cal BP), Late Archaic (6,000-4,500 BP or 6,950-5,250 cal BP), and Terminal Archaic (4,500-3,600 BP or 5,250-3,950 cal BP).

Lately, José M. Capriles and Juan Albarracín-Jordan (2013) attempted to assess the current state and to summarize the available data of archaeological research regarding the earliest human occupations in Bolivia. Their paper provided an overarching synthesis of the history of archaeology, different interpretation frameworks, and results of recent investigations on early human occupations. It also provided information on available radiocarbon dates associated with early human settlements and discussed their archaeological context and implications.

For the time being, on the area of present-day Bolivia, there have been already a large number of archaeological sites which can be related to the Archaic Period. Among them, there are seven sites dated by radiocarbon measurements. For all of the archaeological sites, the original name has been taken, disregarding the fact of the recent revisions in the official spelling for place-names originating from Aymara and the Quechuan languages. A typical change is to replace the digraph (hu or gu), characteristic for the Hispanicized spelling, with the single letter (w) (see e.g. the site Wakolli=Huacolli). In **Fig. 1.** 58 Archaic Period archaeological sites sorted in alphabetical order and the two PAM (Proyecto Arqueológico Mauri) site complexes near Charaña; furthermore the known basalt quarries are represented. In the first part of the paper, only the archaeological sites with reported basalt utilization will be described. During the description, in general, we will follow the north-south direction. The sites were sorted ascending after their latitude coordinate and were numbered from B1-B22. The two PAM (Proyecto Arqueológico Mauri) Complexes got the identification of B23 and B24 respectively.

**Fig. 1.:** Known Bolivian Archaic Period archaeological sites and basalt quarries.

Archaeological sites in alphabetical order

1=Abrigo Clemente, 2=Aguallamaya, 3=Betanzos, 4=Cala Cala, 5=Callapa, 6=Cerro Cobre, 7= Chuñu Chuñuni, 8=Cinti, 9=Corque, 10=Cueva Bautista, 11=Eucaliptus, 12=Huari, 13=Huerta Mayo, 14= Iroco KCH20, 15=Irohito, 16=Iscayachi, 17=Isla del Sol, 18=Jaihuayco, 19=Jiske Molle Pukara, 20=Kayarani, 21=Laguna Colorada, 22=Laguna Hedionda, 23=Laguna Verde, 24=Lagunas de Taxara. 25=Maira Pampa, 26=Maragua, 27=Mecoya, 28=Nuapua, 29=Paja Colorada, 30=Palacio Tambo, 31=Potosi, 32=Pumiri, 33=Quebrada Honda, 34=Quetena, 35=Quetena Chico, 36=Quila Quila, 37=Rejara, 38=Sacaba, 39=Salar de Coipasa, 40=Sama (Tarija), 41=San Agustín, 42= San Bartolomé, 43= San Cristóbal SC-1, 44= San Cristóbal SC-2, 45= San Cristóbal SC-3, 46=San Lucas, 47=San Luís, 48=San Pablo, 49= Santiago de Huata, 50=Soniquera, 51=Taxara, 52=Tomarapi, 53=Viacha, 54=Vila Vila, 55=Viscachani, 56=Wakolli, 57=Wiskachcalca, 58=Yunchará, 59=PAM (Proyecto Arqueológico Mauri) Complex-1, 60= PAM (Proyecto Arqueológico Mauri) Complex-2

Basalt quarries

Q1= Chiñimayu, Q2= Montaña Santa Bárbara, Q3=Palacio Tambo, Q4=Querimita, Q5=San Juan Mallku, Q6=Carapari

**1. ábra:** Az Archaikus Periódus ismert régészeti lelőhelyei és bazalt bányák Bolíviában

The complete list of the sites is the following: B1=Irohito, B2=Aguallamaya, B3=Viscachani, B4=Abrigo Clemente, B5=Iroco KCH20, B6=Wakolli, B7=Tomarapi, B8=Jiska Molle Pukara, B9=San Lucas, B10=Palacio Tambo, B11=Cueva Bautista, B12=San Cristóbal SC-03, B13=San Cristóbal SC-02, B14=San Cristóbal SC-01, B15=San Agustín, B16=Alota, B17=Laguna Hedionda, B18=San Pablo, B19=Soniquera, B20=Quetena Chico, B21=Laguna Colorada, B22=Quetena.

In **Fig. 2.**, the above-mentioned Bolivian (B1-B22) archaeological sites, and the two PAM Complexes (B23-B24) belonging to the Archaic Period, and the identified Bolivian basalt quarries (Q1-Q5) can be seen. For the classification of the raw materials from the provenance point of view, a simplified system has been used, which is based mainly on the radius of the raw material procurement areas, disregarding the geographical situation and the availability of the raw material sources. Each raw material type that can be collected from a distance of not greater than 25 km as the crow flies should be considered as local. The medium distance or regional group is formed by raw materials which can be collected from a distance of 25-80 km. The raw material types stemming from a distance greater than 80 kilometres make up the long-distance group.

In the second part of the paper, a summary will be given on the basalt as a lithic raw material and the possible geological sources of the various igneous rocks.

## *Environment and topography of the area of focus*

In Bolivia's mountainous western region, the Andes reach their greatest breadth and complexity. The system in Bolivia is dominated by two great parallel ranges. To the west along the border with Chile is the Cordillera Occidental, which contains numerous active volcanoes. To the east is the Cordillera Oriental, whose spectacular northern section near La Paz is called Cordillera Real ("Royal Range"). An impressive line of high peaks, some exceeding 6,100 metres, characterize this northern section, which maintains an average elevation of more than 5,500 metres for more than 320 km. Between these ranges lies the Bolivian Altiplano, the main focus area for this paper. The Altiplano, English High Plateau, also called Puna, is occupying parts of Southern Peru, Northern Chile, and Western Bolivia. Its northwestern edge is situated at Lake Titicaca in Southern Peru and it extends about 965 km southeast to the southwestern corner of Bolivia. It consists of a series of intermountain basins, wide valleys between mountain ranges which are partly filled with alluvium, lying at about 3,650-4,000 metres above sea level. Lake Titicaca occupies the northernmost basin, to the south there are the Lake Poopó and the Coipasa and Uyuni salt flats. The basins are separated by spurs reaching eastward from the Cordillera Occidental of the Andes Mountains. On the eastern side of the Altiplano, however, there is a continuous passageway of gentle gradient extending southward across Bolivia.

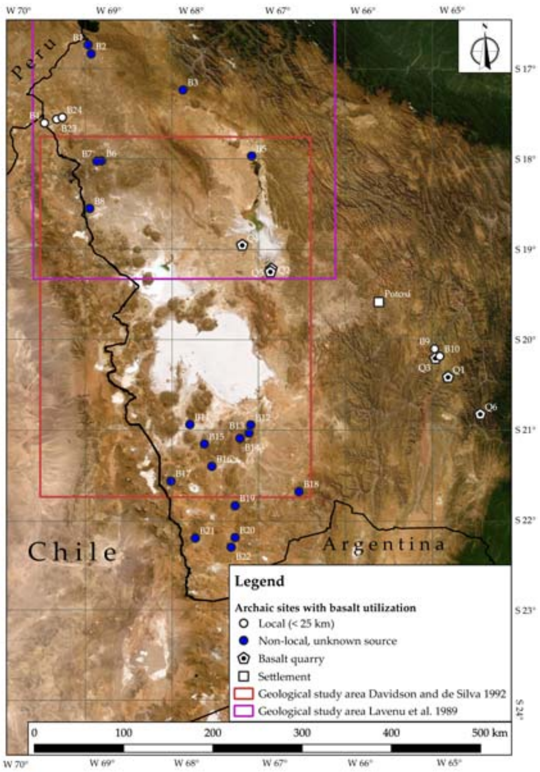

**Fig. 2.:** Bolivian Archaic Period archaeological sites with basalt utilization and basalt quarries

The complete list of the sites is the following: B1=Irohito, B2=Aguallamaya, B3=Viscachani, B4=Abrigo Clemente, B5=Iroco KCH20, B6=Wakolli, B7=Tomarapi, B8=Jiska Molle Pukara, B9=San Lucas, B10=Palacio Tambo, B11=Cueva Bautista, B12= San Cristóbal SC-03, B13= San Cristóbal SC-02, B14= San Cristóbal SC-01, B15=San Agustín, B16=Alota, B17=Laguna Hedionda, B18=San Pablo, B19=Soniquera, B20=Quetena Chico, B21=Laguna Colorada, B22=Quetena, B23= PAM (Proyecto Arqueológico Mauri) Complex-1, B24= PAM (Proyecto Arqueológico Mauri) Complex-2

Bolivian basalt quarries

Q1= Chiñimayu, Q2= Montaña Santa Bárbara, Q3=Palacio Tambo, Q4=Querimita, Q5=San Juan Mallku

**2. ábra:** Bazalt felhasználás az Archaikus Periódus ismert régészeti lelőhelyein és bazalt bányák Bolíviában

The Cordillera Oriental of the Andes forms the eastern boundary of the Altiplano. The Altiplano Basin, a sedimentary basin, is located on the Altiplano plateau between the Cordillera Occidental and the Cordillera Oriental. The basin has evolved through time in a context of horizontal shortening of Earth's crust. The great thickness of the sediments accumulated in the basin is mostly the result of the erosion of Cordillera Oriental (Arnade & McFarren 2019).

The highest peak of the Western Cordillera is the Nevado Sajama, reaching an elevation of 6,542 metres on the eastern side of the cordillera. It is an extinct composite volcano consisting of an andesitic stratovolcano overlying several andesitic-to-rhyodacitic lava domes. The volcano has erupted rocks ranging from andesite to rhyodacite. The mountain has a conical shape and is capped by a summit crater; at lower elevations the whole volcano features glacially deepened valleys. The ground moraines are the most prominent moraines on Nevado Sajama and have varying colours depending on the source of their component rocks.

The water resources of the Nevado Sajama region are made up of the lakes Huaña Kkota, Isla, Chiar Kkota, Inca Ingenio, along with others of lesser size and the rivers Mauri, Sajama, Sabaya, Tomarapi, Copasa, Esquillani and many others of smaller volume which disappear in the dry season. Starting in the lake Laguna Huaña Kkota on the northwestern foot of Nevado Sajama, the Tomarapi River flows firstly eastward, then east, south and southeast around the northern and eastern flanks of the volcano; the Sicuyani River which originates on Nevado Sajama joins it there. The Sajama River originates on the western side of the volcano and flows to the south, increasingly turns southeast before joining the Lauca River. Other rivers draining Nevado Sajama and its ice cap also eventually join the Lauca River and end in the Salar de Coipasa (MISS 2016).

## *Basalt utilization in the Bolivian Highlands*

### 1. The southern part of the Lake Titicaca basin (Fig. 2., B1-B2)

The paper of Adolfo E. Pérez (2006) reviewed the results of a typological analysis made on projectile points obtained from the southern part of the Lake Titicaca basin, from the Archaic Period archaeological sites of Aguallamaya, Chuñu Chuñuni and Irohito and the comparison with those of the South Central Andes region.

The site Aguallamaya (**Fig. 2.**, B2) is located in the Ingavi Province of the Department of La Paz on the banks of the Jacha Jahuira River, a tributary of the Desaguadero River. The site with lithic material is twelve kilometres to the southeast of Irohito and approximately two kilometres from the eastern bank of the Desaguadero River on a natural hill eight to ten metres above the level of the river. The lithic material from the surface collection is composed of several fragmented and entire projectile points together with flakes and knapping waste product mainly of black basalt, and to a lesser extent, siliceous rocks and obsidian. It is presumed that it is a lithic workshop (Álvarez 1999, 12). In the photographs and scaled drawings, it is observed that the fragments of the projectile points belong all to the proximal part of the said instruments, so it is possible that in this site have been carried out tasks of their production and maintenance. Among the artefacts, there is a projectile point of grey basalt related to the unstemmed forms with rounded shoulders of Series 2 (Pérez 2006, 22, Fig. 8, A-01). The pentagonal shape with wide straight or slightly convex base resembles the Type 2C of Klink and Aldenderfer. This type of projectile points is considered as diagnostic of the Middle Archaic between the years 8,000 and 6,000 BP. (Klink & Aldenderfer 2005, 34). The other grey basalt projectile point of triangular shape with pointed stem and little marginal retouching (Pérez 2006, 22, Fig. 8, A-02). It has no relation to any of the types proposed by Klink and Aldenderfer (2005). This type of projectile point can be considered as a local variant of the Middle Archaic (8,000 – 6,000 BC).

Irohito (**Fig. 2.**, B1) is located in the Ingavi Province of the Department of La Paz at a height of 3,810 m.a.s.l. on the eastern shore of the Desaguadero River. No research has been conducted on the site focused particularly on the Archaic Period. However, during the excavation and renewed surface collection, lithic material could be registered, and specifically, some projectile points (Pérez 2005). In the southern sector of the site, at a distance of 50 metres from the shore, there is a small hill approximately six metres high correlate with the river level. Several artefacts and some projectile points were collected in an area of approximately 5 $m^2$. A black basalt projectile point was found in stratum IV-2 in the east sector of the site (Pérez 2006, 21, Fig. 7, H-02). It does not have a direct relationship with the typology of Klink and Aldenderfer (Klink & Aldenderfer 2005). It could only be compared with the unstemmed form of Series 4 of these authors, but the comparable type (4F) differs in several important aspects (Klink & Aldenderfer 2005, 42). According to Pérez, it is likely that this type can be considered as a local variant within the Archaic Terminal (4,400 – 3,600 BC) (Klink and Aldenderfer 2005, 47).

### 2. Viscachani (Figs. 2-3., B3)

The site of Viscachani is located in the northern part of the Altiplano, along the road between La Paz and Oruro, near the settlement of Huancarani at 3,820 metres above sea level. Around the village of Viscachani an area of about six to seven hectares covered by stone artefacts. The main concentration is in the eastern part, with an extension of at least 400 $m^2$. There appear several cores, modified flakes, bifaces and monofaces, as well as scrapers and projectile points of different shapes. The raw material is first of all dark red quartzite and green quartzite. Eastwards from the site, the Viscachani River meanders through the valley, cutting a plain extended to a level lower than the site and interpreted as the rest of an old lake. Surface collections carried out between 1954 and 1960 produced over 9,000 artefacts. Excavations conducted at the site firstly included five test pits, shortly after the preliminary report of the site, and

30 additional test pits conducted in 1960 in collaboration with German scholars. No substantive stratigraphy was documented from the excavations, due to a combination of agricultural ploughing and soil erosion (Capriles & Albarracín-Jordan 2013).

Within the framework of the doctoral thesis of Yara Lizarraga-Mehringer (2004), supervised by Prof. Dr G. Bosinski, two field investigations were carried out in 1995 and 1996, to find the exact location of the different archaeological sites and registering the existence of raw material deposits. As a result of these field works, it was possible to locate a small hill in Viscachani with deposits of sandstone and green quartzite in the form of fragments and slabs. In the nearby river, there is quartzite of different colours and other raw materials in the form of boulders. After a second, more detailed field investigation, systematic and restricted excavation of a square metre trench was carried out in Viscachani.

The total surface collection consists of an approximate number of 13,000 specimens. The archaeological artefacts of Viscachani were made of different raw materials. There are metamorphic, sedimentary and magmatic rocks, as well as microcrystalline siliceous rocks among the lithic artefacts. The classification of the raw materials was made by the geologist Ramiro Suárez S., Jorge Mitchell and Rolando Mocobono of the petrographic laboratory of YPFB (Yacimientos Petroliferos Fiscales Bolivianos). A large part of the Viscachani lithic artefacts (73.21 %) was made of local quartzite. The second largest group consists of magmatic rocks (14 %) and siliceous rocks (9.54 %). Among the magmatic rocks, dark grey or black basalt stands out with 89.83 %. Its texture is fine and is provided with small crystals. The reddish, pink and lilac trachyte covers 9.21 % of all igneous rocks present. This raw material has a porphyritic structure with small crystals. Lizarraga-Mehringer emphasized the fact, that the exact origin of basalt, trachyte and obsidian, used in Viscachani, is unknown. She suggested that presumably these raw materials were brought to the site from the western mountain range. This area is located at a distance of approximately 150 kilometres from Viscachani and available via the safe natural path formed by the Desaguadero and Mauri rivers. Also the origin of the fine-grained rocks, like silex, chert, flint and microcrystalline quartz varieties like agate, opal and other subforms of the chalcedony, from which finely worked artefacts were made, could not be determined with precision. Lizarraga-Mehringer summarized the statistical data on the raw materials of the surface collection at Viscachani. Observing the spectrum of the raw material used in other archaeological sites of the leaf-point tradition, that is, of the „Ayampitín" inventory of the highlands of the Andes, such as that of the rock shelter Telarmachay in the district of San Pedro de Cajas, Junin, Peru (Julien et al. 1987) and comparing it with that of Viscachani, it is obvious that these are the same raw materials, even when they are present in different quantities.

The 466 lithic artefacts from the 1997 excavation were also made of very different raw materials. Like in the case of the surface artefacts, the metamorphic and sedimentary rocks are here also the most represented with 76.61 % (357 pcs.). Unlike the surface findings, the igneous rock artefacts from the excavation (6.65 %: 31 pcs.), are less represented than those made in microcrystalline siliceous rocks (7.08 %: 33 pcs.). Among the metamorphic and sedimentary rocks, fine and coarse-grained quartzite of different colours are also present. The black basalt stands out from the magmatic rocks (77.42 %), trachyte, on the other hand, are less represented.

Patterson and Heizer (1965) carried out a technological and stylistic analysis on a selected sample set consisting of 63 artefacts of Viscachani stone tools. The sample was predominated by projectile points. It was found that 58 of the 63 artefacts are made of quartzite of different colours. Concerning the other artefacts, it is a pink chalcedony side-scraper, two small lanceolate projectile points of red jasper and two pedunculated points of a specific type of andesite (hornblende andesite). On the basis of the analysis, the bulk of the assemblage was similar to the earliest („Ayampitín") level of Intihuasi Cave (8,060±100 BP (P-345); Prates et al. 2013), in Northwestern Argentina, and the Luz (ca. 5,500 BC) and Canario (ca. 4,950 BC) complexes of the Peruvian coast. Exceptions included small stemmed points, characteristic of Laguna Hedionda and the Pichalo Preceramic II of Northern Chile, dated to approximately 2,000-3,000 BC. As regards the projectile points, according to Lizarraga-Mehringer, the Viscachani findings can be compared, more appropriately, with those of the Camarones 14 and Hakenasa sites in Northern Chile, because in these sites similar elongated triangular tips are found along with simple foliaceous projectile points. As a consequence, Viscachani was interpreted as a "typical" Archaic Period settlement associated with an adaptation to highland hunting and gathering, an interpretation still employed by many researchers (Lizarraga-Mehringer 2004, 245; Capriles & Albarracín-Jordan 2013). On the whole, it can be stated, that both from typological and raw material utilization point of view, the lithic assemblage of Viscachani suggests distant cultural connections.

## 3. Mauri and Pampa de Charaña (Figs. 2-4., B4, B23-B24)

Abrigo Clemente (Figs. 2-4., B4)

A very important site identified by Arrellano and Kuljis is the rock shelter Abrigo Clemente Coat. This cave has evidence of continuous occupations that left remains of projectile points, bifacial knives, bifacial preforms, flakes, cores and knapping waste products (Arellano and Kuljis 1986, Michel 2000). The projectile points have various forms, there are lanceolate, stemmed, notched and small triangular and rhomboid points as well. The knives are lanceolate and asymmetrical, of varying sizes, the preforms of projectile points are of lanceolate shape with base. The raw material includes basalt, high-silica rhyolite and obsidian.

Markenasa Valley, PAM (Proyecto Arqueológico Mauri) Complexes (**Figs. 2-4.**, B23-B24)

Along the banks of the Mauri River, numerous lithic workshops and shelters had been identified by Arrellano and Kuljis (1986) in rocky eaves located on the old terraces of the Mauri and in the Pampa de Charaña. The lithic assemblages included secondary flakes, fragmented bifaces, end-scrapers and side-scrapers which were classified within the preceramic period. However, since the artefacts are always found with remains from the Late Intermediate Period, there are some doubts about this classification. The raw materials are varied (quartz, opal, dacite, basalt, etc). The identified artefacts at the sites of Pando and General Campero had wide typological diversity and forms, which would imply that the place was successively occupied. A detailed typology describes the lanceolate and triangular forms of this complex made of varied raw materials of basalt, dacite, opal, rhyolite and other materials possibly brought from the south. More recently, field surveys were made in the Markenasa Valley, near Charaña by Vanessa Jiménez (2013). Eighteen open-air sites and seven rock shelters were documented. At two of the rock shelters (PAM-5 and PAM-06) test excavations were carried out, which yielded stratigraphic and projectile point sequences, comparable to the nearby site of Cueva Hakenasa in Northern Chile (Osorio et al. 2011). Regarding the raw material utilization, different types of volcanites of likely local origin, such as basalt, black basalt, olivine basalt, dacite, hornblende dacite, rhyolite, trachyte, trachyandesite dominate in all lithic assemblages.

## 4. Iroco KCH20 (Fig. 2., B5)

Iroco is located at the northern margin of Lake Uru-Uru west to Oruro. Here, fieldwork has been carried out since 2003. During systematic high-intensity, full-coverage surveys of a large area of about 38 km$^2$, 35 Archaic Period settlements were documented. In 2005, systematic collections and excavations were conducted at one of these sites, at KCH20. On the whole, 4,439 lithic artefacts were collected from the surface, mainly consisting of flakes and debitage products (91 %). The most frequent raw material was black basalt (62 %), followed by two types of chert (23 %), and other less frequent raw materials, including obsidian. Black basalt probably originated from Querimita, from the formerly mentioned quarry located at the southwestern shore of Lake Poopó (Capriles et al., 2011; Capriles & Albarracín-Jordan 2013; Capriles et al. 2017).

Excavation Unit 6 contained 146 lithic artefacts. The majority of the assemblage was manufactured from non-local black basalt; other non-local raw materials included chalcedony and various kinds of large dark-coloured chert cobbles. In the environs, there are small nodules of a variety of cherts, which seemed to have been occasionally used. Most sources of good quality cherts are situated between 40 and 120 km towards the eastern Cordillera. The best source of igneous extrusive, high-quality basalt is Querimita, situated approximately 110 km to the south of Iroco (Giesso, 2003). Some of the outcrops are dispersed mainly to the south of Querimita (Montaña Santa Bárbara and San Juan Mallku), but still substantially far from Iroco. In the case of black basalt flakes, no cortex was observed. It is thus very likely that primary preparation occurred at the quarry and black basalt was entering the site in the form of prepared cores, blanks, preforms or finished tools. All three projectile points were made on black basalt. The evidence, that most stone tools were manufactured with non-local raw materials, suggests the hypothesis that highland foragers engaged in relatively high and possibly seasoning mobility. The two shouldered and stemmed „Patapatane" style projectile points indirectly suggesting an Early Archaic Period age of the site. The two samples of bone recovered from the trash pit feature were AMS dated 9,304-9,033 cal BP (AA91568) and 9,115-8,774 cal BP (AA91569). Both dates produce the range estimate of 9,396-8,985 cal BP for the feature.

## 5. The Sajama region and surrounding areas (B6-B8)

Before the Inca period, the Lordship of Carangas was one of the last developed cultural entities in the Altiplano of Bolivia. It had its roots among the hunter-gatherers who inhabited the vast plain of Oruro and its foundation in the rich formative tradition of the Wankarani Cultural Complex. The study of Marcos Michel (2000) intended to be an introduction to the complex problem of the regional cultural developments of the Bolivian highlands, being one of the first attempts in archaeology to try to understand the phenomenon of the formation of the so-called "Señoríos", "Pre-Columbian Reynos" and also "Señoríos post Tiwanaku". The study was based on archaeological field survey carried out in 1993 when 16 archaeological sites were documented on the margins of Lake Poopó. The area of this work included the basin of Lake Poopó, the Huayllamarca mountain ranges to the northwest and the Pampa Aullagas region to the southwest. Later on, the roads to the Sajama region were taken as a sample reference for the evaluation, considering that these roads are crossing the region in different directions thus forming transects. A stratified sampling work carried out in the vicinity of these roads allowed the identification of 43 archaeological sites.

Among the localized sites, there were some with lithic archaeological assemblages which correspond to the first hunter-gatherers of the Altiplano, although the chronological interpretation of the sites has encountered many problems. The archaeological material is generally mixed on the surface without any sediment present or stratigraphic position that would provide the sequence of artefacts with a proper excavation. On the other hand, the comparisons of the lithic materials, to make comparative-typological dates, were always made concerning distant regions.

Wakolli (**Figs. 2-5.**, B6)

The site of Wakolli (Estancia Huacolli) is located at the small settlement with the same name, which can be accessed by a road from Tomarapi. The site covers approximately one hectare and is located next to an area with an abandoned church, one kilometre to the west of the bed of the Tomarapi River. Although the majority of the material from this place is dated to the colonial period, projectile points from the Archaic period were also collected. The shapes of the collected projectile points are varied, but the majority is oval and elongated forms worked with bifacial retouching made by percussion technique, the triangular forms with a semicircular base, or with a rectangular tongue and the large oviforms with double wings and a central notch. There are many large and small knives obtained by retouching and micro-retouching at the edge of the flakes. This material has characteristics similar to the projectile points of the Archaic Period of northern Chile. Although some of the above-mentioned projectile point forms are similar to those found along the Mauri River, the types of raw materials (black basalt) and the existence of greater variability of artefacts in this region suggest that the Carangas sites correspond to some form of archaic regional development.

Cueva de Tomarapi (**Figs. 2.**, **5.**, B7)

This site is located in the Sajama region, north of the Tomarapi bridge. It consists of two caves, a large one and a small one; both were used as habitat sites and also served for the execution of mural paintings. A lithic workshop for the production of hoes, knives, arrowheads and other tools made of black basalt was located concerning the larger cave. The ceramics and lithic artefacts found within a radius of 50 m which represent local characteristics of continuous occupation, from a hunter's epoch to the times of Carangas and of Inca occupation.

Jiska Molle Pukara (**Figs. 2-3.**, B8)

It is a lithic workshop located at the foothills of the hill with the same name south of Nevado Sajama, which extends to a plain near the Macaya lagoon. The site presents abundant remains of lithic material worked in black basalt: knives, side-scrapers, hoes, arrowheads and remains of slabs and manufacturing waste: cores, flakes, debitage products, covering an area of about 1 hectare. According to the characteristics of the lithic and ceramic material, it can be said that the site was occupied from the Archaic Period until the Carangas times.

### 6. Pueblo Sajama

In his doctoral thesis, Adam Birge (2016) dealt with the issue of the so-called Sajama lines in western Bolivia. These are a network of ritual trails that cover an estimated area of 22,000 km$^2$ and connect forts (pucara), ancient Aymara funerary towers (chullpa), villages and chapels. During his field surveys in the environment of Pueblo Sajama, mainly in the valley of the Tomarapi River, Birge documented 13 lithic artefacts as well. Out of these, he recorded five modified flakes, four ground stones, three preforms, and one core. The most common type of raw material was basalt, but two examples of obsidian and two white chert preforms are also reported. The lithic artefacts distributed across different types of sites. According to Birge, the lithics may be from prehistoric contexts, but cannot be discarded the possibility that they originate from later archaeological contexts. In connection with the site of “Chapel N1”, Birge mentioned, that: “*The site was also the only place where we found possible lithic projectile points*.” (2017, 7).

### 7. Southwestern Bolivia (Figs. 2., 5., B11-B22)

Cueva Bautista (**Figs. 2.**, **5.**, B11)

Field survey and excavations were conducted in the Sora River Valley in southwestern Bolivia in 2008 and 2010. It is a small watershed, which is located between San Agustín and Alota, along the southern edge of the Lípez Desert. As a result of the surveys, 17 Archaic Period settlements were documented, of which 11 proved to be caves and rock shelters. Some of these sites include evidence of occupation earlier than 9,500 BP or 10,950 cal BP. In 2008, a 1 m$^2$ test pit was excavated in Cueva Bautista, situated at 3,932 metres above sea level. The unit was located at the centre of the cave and produced a 1.8 m deep stratigraphic sequence. A charcoal sample from this occupation surface was AMS dated to 10,917±69 BP or 12,684-12,878 cal BP

(AA84158). Lithic artefacts recovered from the Late Pleistocene stratum at Cueva Bautista included five light brown chert flakes, one red jasper flake, one chalcedony flake, five obsidian flakes (one with retouch), and one black basalt flake. Most of the identified lithic raw materials are locally and regionally available, but the closest known obsidian source is Laguna Blanca/Zapaleri, near the Bolivian-Chilean-Argentinean border, and roughly 150 km south of the site (Nielsen 2004; Yacobaccio et al. 2004; Seelenfreund et al. 2010). The research in Cueva Bautista involved excavations of 20 contiguous one-metre units, the first of which was initially excavated as a test pit. The complete recovered lithic assemblage consists of 439 artefacts, some formal tools and debitage products. The majority of the artefacts (384 pcs.) correspond to the Late Pleistocene occupation. Among them, there are three black basalt flakes. Obsidian is the most common raw material, followed by an extremely fine homogenous chert. XRF (X-Ray Fluorescence) analyses were carried out on an obsidian sample. The source of the analysed obsidian is a previously unknown outcrop of Cerro Kaskio (Cerro Kasquiu), located 15 km southwest from Cueva Bautista (Albarracin-Jordan & Capriles 2011; Capriles & Albarracín-Jordan 2013; Capriles et al. 2016; Capriles et al. 2018). The possible provenance of the black basalt was not discussed at all.

South Lípez Province (**Figs. 2., 5.,** B12-B22)

In 1958, an expedition of the University of Cambridge explored the salt lakes of Atacama Desert, in Northern Chile. Besides, field surveys were taken in the environment of the adjacent highland lakes of the Lípez Desert, in Southwestern Bolivia. As a result of these surveys, several preceramic sites were reported mainly from Laguna Colorada (**Figs. 2., 5.,** B21) and Laguna Hedionda (**Figs. 2., 5.,** B17). Among the lithic artefacts collected from the sites, several projectile points were described by Lawrence Barfield (1961). In Barfield's interpretation, the typological similarity, observed between the „Puripica" (Northern Chile; contemporary with „Ayampitín" of the Inti Huasi Cave in Northwestern Argentina) and the assemblage of „Colorada" "give an indication of a long tradition of hunting in the area, but at present can only be tentatively fitted into a cultural or chronological scheme" (Barfield 1961, 96).

Around the shores of the Laguna Hedionda (**Figs. 2., 5.,** B17), five sites were localized, one of them, the earliest one, Site V was a one-period encampment, where numerous flakes and broken „Puripica" type projectile points made on black basalt, scattered near the water's edge, were collected. At the cave site, Site IV, a little excavation was carried out. The lowest deposit of the cave, Layer 12 contained tiny flakes of basalt, refuse from the secondary flaking of stone implements. In the layer above, in Layer 11b, the basalt flakes were accompanied with basalt tools and chips of obsidian and quartz.

Le Paige (1964) carried out explorations in the Atacama Desert of Northern Chile and made some explorations in the Bolivian part of southern Altiplano. He documented sites in the southwestern part of the Province of Potosí. Several artefacts had been collected from the sites of San Agustín (**Figs. 2., 5.,** B15), Laguna Hedionda (**Figs. 2., 5.,** B17), San Pablo de Lípez (**Figs. 2., 5.,** B18), Soniquera (**Figs. 2., 5.,** B19), Quetena Chico (**Figs. 2., 5.,** B20), Laguna Colorada (Figs. 2, 5, B21), Quetena (**Figs. 2., 5.,** B22), and described them as mostly manufactured from black basalt and some local raw materials. According to Le Paige, the occupations in Southwestern Bolivia correspond well with the chronological phases he identified in the different environments of the Atacama Desert.

Jorge Arellano López (1984; 1987) was working in Lípez and reported Archaic settlements near Alota (**Figs. 2., 5.,** B16), San Pablo de Sud Lípez (**Figs. 2., 5.**, B18), Soniquera (**Figs. 2., 5.,** B19), and Quetena (**Figs. 2., 5.,** B22). Without any absolute dates and chronology, he gave a functional interpretation and described three types of located sites: lithic workshops, temporary camps (paraderos) and hunting camps. In general, the lithic workshops were located on top of terraces of rivers. At such lithic workshops, he found that principally two classes of raw material were used for the artefacts: basalt of black colour and devitrified obsidian of olive green colour. Along the rivers of Lípez and Quetena, four further sites were localized. Each of the sites has a close relationship with each other in terms of typology of artefacts (especially projectile points) and of raw material (black basalt, devitrified greenish obsidian, opal and milky quartz). Arellano López interpreted the site of Ichu Pampa as a hunting station. The lithic artefacts range from projectile points of various types to side scrapers, end-scrapers, borers and retouched flakes. However, in the close vicinity of the site, there is no similar raw material source to manufacture these instruments (Arellano López 1987; Capriles & Albarracín-Jordan 2013).

## 8. Nor Cinti Province in Chuquisaca (Fig. 2., B9-B10)

The region of San Lucas is located in the Nor Cinti Province of the Department of Chuquisaca, which physiographically corresponds to the sub-Andean valleys or torn puna. Within the study region, different formations and geological units are present, consisting mainly of sedimentary rocks such as sandstones, shales, limonites, marls, limestones and claystones. Also, quartz and various types of quartzite are common. Claudia Rivera

Casanovas and Sergio Calla Maldonado (2011) have recently carried out systematic field surveys in the region. In the San Lucas region, a total of 33 sites belonging to the Archaic Period were recorded (8,000-2,000 / 1,500 BC), 14 of them are in the San Lucas valley (**Fig. 2.,** B9) and 19 in the Palacio Tambo (**Fig. 2.,** B10). Among the reported sites, about 58 % were located in the high sierra and 42 % in lower quebradas. In the frame of their work in the valley, they cleaned up a naturally occurring profile in a river cut. For the site of SL79, an AMS date of an unearthed hearth produced the date of 7,041±60 BP (OZK-824) or 7,745-7,925 cal BP. They provided a typology of projectile points and other stone tools that suggests people in the valleys and the highlands shared a similar technological tradition.

The raw materials used in the lithic assemblages were not locally available in the San Lucas valley, while in Palacio Tambo (**Fig. 2.,** Q3) they were immediately accessible. Preferably, the regional raw material was favoured, followed by local ones, basalt and quartzite, respectively, present in geological formations of the region at close and relatively short distances. Other varieties of materials that occur in a lesser proportion in the analyzed sets are flint, chalcedony and milky quartz. Interestingly, despite its immediate availability, quartzite had a smaller impact on the archaeological record of the region, especially in the valley of San Lucas where there is an immense quarry. The reduced exploitation of quartzite contrasts with the high use of basalt in the lithic assemblages. In the case of basalt, the mobility circle for obtaining this raw material pose wider contact dynamics, since obtaining them involves relatively larger distances to travel, especially for the groups of the San Lucas valley. The sources of basalt identified in the region are at distances of 15–20 km within the study area and 40 to 100 km away from it.

The main procurement areas are to the south and the east of the region and can be divided into four sectors. The closest source is in the Palacio Tambo area, where the basalt appears in the bed of the rivers in the form of boulders. The human groups of the San Lucas valley had to travel between 15 and 20 km to access this raw material, while those of Palacio Tambo had it close.

The second area is in the Chiñimayu region (**Fig. 2.,** Q1), where there are sources of basalt from the Cretaceous period. This is 39 km away from the sites located in the northern sector of the San Lucas Valley and 14-17 km away from the sites located in Palacio Tambo. Other far basalt quarries are located in the Caraparí area in the Corral Blanco (**Fig. 2.,** Q6) and Algodonal mountains to the southeast. The distance from Cerro Algodonal to the valley sites is approximately 110 km and 95 km to the sites located in the Palacio Tambo area. The distance from the Corral Blanco hill to the valley is approximately 100 km and up to the sites located in Palacio Tambo is 75 km. X-ray diffraction analysis of the samples has not yet been carried out to obtain the most accurate location of the basalt sources used in the past.

This feature contrasts with data from other sites in this period in which local supply mechanisms were chosen. There is a preference for basalt for the construction of projectile points, perhaps due to certain technical characteristics or a sense of social differentiation between groups and/or individuals. Access to the basalt sources located to the southeast of the region would have been realized by following the courses of major rivers that lead to the Pilcomayo River and the Chaco regions. These routes could also have greater implications on the regional interaction with groups from the foothills of the Chaco region in Argentina.

## *Basalt as a lithic raw material*

In the archaeological literature, the use of names of various types of igneous or volcanic rocks is frequently wrong or inconsequent from a petrological point of view. That is why we should clarify some essential terms in the first place. By the short characterization of basalt, and in general the igneous rocks, we leaned on mainly on the classification scheme of the British Geological Survey (Gillespie & Styles 1999) and the study edited by Le Maitre, R. W. and colleagues (Le Maitre et al. 2005).

According to chemical parameters, igneous rocks can be classified by the Total Alkali-Silica (TAS) classification. The system contain 17 root names, common types of igneous rocks (basalt, basaltic andesite, andesite, dacite, rhyolite, trachybasalt, basaltic trachyandesite, trachyandesite, trachyte, trachydacite, picrobasalt, basanite, tephrite, phonotephrite, tephriphonolite, phonolite and foidite), based upon the relationships between the combined alkali content and the silica content (Le Bas et al. 1986; Le Maitre et al. 2005, 35, Fig. 2.14). The felsitic volcanic rocks contain high silica content, greater than 63 % $SiO_2$ (for example trachyte and rhyolite), intermediate volcanic rocks are between 52–63 % $SiO_2$ content (examples are andesite and dacite), and mafic volcanic rocks have low silica (45–52 %) and typically high iron–magnesium content (for example basalt). Certain igneous rocks will be called aphanitic if the rocks are so fine-grained that their rock-forming mineral crystals are not detectable by the naked eye. The geological texture may have been the result of rapid cooling in igneous or shallow subsurface environments. Several common igneous rocks can be aphanitic (examples are andesite, basalt, dacite, rhyolite).

As per the definition of the International Union of Geological Sciences (IUGS) classification scheme, basalt is an aphanatic volcanic rock, with generally 45–53 % silica ($SiO_2$) (Le Bas & Streckeisen 1991). Basalt commonly features a very fine-grained or glassy matrix interspersed with visible mineral grains. Basalt is usually grey to black, but rapidly weathers to brown or rust-red due to oxidation of its mafic (iron-rich) minerals into hematite and other iron oxides and hydroxides. Basaltic rocks exhibit a wide range of shading because of regional geochemical processes. Due to weathering or high concentrations of plagioclase, some basalt variants can be quite light-coloured, superficially resembling andesite. Basalt has its fine-grained mineral texture due to the molten rock cooling too quickly for large mineral crystals to grow.

As regards the flaking quality of various volcanic rocks, it can be stated that the raw materials for flaked stone tools must fracture conchoidally. Furthermore, they should be elastic, but brittle, and homogeneous both in crystalline structure (amorphous or cryptocrystalline) and in lacking cracks, inclusions or other flaws. The crystalline structure is the most important factor in how easily a given raw material works. The toughest and least amorphous raw materials like basalt and other volcanic rocks are hard to work, and the fracture surfaces are usually rough, with a grainy or sugary texture. The slower the volcanic rocks cooled, the more different minerals sorted out into crystalline formations. For this reason, the flaking qualities are variable, ranging from fairly homogeneous, to coarsely grained, to completely unflakeable. Some basalt variants, in particular, are often porous or vesicular, that is, being pitted with many cavities at its surface and inside. (Whittaker 1994, 66, 69)

## *Basalt occurrences of the Bolivian Altiplano*

The names and terminology applied to different kinds of igneous rocks can be quite confusing for archaeologists. Various terms may refer to rock texture, mineral constituents, or chemical composition. Many names with vague or poorly defined meanings have been applied over the years to the great variety of rocks formed by cooling from magma or lava. That is why, in the literature, concerning the igneous rocks (volcanites) based mainly on classifications made by naked eye view, sometimes incorrect terms can be found. If it is possible, we try to review the known geological availability of several volcanite types, other than basalt.

The Central Volcanic Zone (CVZ) of the Andes is located between latitudes 14° and 29° S of the Andean Cordillera. It is an elevated region, much of it over 4,000 m in altitude (constituting the Altiplano of Bolivia and Puna of northern Chile and Argentina) and forms the western boundary of the Altiplano plateau (de Silva et al 1993; Stern 2004). In CVZ the volumetrically weighted average composition of erupted material is predominantly andesitic in composition, and instances of true basalts (< 52 % $SiO_2$), are rare. Small volcanic centres containing a wide range of igneous rocks (basalt to dacite types) are distributed sparsely over the Bolivian Altiplano, behind the Andean volcanic front. There are three main areas in which the centres are located (Davidson & da Silva 1992; 1995, 388, Fig. 1b). ( 1) immediately behind the arc in the region of Nevado Sajama, (2) immediately behind the arc in the region of the volcano Ollagüe, a massive stratovolcano on the border between Bolivia and Chile, and (3) farther to the east in the Altiplano.

(1) The centres near Nevado Sajama are trachybasalts from small cinder cones. It has a composition between trachyte and basalt, or basalt with high alkali content.

(2) The region to the east of the volcano Ollagüe covers a wide area and includes both silicic andesite and dacite flow complexes and trachybasalt cinder cones. The most evolved centres are located in the Pampa Luxsar region just to the north and northwest of Cerro Luxsar, a Pliocene to Pleistocene composite cone.

(3) The minor centres further to the east on the Altiplano define two broad lineaments subparallel to the line of the arc.

The central Altiplano group comprises basaltic trachyandesites to dacite flows that form isolated plugs or mesa-like flows. The age relations of these again suggest Pliocene to Pleistocene time range. Two small maars (broad, low-relief volcanic craters), between Salar de Coipasa and Salar de Uyuni, Jayu Kkota and Nekhe Kkota are much younger and are probably dated to the Holocene. Chiar Kkollu is a small isolated hill formed by an alkali basalt sill. The lava of this tabular sheet intrusion is fine- to medium-grained olivine-porphyritic basalt. Further to the east, a second lineament occurs along the southwestern edge of Lake Poopó. Rocks here vary from basalts to andesites, which are microporphyritic and contaminated (Davidson & da Silva 1992; 1995).

The quarry of Querimita is located on the southwestern shore of Lake Poopó. This is the only major basalt quarry in the Bolivian Altiplano that has been identified. Basalt cores were pre-formed, worked later in sites, mainly for the manufacturing of different basalt implements. Large amounts of debris accumulated outside the quarried areas and still litter the surface of the basalt outcrop. It is a clear indication of intensive exploitation during several periods of Bolivian prehistory. Martín Giesso from the Illinois University in the USA employed NAA (neutron activation analysis) on the excavated basalt lithic artefacts at Tiwanaku heartland sites. For the majority of the samples, the analysis proved their provenance from Querimita quarry. However, several samples were not from Querimita, implying that one or two other basalt quarries were in use (Giesso 2011, 142).

Besides the main basalt quarry of Querimita, south to the Lake Poopó, at San Juan Mallku and Santa Bárbara in Quillacas, there are additionally basalt outcrops. Michel López (2008) suggests that Querimita, at a lower degree, San Juan Mallku and Santa Bárbara and the Formative Period site of Casca Kollu were part of a network of extraction quarries and basalt distribution on the south side of Lake Poopó that was also sustained by the main basalt formation.

The following basalt occurrences are very closely linked to the region of Nevado Sajama. In connection with the Neogene magmatism (20.0 to 1.6 Ma) in the Bolivian Andes, Lavenu and colleagues (1989) collected several samples from pyroclastic lava flows. According to the authors in the so-called Mauri Formation, in the Berenguela–Charaña region of the Northwestern Altiplano, basalts and basaltic andesites are common in the lower part, whereas dacitic tuffs and dacitic pumice clasts are dominant in the middle and upper parts. The Abaroa Formation crops out in the same area as the Mauri Formation and consists mainly of dacitic flows. Jiménez and colleagues (1993) mentioned the presence of basalts and andesites, which have $SiO_2$ content ranging between 46 to 56 %.

In **Fig. 3.**. a location map of Central Bolivia can be seen after Lavenu and colleagues (1989, 36, Fig. 1). A single dot pattern area shows the Oligocene-Miocene sediments, the Mauri and Abaroa Formations. Numbered stars indicate the location of analyzed samples taken from pyroclastic lava flows (1=BO-3, 2=LA80-2, 3=PH43, 4=LA80-6, 5=LA80-4, 6=LA80-5, 7=BO4, 8=LA81-4, 9=PH48, 10=PH75, 11=LA82-2, 12=BO7, 13=LA82-1, 14=PH53a, 15=MB158, 16=MB161, 17=MB159, 18=MB160, 20=MB154, 21=MB153, 22=PHM1, 23=PHM2). Based on the petrographic description, the analyzed samples came from andesite lava flows (4, 6, 7), from basalt lava flow (1), from dacitic lava or ash flows (3, 5, 9, 11, 13, 22), rhyolitic lava or ash flows (8, 10, 14). The central and northwestern Bolivian archaeological sites with basalt utilization are marked as well.

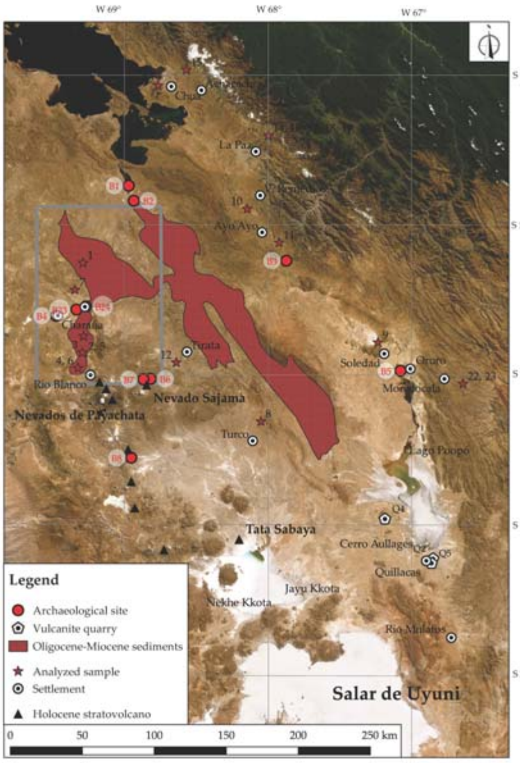

**Fig. 3.:** Analyzed volcanic samples by Lavenu and colleagues (1989) of Central Bolivia and Archaeological sites with basalt utilization

Analyzed volcanic samples

1=E. Kusima, 2=E. Abaroa, 3=Co. Canasita, 4=E. Kolkhe Uma,5=C. Lupijcala, 6=E. Kolkhe Uma, 7=E. Sacacani, 8=Azurita Mine, 9=Soledad,10=V. Remedios, 11=Ayo Ayo, 12=E. Tirata, 13=Chua, 14=Chuquiaguillo, 15=Achacachi, 16=Cota Cota, 17=La Paz, 18=La Paz, 19=La Paz, 20=Rio Kaluyo, 21=Rio Kaluyo, 22= C. Tankha Tankha, 23= C. Tankha Tankha

Bolivian Archaic Period Archaeological sites with basalt utilization

B1=Irohito, B2=Aguallamaya, B3=Viscachani, B4=Abrigo Clemente, B5=Iroco KCH20, B6=Wakolli, B7=Tomarapi, B8=Jiska Molle Pukara, B23= PAM (Proyecto Arqueológico Mauri) Complex-1, B24= PAM (Proyecto Arqueológico Mauri) Complex-2

**3. ábra:** A. Lavenu és kollegái (1989) által vizsgált vulkanikus minták Középső-Bolívia területén, és bazalt felhasználás régészeti lelőhelyeken

Irohito (**Fig. 2.**, B1), Aguallamaya (**Fig. 2.**, B2), Viscachani (**Figs. 2-3.**, B3), Abrigo Clemente (**Figs. 2-4.**, B4), Iroco KCH20 (**Fig. 2.**, B5), Wakolli (**Figs. 2., 5.**, B6), Tomarapi (**Figs. 2., 5.**, B7), Jiska Molle Pukara (**Figs. 2., 5.**, B8), PAM (Proyecto Arqueológico Mauri) Complex-1 and Complex-2 (**Figs. 2-4.**, B23-B24).

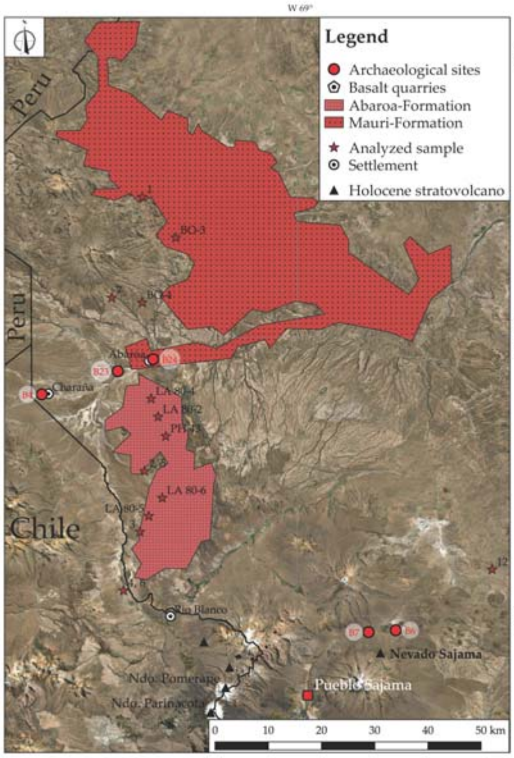

**Fig. 4.:** Analyzed volcanic samples by Lavenu and colleagues (1989) of the Western Cordillera and its Piedmonts near Charaña and archaeological sites with basalt utilization

Analyzed volcanic samples

BO-3=E. Kusima, BO-4=E. Sacacani , LA-80-2=E. Abaroa, LA-80-4=C. Lupijcala, LA-80-5=E. Kolkhe Uma, LA-80-6=E. Kolkhe Uma, PH43=Co. Canasita

Bolivian Archaic Period Archaeological sites with basalt utilization

B4=Abrigo Clemente, B6=Wakolli, B7=Tomarapi, B23= PAM (Proyecto Arqueológico Mauri) Complex-1, B24= PAM (Proyecto Arqueológico Mauri) Complex-2

**4. ábra:** Lavenu és kollegái (1989) által vizsgált vulkanikus minták a Nyugati-Kordillerák és azok Charaña közeli hegylábi területén, és bazalt felhasználás régészeti lelőhelyeken

In **Fig. 4.**, a simplified geological map of the Western Cordillera and its foothills near Charaña can be seen (Box 1 in the grey frame, see **Fig. 3**.) after Lavenu and colleagues (1989, 36, Fig. 2). Dot patterns show the Oligocene-Miocene sediments, the Mauri and Abaroa Formations separated. The samples taken by Lavenu and colleagues (1989) and the nearby archaeological sites are represented too. The samples from top to bottom are as follows BO-3 (basalt lava flow), BO-4 (andesite lava flow), LA 80-4 (dacite lava flow), LA 80-2 (basalt dike), PH 43 (amphibolitic dacite lava flow), LA 80-6 (andesite lava flow), LA 80-5 (andesite lava flow).

According to Vanessa Jiménez (2013), at the two PAM (Proyecto Arqueológico Mauri) Complexes (**Figs. 2-4.**, B23-B24) a large variety of igneous rocks can be found, among them andesite, silicified hornblende andesite, basalt, olivine basalt, dacite, silicified dacite, rhyolite, trachyte, trachyandesite. As mentioned above, in the raw material utilization these volcanites are dominant.

**Fig. 5.** shows the physiographic-geologic map of the Nevados de Payachata volcanic group and the surrounding area after the paper, of Wörner and colleagues (1988). In this paper, the authors had dealt with the subduction-related volcanism in the Nevados de Payachata region of the Central Andes. This region comprises two temporally and geochemically distinct phases. An older period of magmatism is represented by glaciated stratocones and ignimbrite sheets of Late Miocene age. The Pleistocene to recent phase (≤ 0.3 Ma) includes the twin stratovolcanoes Volcan Pomerape and Volcan Parinacota (the Nevados de Payachata volcanic group) and two small centres to the west (i.e. Caquena). The two Nevados de Payachata stratovolcanoes display continuous major- and trace-element trends from high-$K_2O$ basaltic andesites to rhyolites (53-76 % $SiO_2$) that are well defined and distinct from those of the older volcanic centres.

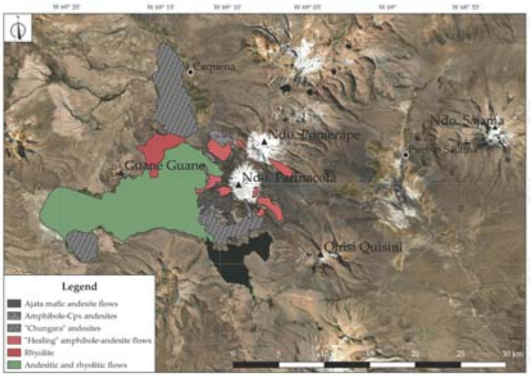

**Fig. 5.:** Physiographic-geologic map of the Nevados de Payachata volcanic group and the surrounding area after G. Wörner and colleagues (1988, 291, Fig. 4.). The older Ajata flows are plagioclase-porphyritic, mafic, andesite flows, and the youngest flows are distinctly olivine-rich clinopyroxene-bearing basaltic andesites. West to the Nevado Pomerape, there are amphibole-clinopyroxene andesite flows. The „Chungara" andesites are monotonous hornblende andesites. The „Healing" flows are amphibole-andesite flows. The different andesitic and rhyolitic flows contain the following debris flow: amphibole andesite, basaltic andesite, clinopyroxene andesite, microporphyritic andesite, plagioclase andesite, rhyolite.

**5. ábra:** A Nevados de Payachata vulkanikus csoport és környékének fizikai-földrajzi‒geológiai térképe Wörner és kollegái (1988, 291, Fig. 4) nyomán.

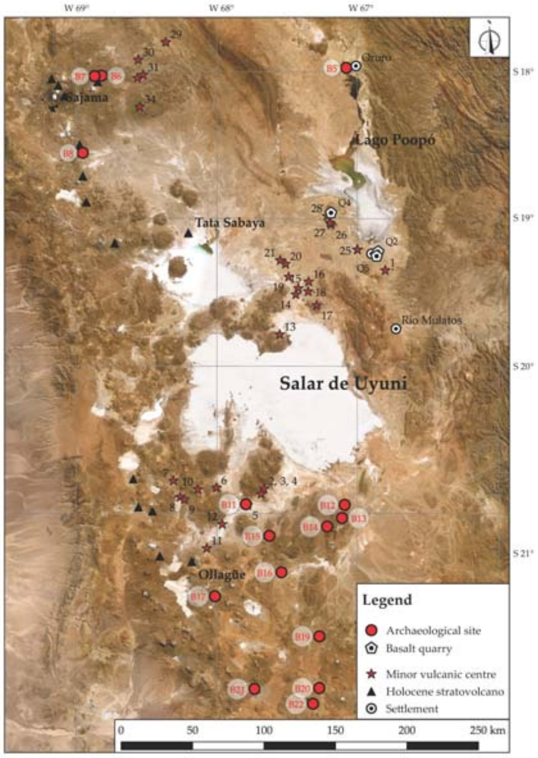

**Fig. 6.:** Holocene stratovolcanoes and minor volcanic centres after Davidson & de Silva (1995) and archaeological sites with basalt utilization.

Minor volcanic centres

Southern Bolivian Altiplano: 2=Lomas Uchimilles, 3-12; Central Bolivian Altiplano: 13=Cerro Jata, 14=Nekhe Kkota, 15=Jayu Kkota, 16=Chiar Kkollu, 17-20, 21=Cerro San Martín/Cerro Vili Vili); Eastern Bolivian Altiplano: 1=Cerro Gordo, 22-24=Quillacas, 25=Cerro Aullagas, 26-28).

Bolivian Archaic Period Archaeological sites with basalt utilization

B5=Iroco KCH20, B6=Wakolli, B7=Tomarapi, B8=Jiska Molle Pukara, B11=Cueva Bautista, B12=San Cristóbal SC-03, B13=San Cristóbal SC-02, B14= San Cristóbal SC-01, B15=San Agustín, B16=Alota, B17=Laguna Hedionda, B19=Soniquera

**6. ábra:** Holocén sztratovulkánok és kisebb vulkanikus központok Davidson és de Silva (1995) nyomán, és bazalt felhasználás régészeti lelőhelyeken

In **Fig. 6.,** some Bolivian archaeological sites with basalt utilization and the Holocene stratovolcanoes and minor basalt centres can be seen (after Davidson & de Silva 1992; 1995, 388, Fig. 1b). Sample numbers match analyses in Tables but have the prefix BC90- omitted. The three groups of centres from the Altiplano are subdivided into a southern (samples 2 to 12), central (samples 13 to 21) and eastern (samples 1 and 22 to 28) group. The most typical volcanic rock occurrences are the following: andesite (1=Cerro Gordo, 2-4=Lomas Uchimilles, 6, 21=Cerro San Martín/Cerro Vili Vili, 25=Cerro Aulalgas), basalt (5, 16=Chiar Kkollu, 21=Cerro San Martín/Cerro Vili Vili). Basaltic trachyandesite to dacite rocks are present at Nekhe Kkota (14) and Jayu Kkota (15).

It is obvious that at some southwestern Bolivian sites (e.g. Alota (**Figs. 2., 5.,** B16), Cueva Bautista (Figs. 2, 5, B11), Laguna Hedionda (Figs. 2, 5, B17), San Agustín (Figs. 2, 5, B15)) and at the three San Cristóbal sites (**Figs. 2., 5.,** B12-14) the raw material named basalt can be regarded as local or at the most regional raw material.

## *Discussion*

In the following, we will summarize the gathered information on basalt utilization in the study area. Our remarks can only be based on a geographic comparison of geological maps with archaeological sites. Without making such comparison, we cannot understand the raw material procurement strategy of the Archaic Period hunter-gatherers. The vicinity, the easy availability or the remoteness of the raw material sources have great significance in lithic analysis. The distinction between curated and expedient technologies was developed by R. L. Binford (1979, 1980). The curation is a strategy of caring for tools and toolkits that can include advanced manufacture, transport, reshaping, and caching or storage. On the other hand, expediency refers to the minimized technological effort under conditions where time and place of use are highly predictable. Nora Franco (2012, 85) stated simply that curated tools were those made in one place, used in another, and discarded in yet another place. On the contrary, expedient tools were those made quickly, used, and discarded in one place. Curation anticipates the need for materials and tools at “use locations”, expediency anticipates the presence of sufficient materials and time (Nelson 1991, 62-64). In addition to the concepts described by Binford, Nelson (1991, 62) added the opportunistic behaviour. However, she contrasted this opportunistic, unplanned technological behaviour with expediency. The opportunistic behaviour is a response to immediate, unanticipated conditions. It is very likely that in the case of locally available raw materials of relatively low flaking quality, such as quartzite and the most volcanic rocks as well, an opportunistic behaviour can be assumed. Only a detailed lithic analysis made on a complete lithic assemblage, containing not only manufactured tools but debitage products as well, can imply the nature of the used technological behaviour.

Concerning the Bolivian archaeological sites, except for the sites B10 (Palacio Tambo), B17 (San Lucas) in the San Lucas Valley and the PAM Complexes (B23-B24), we have only macroscopic evidence, the geological source of the basalt raw material is mostly unknown.

At the site of Aguallamaya (**Fig. 2.,** B2) in the southern part of the Lake Titicaca basin, a projectile point of grey basalt was reported (Pérez 2006, 22, Fig. 8, A-01). A particular kind of volcanic rock, the olivine basalt, exotic to the southern Titicaca Basin, comes from geological outcroppings near Incatunahuari, just north of the town of Chucuito, south of Puno (southeastern Peru). This olivine basalt is a fine-textured, homogeneous grey rock including frequent yellow or white olivine phenocrysts. Overall, it presents a very distinctive appearance. It differs from the more common andesite, which has a very similar colour but contains frequent plagioclase feldspar inclusions as well as biotite and is generally more porous and coarse-grained. Feldspar is not present in the olivine basalt. M. S. Bandy made the assumption (2001, 142) that the "grey andesite" reported by Seddon, which makes up upwards of 90 % of the lithic sample at the Formative site of Tumatumani (southern Peru) (Stanish et al. 1994, 70), is possibly olivine basalt. Despite the distance of about 150 kilometres between the source of the olivine basalt and the site of Aguallamaya, it is very likely that there at the site the same raw material is present.

In connection with the largest and richest site of Viscachani (**Figs. 2-3.,** B3) Lizarraga-Mehringer (2004) emphasizes the fact, that the exact origin of most raw materials, among them the igneous rocks, such as basalt and trachyte is unknown. As for the basalt, it is surprising that the Querimita basalt quarry as a possible source was not mentioned, although the existence of this basalt quarry had been noticed formerly by Ponce and Mogrovejo (1970). Both from typological and raw material utilization point of view, the lithic assemblage of Viscachani suggest distant cultural connections. Owing to this fact, it cannot be excluded the possibility that despite the significant distance from the site (ca. 205-210 km), the basalt quarry of Querimita is the geological source of the utilized basalt. Lizarraga-Mehringer (2004, 77) mentioned also the present of grey basalt. The distance between the site and the above-mentioned geological source of olivine basalt at Incatunahuari is about 260 kilometres.

At the site of Iroco KCH20 (**Fig. 2.,** B5), the evidence, that most stone tools were manufactured on non-local raw materials (chalcedony and various kinds of chert), suggests high seasonal mobility. Regarding basalt, as a supposed source, the quarry of Querimita was given.

For all the remaining sites, both in Northwestern Bolivia, in the surroundings of Nevado Sajama, and Southwestern Bolivia (except for the site of Cueva Bautista (**Figs. 2., 5.,** B11)), no suggestion had been made in the available literature concerning the provenance of the utilized raw materials, among others the basalt.

In the case of the sites of Iroco KCH20 (**Fig. 2.,** B5) and Viscachani (**Figs. 2-3.,** B3), the paper of Lavenu and colleagues (1989) yielded supplementary information about the possible provenance of the basalt. Besides an assumed origin from the Querimita quarry at Lake Poopó, the possibility of incidental local origin should be taken into consideration. The site of Iroco KCH20 (**Fig. 2.,** B5) is situated between the Soledad area and the Morococala volcanic field. The former is a complex volcanic structure which is surrounded by lacustrine detrital deposits of supposed Pliocene-Pleistocene age. The Soledad crater has erupted dacitic material (Redwood 1987; Monrroy et al. 1994). The latter is a volcanic field, which is formed by ignimbrites and associated volcanic features. The rocks of Morococala are dominantly dacite and rhyodacite (Ericksen et al. 1987; Morgan et al. 1998). Next to the site of Viscachani (**Figs. 2-3.,** B3), in the Ayo Ayo and Villa Remedios area, dacitic ash flows are known (Hoffstetter et al. 1971; Lavenu et al. 1989, 40, 42).

## *Conclusion*

In this short paper, based on the available literature, we gathered the facts about the occurrence of basalt and volcanic rocks and their use in several archaeological sites during the Archaic Period of the Bolivian Altiplano. The present paper can be considered as a sketchy summary, instead of being an archaeological evaluation of the sites. However, we would like to make some closing remarks about the use of lithic raw materials at the sites and the typological characteristics of the lithic assemblages that highlight the regional issues of the Archaic Period.

Concerning the use of raw materials, it is important to emphasize the fact that in some of the lithic assemblages of archaeologically significant sites (e.g. Viscachani, Iroco KCH20, Cueva Bautista), raw materials from 100 to 200 km are often used.

Among the typological features, it is necessary to mention the presence of the so-called Patapatane type leaf-points which can be found at Iroco KCH20 and Wiscachcalca sites. Wiscachcalca is a wetland (bofedal) located northwest of Patokho, a small settlement located on the slopes of the Nevado Sajama volcano (Marcos Michel 2000). The landscape of Wiscachcalca has several rocky outcrops in the form of small hills, and one of them represented an important find. A projectile point was located at the lower part of a hill, which was discarded during elaboration. It has a triangular form, stemmed with shoulders, made of volcanic quartz, and being similar to those ones associated to the „Patapatane" (Osorio et al. 2017a; 2017b) and „Tojo Tojone" (Dauelsberg 1983; Osorio 2013; Osorio et al. 2016) phases in Northern Chile, which are dated by radiocarbon method ranging from 9,500 to 6,000 BP.

Around 9,500 BP hunter-gatherers began to employ more regularized settlement patterns, connected mainly to high altitude environments, at the same time they abandoned the earlier pattern of high environmental mobility. These events have been separated as a late phase within the Early Archaic Period, which we have called "Patapatane", placed chronologically between 9,500 and 8,000 BP. During the initial episodes of this phase, the manufacturing of triangular-shaped projectile points continued, at the same time the classic lanceolate form that later became popular appeared. The Patapatane projectile point is a strong indicator of a highly specialized bifacial and curator technology (Santoro & Núñez 1987; Santoro 1989, 40-46; Klink & Aldenderfer 2005, 32-33). It should seem that this particular type of projectile point persisted for most of the early Holocene, suggesting some form of stability over time. „Retaining a similar design of projectile points might relate to information transmission within a common cultural background, and consequently serve as an identity marker that the earliest hunter-gatherer groups shared throughout most of the south-central Andes during the late Pleistocene to early Holocene" (Osorio et al. 2017a, 9).

According to Santoro (1989, 52, 64-65), the style of particular artefacts can serve as archaeological evidence for an assumed existence of social identity over wide areas. For instance, the rhomboidal points at Toquepala, Caru and Patapatane (all three sites are situated in pre-cordilleran valleys of Northern Chile) seem to be a specific form in the Early Archaic Period. At the same time, the rhomboidal points, some with side barbs from Tiliviche in Northern Chile (Nuñez 1980, Lámina 4-6.), which resembles those at Caru and Patapatane may indicate some kind of interaction between highland and lowland groups. The use of long-distance lithic raw materials, indicating distinct cultural connections and the obvious resemblance of projectile points gives a larger dimension to the sharing of technological know-how, subsistence strategy, settlement organization, and other cultural patterns of these early highland hunter-gatherer groups.

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# KNIFE IN THE WALL: THREE EXAMPLES OF A RARE TOOL-FORM ON NUKU HIVA, MARQUESAS ISLANDS, EASTERN POLYNESIA[•]

## KÉS A FALBAN: HÁROM RITKA ESZKÖZFORMA NUKU HIVÁN (MARQUESAS-SZIGETEK, KELET-POLINÉZIA)

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## Abstract

*Between 1994 and 1998 Judit Antoni worked on Nuku Hiva, under the direction of Pierre Ottino, archaeologist of the O.R.S.T.O.M. (Institut francais de recherche scientifique pour le développement en coopération). It was in 1998, that the permanent archaeological technician of the staff, the Marquesan Alfred Falchetto discovered a crescent-shape basalt tool, hidden in the wall of one of the structures on Kamuihei site, near Hatiheu village. Later on J. Antoni found another tool of the same shape (but made of different raw material) in the Bishop's Office collection at Taiohae and in 2002 she had the chance to take photos and drawings from a third one.*

*Because of the lack of any possibility to investigate these tools in-depth (for example analysis of the raw material's provenance) the current communication is intended only to make them acquainted for the public and to suggest opinions on the method of their use.*

## Kivonat

*1994 és 1998 között Antoni Judit Nuku Hiván dolgozott, Pierre Ottino, az O.R.S.T.O.M. régészének irányításával. 1998-ban a csapat állandó tagja, a marquesasi Alfred Falchetto felfedezett egy félhold alakú bazalt-eszközt, a Hatiheu faluhoz közeli Kamuihei közösségi központ egyik épületének alapját képező nagy bazalttömbök közé rejtve. Később Antoni J. talált egy hasonló alakú, de más, helyidegen nyersanyagú eszközt a Püspöki Hivatal gyűjteményében, Taiohae-ban, majd 2002-ben sikerült lefényképeznie és lerajzolnia egy harmadikat is. Mivel nincs semmiféle lehetőségünk e tárgyak alaposabb vizsgálatára (pl. a nyersanyag származási helye vagy a használati nyomok szempontjából), jelen közlemény pusztán arra szolgál, hogy megismertesse az eszközöket és ötletet adjon a használatukkal kapcsolatban.*

KEYWORDS: BASALT, POLYNESIA, NUKU HIVA, TAIOHAE

KULCSSZAVAK: BAZALT, POLINÉZIA, NUKU HIVA, TAIOHAE

## Introduction

From November 1994 we participated in the archaeological and ethnographical researches led by Pierre Ottino on the Marquesas Islands, mainly at Nuku Hiva, the largest island of the archipelago.

The aim of the researches among others was to study the sites selected as scene for the Festival of Arts of the Marquesas Islands on the turn of the year 1999/2000.

One of these sites is the architectural complex near the actual village of Hatiheu: the *me'ae* (ceremonial center, sacred site) of Te I'ipoka, the tohua (communal site for public festivities) Kamuihei and the *tohua* Tahakia, with their *paepae* (habitation site, house platform) all around.

Hatiheu is situated on the northern coast of Nuku Hiva, in a large bay. The valley, which is opened to the sea is about 2.3 km long and 4 km wide, is emerging in the direction to the mountains (**Fig. 1.**).

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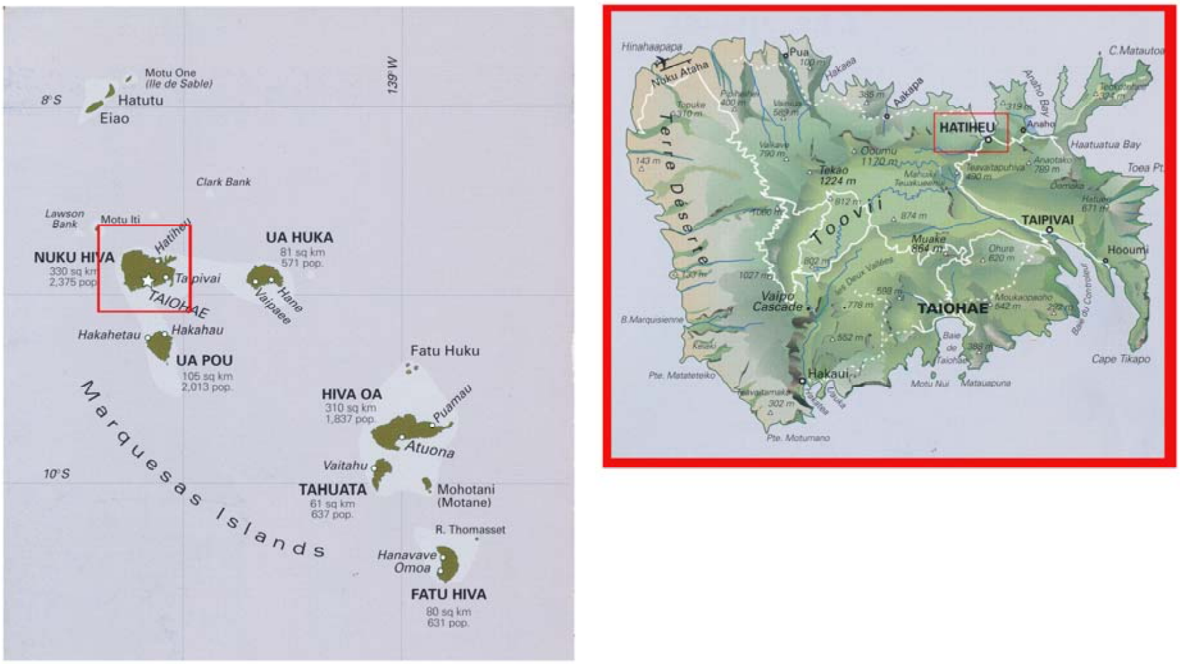

**Fig. 1.**: Map of the Marquesas Islands and Nuku Hiva Island, respectively (after Chester, et al. 1998)

**1. ábra**: A Marquesas-szigetek és Nuku Hiva térképe (Chester et al. 1998 nyomán)

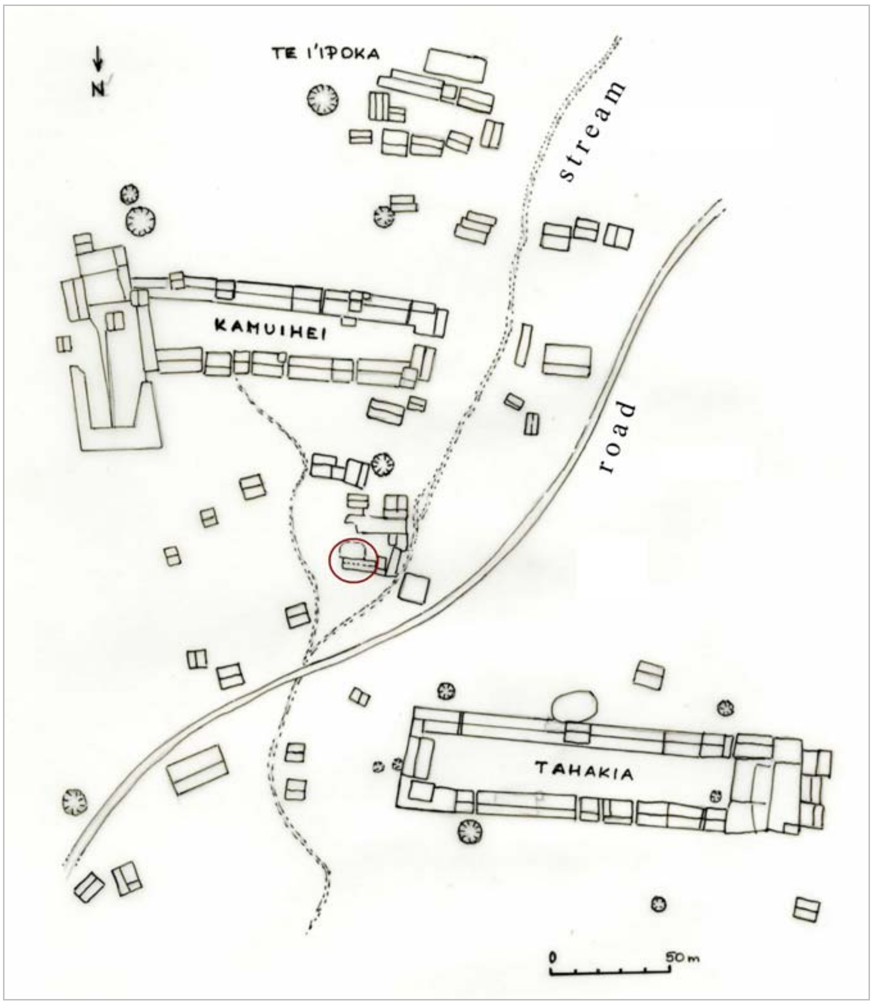

**Fig. 2.:** Locality of the knife (1) shown on Fig. 3. (after Ottino 2001)

**2. ábra:** A 3. ábrán látható kés lelőhelye (Ottino 2001 nyomán)

The western part of this valley was inhabited formerly by the tribe Puhioho, known after their reputed warriors. Their territory (about 10 hectares) was important because of the protective role against the enemies arriving from the nearest villages (Aakapa on the west or Taipivai on the south).

In 1998, Pierre Ottino registered 189 structures in the complex (Ottino, 1998: 47–62): beside the parts of the *me'ae* and the two *tohua*, more than 80 *paepae*, some funerary structures, 8 *ua ma* (pits for fermented breadfruit) and many others (**Fig. 2.**).

The structure No. 110, between the *tohua* Kamuihei and Tahakia, is like a *paepae*, but after Ottino, it can be a part (stairs) – with other structures nearby – of a little *tohua*. (Ottino, 1998: 55)

On one of the great stone blocks in the wall there is a petroglyph (*mata tiki* = eyes of god) and an other block is a polishing stone with many hollows.

## Discovery of the crescent-shape knife

In the north-east corner of the structure, in 1998, A. Falchetto discovered a crescent-shape tool, hidden between the great blocks of the wall.

It was nearly invisible, but in the moment, when he passed before the wall to see the petroglyph, suddenly something „strange" catched his attention in the slit, between two blocks.

The crescent-like object – a tanged blade – was made of a fine grained slate-grey material (basalt) with greenish-grey patina on its surface. It is 18.5 cm high, the width is 23.3 cm, the greatest thickness is 1.6 cm and it weights 410 g. It is very flat and retouched all around the rim. On the side „**A**" we can see three little spots where the tool was polished, and there are traces of wear on the rising lines (on the edges of the knapped parts) on each side, not only on the cutting edge but on the „handle", too, although here they are less intensive. The use wear traces are shining. (Crescent shape knife (1), **Fig. 3.**)

## Analogies of the knife

A year later, in 1999 we had a chance to discover a similar object in the Bishop's Office collection at Taiohae ((Crescent shape knife (2), **Fig. 4.**). It is different from the first one: the shape is nearly the same, but the raw material is flint, not basalt. The tool has a yellowish-brown colour on the retouched surfaces, on the splits, the colour is like that the honey. Its length is 21.7 cm, the width is 17.8 cm and the greatest thickness is about 4-5 cm. We have no data about the weight: it must be about 5-600 g.

On the Marquesas Islands, this material is unknown, therefore we can suspect that it has arrived in the form of a block of flint with some european ship as ballast and it was thrown out in the Bay of Taiohae. It was a Marquesan master who formed a tool from the block seeing the good quality of the stone. On the „**A**" and „**B**" surfaces, in the middle, there is the rest of the original surface – the cortex – of the block, and the edges are retouched all around on each side.

The „handle" is wrapped around with a dark-brown coloured braided cord made of the fibres of a coconut shell. Under it, fixed with this cord, there are three, about 9-10 cm long yellowish braided and knotted cords, each ending in a loop – for hanging on something? – made of the same material. We have'nt any information where it was found, but surely on Nuku Hiva: it was given by someone from the village to the Bishop's Office.

The third object was found before 2002, by one of our Marquesan acquaintances. After his information, it was lying on the eastern seashore, in the Bay of Taiohae, near the Residence.

The tool is not so elegant in form like the first one and its surface is worn and eroded. The edges are damaged too, mainly because of the sea-currents. There are little fractures on it (some are relatively fresh) on each side and on the cutting edge (Crescent shape knife (3), **Fig. 5.**).

The raw material is a greyish basalt, it is 1.5 cm high, its width is 14.9 cm and it is 1.5-2.2 cm thick. The weight is 495 g. On each surface („**A**" + „**B**") there are some traces of wear (see **Fig. 5.**) but they are not so clear and not so well preserved because of abrasion in the sea.

Currently we have no possibility to investigate the raw material source of these objects, or to analyse the trace-wears on them, we only want to publish the pieces, in hope that someone will interested it and can make the necessary researches in the future.

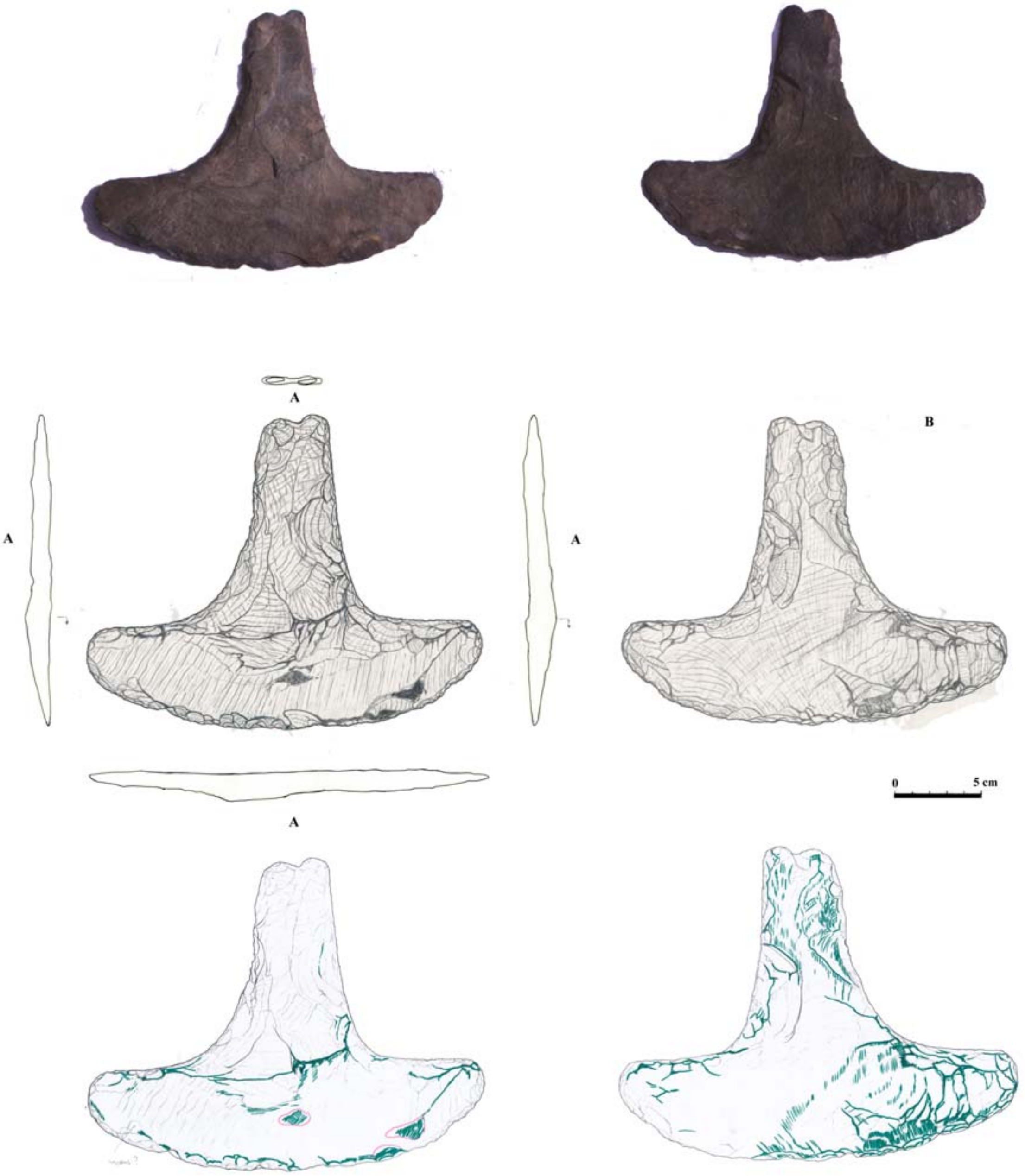

**Fig. 3.:** Crescent shape knife (1), Hatiheu, Kamuihei site, feature nr. 110. Top row: photo, central row: drawing with sections, bottom row: traces of utilisation (in green); marked pink, traces of polishing (by J. Antoni)

**3. ábra:** Félhold alakú kés. Lelőhely: Hatiheu, Kamuihei, 110 sz. objektum. Felső sor: az eszköz fotója, középen rajz a metszetekkel. Alsó sor: használati nyomok (zölddel), csiszolás nyomok (rózsaszínnel)

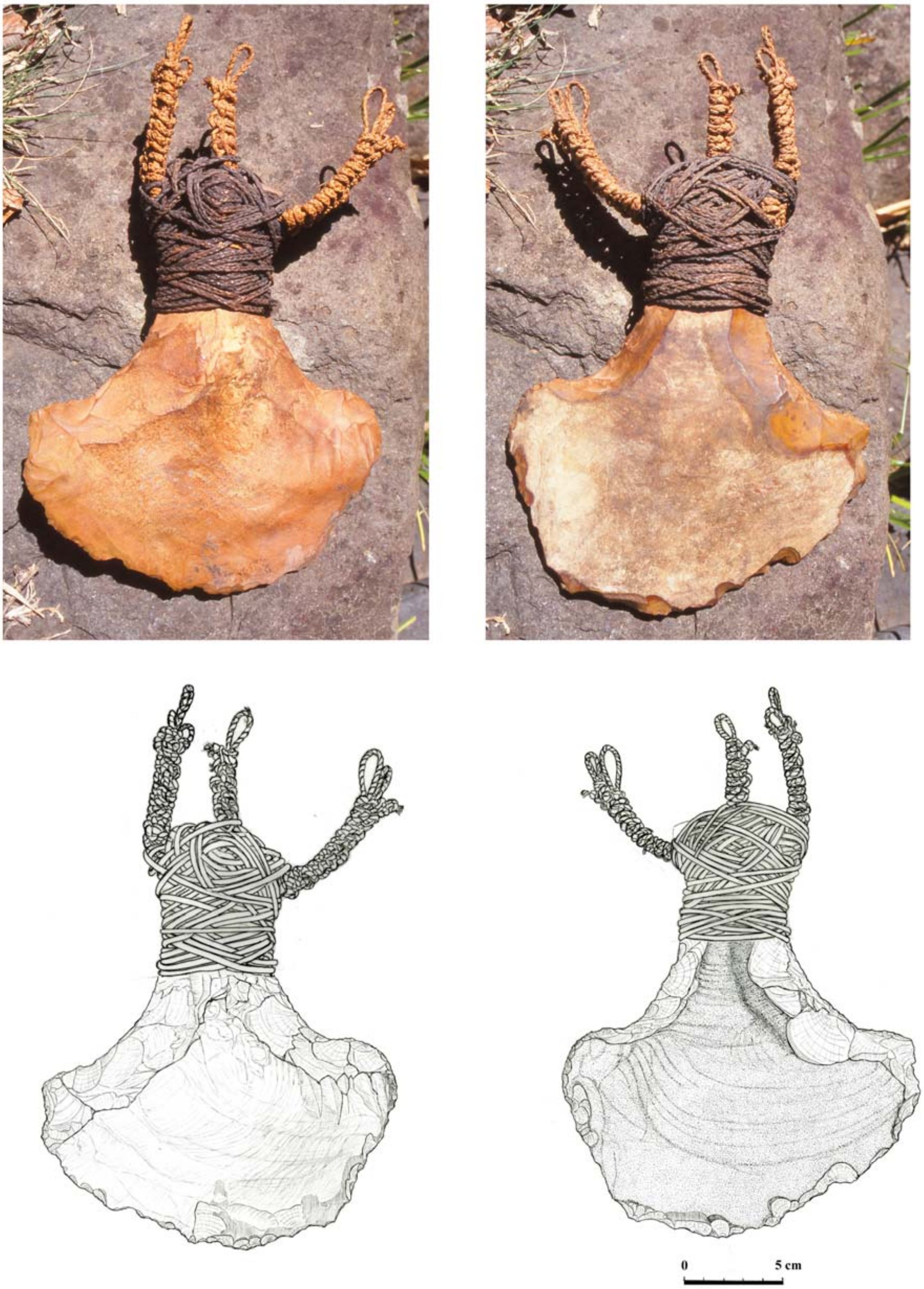

**Fig. 4.:** Crescent shape knife (2), Taiohae, Bishop's Office Collection. Top row: photo, bottom row: drawing (by J. Antoni))

**4. ábra:** Félhold alakú kés (2). Lelőhely: Taiohae, Püspöki Hivatal gyűjteménye. Felső sor: az eszköz fotója, Alsó sor: az eszköz rajza.

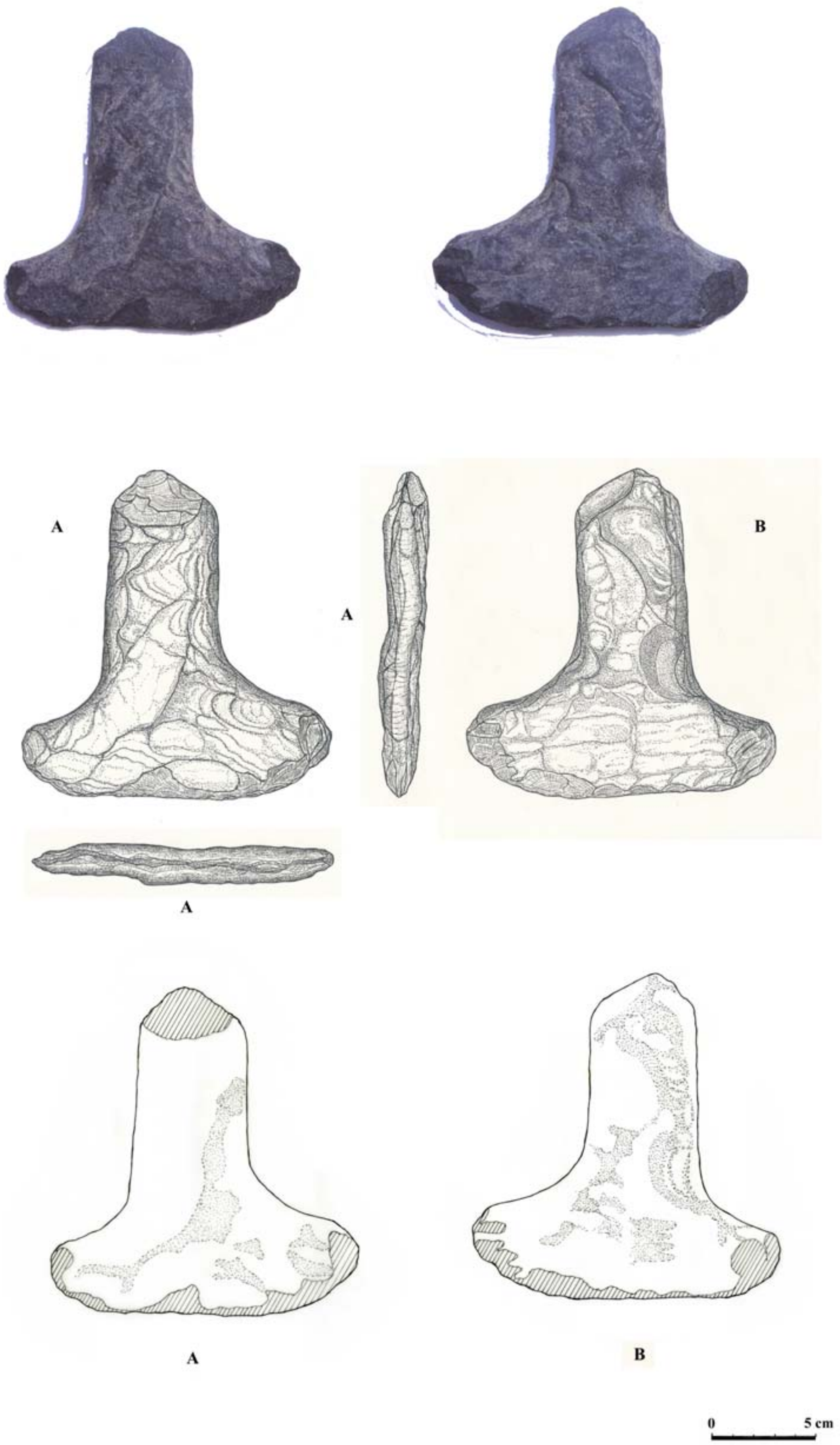

**Fig. 5.:** Crescent shape knife (3), Taiohae Bay. Top row: photo, central row: drawing with sections, bottom row: traces of utilisation and fresh injuries (by J. Antoni)

**5. ábra:** Félhold alakú kés (3). Lelőhely: Taiohae öböl. Felső sor: az eszköz fotója, középen rajz a metszetekkel. Alsó sor: használati nyomok és friss törések.

## Interpretation

We think that each tool is from the last 1-200 years, after the contact with European peoples: the raw material of the second points to this direction, too.

The shape – the tanged crescent – is well-known from different parts of the world, in differents times and different use: as hoe, weapon, blade for cutting something, etc. We do not want to refer on any of them; without trace-wear analyses we cannot establish authentically what they were used for.

We can, however, raise some hypotheses. They are probably in connection with the harvest and the preservation of the breadfruit: in the Museum at Tahiti (Musée de Tahiti et des iles) there are some examples of these tools, under the name of „*fendoir pour le fruit de l'arbre a pain*" (= hatchet for the breadfruit). One of them has a similar form made of stone, but the others, published by A. Lavondes from the Society Islands (Lavondes ed., 1990: 60) are made of wood: one in form of an adze, and two are elongated, U-shaped oval blades with handle and convex cutting edge.

The breadfruit was one of the most important basic food on the Marquesas Islands: because of the possibility for long-term storage in a pit (*ua ma*) in fermented form for many years, in famine it could actually save the life of the people.

Between the utensils used in preparing the breadfruit (*mei*) for food (*ma*), a splitter was used, too, but only in case if the fruit wasn't ripe enough. Linton (Linton, 1923: 351, Pl. LVII. B.) reports on one splitter from the Bishop Museum's collection and he wrote:

„*When properly ripe, the breadfruit are soft enough for the raw pulp to be easily separated from the core with the fingers. Slightly unripe fruits are sometimes cut up for ma making. In ancient times this was probably done with a wooden breadfruit splitter. An implement of this sort in the Bishop Museum is eight inches long, with a maximum width of four inches. It has a long oval blade terminating in a broad flat knob. Only the outer end of the blade is sharpened. It is made of some rather hard, light weight wood.*" ( about 20 cm x 10 cm)

This splitter is like the two blades in wood, published by Lavondes: these objects can be the antecedents of the hatchets in stone. The only problem for us is the crescent shape of our tools: we think, it is not accidental, but necessary for the use. The hatchets require another, a swinging movement to cut. With our tool-type, on the other hand, we can also do cutting, but with moving it back and forth. We use similar implements for materials like cheese or peat:

Their form are the same, because of the resistence of the solid and elastic material, which is resistant to cutting in one movement. The stored and partially dried *ma* is a material somewhat similar in consistence.

We can imagine – it's only an idea – that these tools were used by the chiefs, in famine, when the chief had to take out the stored *ma* from the pit and distribute them for the people, by cutting up in pieces.

These tools, comparing the thousands of stone artifacts from the Marquesas are extremely rare and have never been published, as far as we know. After their unique shape, their fine elaboration and their rarity, perhaps it is not too erroneous to say that these objects were made and used for a specific purpose, by special persons and for a specific occasion.

The structure 110, where the first tool was discovered, was the property of a prominent family - the ancestors of the mayor of Hatiheu, Yvonne Katupa.

Now the object is deposited in the little museum of the village. Several years later, after our last trip to Nuku Hiva together (2002), one member of the Falchetto family founded on Eiao island a similar tool, which is presented here as first. Alfred saw them in 2011 in the Museum at Hatiheu, so we have the hope to find some others of this type in the future.

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# KÖZLEMÉNYEK

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## *IOC 2019 – Nemzetközi obszidián konferencia Sárospatakon*

2019. május 26 és 29 között került megrendezésre Sárospatakon az IOC-2019 (*International Obsidian Conference*, azaz Nemzetközi Obszidián Konferencia). A konferencián 23 ország 76 szakembere vett részt, akik az obszidián geológiai, régészeti és anyagvizsgálati kutatásáról tartottak előadásokat és mutattak be posztereket.

A konferenciát a „kárpáti obszidiánok” előfordulási és elterjedési területének szakembereinek közreműködésével rendeztük meg. Kirándulásaink során három ország területén és szakebereinek együttműködésével bemutattuk az ismert kárpát-medencei lelőhelyeket és a legfontosabb helyi feldolgozó központokat.

A konferenciához kapcsolódóan egy kiállítást is rendeztünk „*Obszidián a Tokaji-hegységben: a kőkorszaki Európa ipari központja*” címmel, amelyen az obszidián geológiai, régészeti és néprajzi felhasználásáról adtunk áttekintést. A konferencia honlap (http://ioc-2019.ace.hu/ ) jelenleg is hozzáférhető, ahol az IOC-2019-re megjelent kiadványok (program- és előadáskivonatok, kirándulásvezető, valamint az Archeometriai Műhely 2018/3-as különszáma) hozzáférhetők, letölthetők.

A konferencián elhangzott előadásokat terveink szerint a Magyar Nemzeti Múzeum *Inventari*a *Praehistorica Hungariae* (IPH) sorozatában fogjuk megjelentetni.

A következő obszidián konferenciák helyszíne Kalifornia (USA, 2021) majd Hokkaido (Japán, 2023) lesz.

*T. Biró Katalin* és *Markó András*

Magyar Nemzeti Múzeum

A konferencia résztvevői (Kasztovszky Zsolt felvétele) / Participants of IOC-2019. Photo by Zs. Kasztovszky

## *5th International Conference Archaeometallurgy in Europe*

Miskolci Egyetem, 2019. június 19-21.

2019. június 19. és 21. között került megrendezésre ötödik alkalommal az Archaeometallurgy in Europe elnevezésű nemzetközi tudományos konferencia, amelynek helyszíne ezúttal Miskolc, a Miskolci Egyetem volt.

A konferencia főszervezője Dr. Török Béla a Miskolci Egyetem Anyagtudományi Karának egyetemi docense, a Metallurgiai Intézet igazgatója, az egyetem archeometallurgiai kutatócsoportjának (ARGUM) vezetője. A négyévente megtartandó nemzetközi konferencia nemcsak Európa, hanem a világ legnagyobb archeometallurgiai tudományos találkozója. Az eddigi négy alkalommal kétszer Olaszországban (Milano és Aquileia), egyszer Németországban (Bochum) és legutóbb, 2015-ben, Madridban rendezték meg a szimpóziumot. A mostani főszervező egyéni pályázata által először adott otthont a konferenciának kelet-közép-európai ország. Az archeometallurgia relatíve fiatal, de dinamikusan fejlődő, tipikusan interdiszciplináris tudományterület, amely egyesíti a korabeli fémelőállítással, fémműveléssel kapcsolatos régészeti, ipartörténeti, valamint természet-tudományi és műszaki vizsgálati jellegű – archeometriai - vonatkozásokat.

A konferencia honlapja a következő címen érhető el:

http://www.aie2019.argum.hu

A rendezvényen mintegy 200 résztvevő és vendég volt jelen, nemcsak Európa, de a világ minden tájáról, több mint 30 országból, az érintett hazai kutatók részvétele mellett. A háromnapos tudományos program 109 szóbeli előadást és 57 poszteres prezentációt tartalmazott. Az előadások párhuzamosan, 24 szekcióban zajlottak a szakterület legismertebb tudósai, kutatói elnökletével. A legjobb fiatal szóbeli előadó és poszteres prezentáló számára a Historical Metallurgy Society díjakat ajánlott fel.

A rendezvény programjához tartoztak archeometriai vizsgálatokra is alkalmas műszerforgalmazó cégek kiállításai és előadásai, valamint szakmai bemutató jellegű látogatások (múzeumlátogatások) Miskolcon és az egyetemen. A program reprezentatív eseménye a június 20-ai díszvacsora volt, a miskolci Vigadó épületében. Június 22-én, szombaton, a résztvevők Miskolc környékén és a Zemplénben szakmai és turisztikai jellegű kirándulásokon vehettek részt.

A konferencia absztrakt-gyűjteményét – elektronikus formában - a helyszínen kiosztott konferenciacsomagban található pendrive tartalmazta. A prezentációkból készülő, válogatott és bírált tudományos írásokat önálló konferenciakötetben publikáljuk majd.

A konferencia szervezésében és lebonyolításában közreműködött a Miskolci Egyetem, az MTA Miskolci Területi Bizottságának Anyagtudományi és –technológiai Szakbizottsága, a Herman Ottó Múzeum, a Magyar Műszaki és Közlekedési Múzeum Kohászati Gyűjteménye, a Miskolci Kulturális Központ Nonprofit Kft, a Magyar Nemzeti Múzeum sárospataki Rákóczi Múzeuma és a sátoraljaújhelyi Kazinczy Ferenc Múzeum. A rendezvényt támogatja az MTA CSFK Földtani és Geokémiai Intézet, az ÁSATÁRS Kft, az OAM Ózdi Acélművek Kft, a Magyar Vas- és Acélipari Egyesülés, a FUX ZRt, a Miskolc Városi Közlekedési Zrt és a B-A-Z Megyei Önkormányzat.

A nagyszámú helyszíni, illetve a konferencia után beérkező, pozitív, gratuláló, az esemény szakmaiságát és rendezését méltató visszajelzések alapján a szimpóziumot egyértelműen sikeresnek lehet értékelni. Ezt jelzi többek között az is, hogy a konferencia főszervezőjét beválasztották az Archaeometallurgy in Europe Állandó Bizottságának (Standing Committee) tagjai közé.

*Török Béla*

Miskolci Egyetem

A konferencia résztvevői / Participants of 5th International Conference Archaeometallurgy in Europe

# KÖZLEMÉNYEK

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## *IOC 2019 – Nemzetközi obszidián konferencia Sárospatakon*

2019. május 26 és 29 között került megrendezésre Sárospatakon az IOC-2019 (*International Obsidian Conference*, azaz Nemzetközi Obszidián Konferencia). A konferencián 23 ország 76 szakembere vett részt, akik az obszidián geológiai, régészeti és anyagvizsgálati kutatásáról tartottak előadásokat és mutattak be posztereket.

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A következő obszidián konferenciák helyszíne Kalifornia (USA, 2021) majd Hokkaido (Japán, 2023) lesz.

*T. Biró Katalin* és *Markó András*

Magyar Nemzeti Múzeum

A konferencia résztvevői (Kasztovszky Zsolt felvétele) / Participants of IOC-2019. Photo by Zs. Kasztovszky

## *5th International Conference Archaeometallurgy in Europe*

Miskolci Egyetem, 2019. június 19-21.

2019. június 19. és 21. között került megrendezésre ötödik alkalommal az Archaeometallurgy in Europe elnevezésű nemzetközi tudományos konferencia, amelynek helyszíne ezúttal Miskolc, a Miskolci Egyetem volt.

A konferencia főszervezője Dr. Török Béla a Miskolci Egyetem Anyagtudományi Karának egyetemi docense, a Metallurgiai Intézet igazgatója, az egyetem archeometallurgiai kutatócsoportjának (ARGUM) vezetője. A négyévente megtartandó nemzetközi konferencia nemcsak Európa, hanem a világ legnagyobb archeometallurgiai tudományos találkozója. Az eddigi négy alkalommal kétszer Olaszországban (Milano és Aquileia), egyszer Németországban (Bochum) és legutóbb, 2015-ben, Madridban rendezték meg a szimpóziumot. A mostani főszervező egyéni pályázata által először adott otthont a konferenciának kelet-közép-európai ország. Az archeometallurgia relatíve fiatal, de dinamikusan fejlődő, tipikusan interdiszciplináris tudományterület, amely egyesíti a korabeli fémelőállítással, fémműveléssel kapcsolatos régészeti, ipartörténeti, valamint természet-tudományi és műszaki vizsgálati jellegű – archeometriai - vonatkozásokat.

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A konferencia absztrakt-gyűjteményét – elektronikus formában - a helyszínen kiosztott konferenciacsomagban található pendrive tartalmazta. A prezentációkból készülő, válogatott és bírált tudományos írásokat önálló konferenciakötetben publikáljuk majd.

A konferencia szervezésében és lebonyolításában közreműködött a Miskolci Egyetem, az MTA Miskolci Területi Bizottságának Anyagtudományi és –technológiai Szakbizottsága, a Herman Ottó Múzeum, a Magyar Műszaki és Közlekedési Múzeum Kohászati Gyűjteménye, a Miskolci Kulturális Központ Nonprofit Kft, a Magyar Nemzeti Múzeum sárospataki Rákóczi Múzeuma és a sátoraljaújhelyi Kazinczy Ferenc Múzeum. A rendezvényt támogatja az MTA CSFK Földtani és Geokémiai Intézet, az ÁSATÁRS Kft, az OAM Ózdi Acélművek Kft, a Magyar Vas- és Acélipari Egyesülés, a FUX ZRt, a Miskolc Városi Közlekedési Zrt és a B-A-Z Megyei Önkormányzat.

A nagyszámú helyszíni, illetve a konferencia után beérkező, pozitív, gratuláló, az esemény szakmaiságát és rendezését méltató visszajelzések alapján a szimpóziumot egyértelműen sikeresnek lehet értékelni. Ezt jelzi többek között az is, hogy a konferencia főszervezőjét beválasztották az Archaeometallurgy in Europe Állandó Bizottságának (Standing Committee) tagjai közé.

*Török Béla*

Miskolci Egyetem

A konferencia résztvevői / Participants of 5th International Conference Archaeometallurgy in Europe