



Neolithic Phonolite mine and workshop complex in Hungary

KATALIN T. BIRÓ¹, GYÖRGY SZAKMÁNY² & ZSOLT SCHLÉDER²

¹Hungarian National Museum, H-1088 Bp. Múzeum krt. 14-16, Budapest, Hungary

²Eötvös L. University, Dept. of Petrology and Geochem., H-1117 Budapest, Pázmány Péter sétány 1/C, Hungary

Abstract. Phonolite is a very specific volcanic rock which can be spotted in the archaeological material by simple means. Recently it was found among the polished stone tools of Late Neolithic Lengyel culture. Tools were identified within a 100 km circle around the sources. Workshop activity (production of phonolite axes) was documented by a detailed study of the well-known prehistoric settlement of Zengővárkony. Detailed field survey also resulted in the localisation of the prehistoric quarry region.

Keywords: Phonolite, Prehistoric quarry, workshop, distribution, polished stone tools, Late Neolithic

Introduction

In the frame of IGCP-442, basically provenance of polished stone tool raw materials are investigated with an aim of reconstructing European trade network routes. For a number of materials, we are facing the following difficulties:

- inferior quality local stuff, used for symbolic artefacts e.g. „grave axes“ have really no significance for trade networks
- high quality raw materials preferentially used (e.g., greenschist, serpentinite, basalt) may occur at several places within the reach / contact zone of prehistoric communities, therefore they should be unambiguously characterised (fingerprinted) by the sources before distribution data could be interpreted in a source-to-site relation.

Recently, the study of Late Neolithic basalt artefacts by Schléder and Biró (1999) and Judik et al (1999, in press) dealt with the apparent difficulties of the second type.

It is but in rare fortunate cases that petroarchaeological characterisation studies of polished stone tools can rely on single-point or almost single-point sources, where in the possible reach of the prehistoric population there was only one source area available. Even less frequently we can say that traces of prehistoric mining and processing of polished stone tools is documented. The fortunate case we would like to present in this paper is **phonolite** – extraction, processing, provenance and distribution as seen in the light of recent research in Hungary.

Phonolite – geological, petrographical description; sources of phonolite in Hungary and wider environs

Phonolite is a volcanic rock. It was originally „Klingstein“ (clinkstone; Hungarian, „csengőkő“) on account of

the sound emitted when it was struck by a hammer. It consists mainly of nepheline and alkali feldspar (sanidine or rarely anorthoclase). Other minerals occurring in phonolite are alkaline pyroxenes, alkaline amphiboles, leucite, analcime and sodalite-group minerals (sodalite, nosean, hauyne). It is the volcanic equivalent of nepheline syenite. Phonolite is grey to dark green, usually with a phryic texture and a greasy lustre due to the presence of nepheline. On surface conditions, the fresh broken fractured surface is getting easily weathered: typically, a yellowish-grey patina is observable on the subfossil (archaeological) specimens. The appearance of the rock resembles a poppy-seed cake with sugar in it, characteristic among the polished stone tool raw materials used for the production of prehistoric artefacts.

It is used today as building stone for interior decoration and ceramic additives.

Phonolite in Hungary occurs on the surface only in the Mecsek Mountains Lower Cretaceous formation termed „Mecsekjános Basalt Formation“. The sequence include a subvolcanic and submarine volcanic rock association forming a differentiation series ranging from (alkali) basalt through trachybasalt and tephrite to phonolite. Its four members include the subvolcanic Szamárhegy Phonolite Member, the Singödör Basalt Member which has the greatest mass and contains also microbasalt, the Balázsorma Tephrite Member, and the Kisbattyán Basalt Member with no extreme differentiates but with spilite. The thickness of the formation is several hundred of metres.

Phonolite can be found specifically at two localities, Hosszúhetény-Kövestető and Kisújbánya-Szamárhegy. Petrographically, both are dominated by sanidine and some plagioclase. Nepheline is occurring in characteristic irregular spots. Analcime or other zeolites may occur in knots. As coloured constituents, they contain primarily

aegirine of columnar habit. In the Szamárhegy phonolite (and only in this type) alkaline amphibole with reddish brown pleochroism can be observed, having a characteristic rim composed of opaque minerals as a consequence of magmatic resorption. The texture of the rock shows fluidal features with phyrical holocrystalline texture. Both phonolite types are of subvolcanic origin. Recent mineralogical and petrological description of the Mecsek phonolite was published by Harangi, 1994 and Harangi & Árvai Soós, 1993.

Approximate chemical composition data for phonolite, as well as some mechanical (mainly thermal) qualities are listed at <http://english.keramost.cz/suroviny5htm>.

Chemical composition data are quoted from here:

| | % | | % |
|--------------------------------|-----------|-------------------|-----------|
| SiO ₂ | 52 - 55 | CaO | 0,8 |
| Al ₂ O ₃ | 20,5 - 23 | MgO | 0,2 |
| Fe ₂ O ₃ | 1,5 - 2 | K ₂ O | 3,5 - 5 |
| TiO ₂ | 0,3 | Na ₂ O | 10 - 10,5 |

Its occurrences apart from Hungary are mentioned from Central Italy (Rome environs, Bracciano-lake), Bohemia (Teplitz, Marienberg, near Aussig, Klein-Priesen), Germany (Siebengebirge, Saurenberg, Eifel, Salzhausen), France (Auvergne, Mont-Dore, Haute-Loire) and Poland (Beskides).

From our more immediate vicinity, phonolite was described from the territory of Yugoslavia (Fruska Gora, Rakovác and Ledinc valley and Pétervárad).

The Szamárhegy phonolite mine

The study of prehistoric mines, more or less naturally, started with the investigation of „flint mines“ in the large sense. Very spectacular instances like Spiennes, Grimes Graves or Krzemionky draw attention to the problem fairly early. The exhibition and thematic monograph consecrated to the problem by the Bochum Museum of Mining (Weisgerber ed. 1980, published already in 3rd edition, Weisgerber ed. 1999) as well as the series of Flint Symposia set the standard of flint mine research and produced a system of cataloguing the known quarries by countries. The most recent, updated „flint mine catalogue“ was published for the VIIth Flint Symposium (Lech ed. 1995). The system of registering included a reference number by country and the following standard data:

- name, county, geological co-ordinates, geographical setting
- history of research
- geology and the characterisation of the raw material mined
- mining methods and exploitation units
- mining tools and the other finds
- quantity of the output
- palaeoecological data
- processing of the raw material
- chronology and the culture implications
- references

Of course most of these data can be supplied only in case of archaeologically investigated (excavated, prospected etc.) localities. It is imperative however to supply as much details as we can for the sake of a standard description.

The number of prehistoric „flint“ mines presented in 1995 (H-1-12) was completed by Biró and Dobosi by 1998. 2 new „flint“ (=silex) mines (Hejce and Budapest-Farkasrét) were added and the only known Palaeolithic paint mine, Lovas added as Nr. 15. It seems reasonable to record other prehistoric quarries in the same manner, at least non-metallic raw material mines. Therefore we suggest Szamárhegy to be added as Nr. 16. on the list of prehistoric mines.

Kisújbánya-Szamárhegy: the first polished stone tool raw material mine in Hungary

While „flint“ (=silex) mines of prehistoric age are relatively frequent, there are very few instances of prehistoric polished stone tool raw material mines in general.

The reason for this is rooted partly in finding very hardly dateable material in a quarry context in general and, typically, by the modern mining typical of most polished stone tool raw materials which destructed / covered traces of possible prehistoric mining activities. The so-called „pen-knife mines“ known in the vicinity of almost any village with suitable raw material outcrops could be well originated from prehistoric periods, as well. Such was the case for the important greenschist outcrops in the vicinity of Felsőcsatár. The use of this material is adequately demonstrated both by archaeological and petrological evidence (Harcos 1997, Szakmány & Biró 1998, Kasztovszky & Szakmány 1999, Szakmány & Kasztovszky in press for IGCP 442 Udine abstracts). Modern quarrying of the material (from Roman times on, the Felsőcsatár greenschist was exploited on „industrial“ scale) partly, erased possible prehistoric evidence, partly made small-scale extraction pits indistinguishable from traces of prehistoric mining.

In case of phonolite, petroarchaeological research is more fortunate. As we know, this distinctive raw material in large amount occurs within the Carpathian Basin only in the Mecsek Mts., S. Hungary, known from two outcrops (Hosszúhetény-Kövestető and Kisújbánya-Szamárhegy, respectively (see map)). The former one is situated close to the southern slopes of the mountain, only 15 kms from the major city Pécs. Due to the superb physical qualities of the material, the outcrop was exploited on industrial scale and prehistoric chipped pieces can no longer be distinguished, even on being found, from modern (also antropogeneous but much more recent), debris.

The other locality, Kisújbánya-Szamárhegy on the other hand is situated in the very heart of the mountain, in strictly protected area for its natural endowments by the Duna-Drava National Park office. Geographical co-ordinates for the locality were determined as 46°14' N and 18° 22' E according to Greenwich co-ordinates. No modern mining was known, recorded or found here, and



Fig. 1. Kisújbánya-Szamarhegy, phonolite exploitation area

thanks to the severe protection measures, probably the area will be preserved intact. In course of petrographical mapping field survey, the students of ELTE Dept. of Petrology and Geochemistry, Budapest became aware of the fact that lithic debris on the northern slopes of the mountain were essentially different in form and consistency than usual for phonolite, observable on the southern slopes. Zsolt Schlöder, part of the survey team recalled artificial forms from his expertise as collaborator in flint mine excavations at Szentgál. Fortunately, he was already involved in the petroarchaeological research concerning the Baranya county polished stone tools, especially Zengővárkony where the presence of phonolite was spotted.

The surface morphological features were checked by K. Biró and J. Antoni, archaeologists with expertise on polished stone tool technology and prehistoric mining activities (Antoni 1990, Biró 1992) and the surface morphological features, extracted blocks and „axe“ pre-forms identified on the spot (Fig. 1.). Some typical forms were collected for the Lithotheca collection of the Hungarian National Museum.

As a first step in more detailed studies, a geodetic survey of the area was prepared. By the help of Gy. Terei, archaeologist/surveyor of the Budapest Historical Museum, mapping and registering surface features was performed in a 1:200 scale over an area of 190 x 100 m (1,9 ha) by a method routinely applied for earth moulds,

elaborated by Gyula Nováki and György Sándorfi. The basis of the method is the detection of distance, direction and drip by the help of ultra-sonic detector and a computer elaboration of the data. The survey was realised in two measurement circles. In both cases, the starting point was set at the geodetic point (562 m a.s.l.) and thus the two circles could be collated.

On the first day, the eastern – north eastern part of the area was surveyed in 17 main measurement points. On the second day, 22 main points were taken. Total error for all measurements was within 110 cm on the first day and 171 cm on the second day, which means that direct reading can be modified some 5-6 cms for each points only. Apart from the current surface features, stone flows, possible exploitation areas were registered in a scale of 1:200.

The results were published first in the short communication for Pécsi Szemle on prehistoric and antique mining in the Mecsek Mts. (Kraft et al. 2000). The exploitation area shows traces of (in all probability, prehistoric) interference, though there is no evidence of direct dating. The known archaeological provenance data suggest a preferential use of the material in the Late Neolithic (Lengyel culture) though oncoming detailed survey may reveal more sites and wider chronological distribution in the near future.

Phonolite in the archaeological material

The possibility of finding phonolite in the archaeological material was raised not very long time ago.

Even former macroscopic classification suggested its existence among the archaeological (polished) artefacts. The certitude came with the revision of petroarchaeological data on the Zengővárkony Lengyel culture site and, mostly, after the identification of the Kisújbánya prehistoric phonolite mine and the workshop-related pieces from Zengővárkony.

The Zengővárkony polished stone producing workshop

The use of phonolite in general seems most important on the famous Late Neolithic settlement and cemetery Zengővárkony, excavated and published in two bulky monographs by János Dombay (Dombay 1939, 1960). At Zengővárkony, the role of lithic industry in general and specially that of polished stone industry surpasses the „average“ known for Hungarian prehistoric sites.

Several students of the subject stressed the importance of the lithic industry including János Dombay, excavator of the site himself.

In the 1980-es, Judit Antoni made a systematic study of the polished stone tools and the antler and bone tools of the settlement. She was aided in her work by Zoltán Almádi who made a preliminary (macroscopic) petrographical classification of the industry. Unfortunately, apart from the manuscript PhD thesis (Antoni 1990) the results of this work remained unpublished.

Also based partly on the Zengővárkony polished stone artefacts, István Zalai-Gaál made a socio-archaeological study on the material, mainly based on the evidence found

in the graves. No petrographical determination of the polished stone tools was made for the support of this study.

Recently, the authors of this paper and Ms. Antoni together made a survey of the total polished stone tool inventory of the site. One of the first observations was noting the presence of phonolite, tephrite and phonotephrites in the material, formerly described by Almády mainly as „microgranite“.

Our study included apart from the survey of finished polished stone tools forms which could be connected with the production of polished stone tools, in the first place, phonolite. By this time the existence of the Szamárhegy mine was already known to us.

Altogether some 200 pieces were registered. Of these, about 10 % was made of phonolite. Polishers and tools for making polished stone axes were also observed.

Pieces which might be associated with the „phonolite-workshop“ were specifically selected for further studies, both archaeological and petrographical.

The typological (morphological) description of the pieces selected is given below:

1. N 2/281-1948 Imperfect axe-blade pre-form, slightly polished. Dimensions: 97 x 48 x 35 mm,
2. N 1/160-1949 Square (sawed?) pre-form with polish, broken axe pre-form ? Dimensions: 138 x 46 x 42 mm,
3. N 2/217-1948 Slightly asymmetrical axe-blade pre-form before finish. Dimensions: 121 x 68 x 36 mm,
4. N 1/79-1947 Fragment of an axe pre-form with traces of polish. Re-used piece. Dimensions: 97 x 40 x 37 mm,
5. N 2/110-1948. Bulky hammer made of axe pre-form with initial polish. Dimensions: 125 x 66 x 46 mm,
6. N 1/405-1947 Sliced large phonolite block before production of pre-form. Dimensions: 110 x 75 x 55 mm,
7. N 1/297-1947 Medium size axe pre-form with traces of polish Dimensions: 102 x 44 x 42 mm,
8. N 1/427 – 1947 Broken axe pre-form with traces of polish. Dimensions: 64 x 61 x 38 mm,
9. Smaller axe pre-form with initial polish. Dimensions: 102 x 44 x 28 mm,
10. N 2/341-1948 Rounded axe pre-form used as hammer. Dimensions: 83 x 50 x 35 mm, (Fig. 2)
11. N 1/379-1947 Large pre-form with parallel planes, broken obliquely in the middle. Dimensions: 102 x 75 x 42 mm,
12. N 12/21-1941 Raw phonolite block with traces of sawing, shaping and initial polish. Dimensions: 110 x 45 x 36 mm.

Even now, the number of pieces identified as phonolite is not too much: revision of southern Hungarian material, however, will probably extend the scope.

Macroscopically identified pieces

Apart from the workshop site of Zengővárkony, phonolite axes have been located so far at the following localities (Fig. 3.):

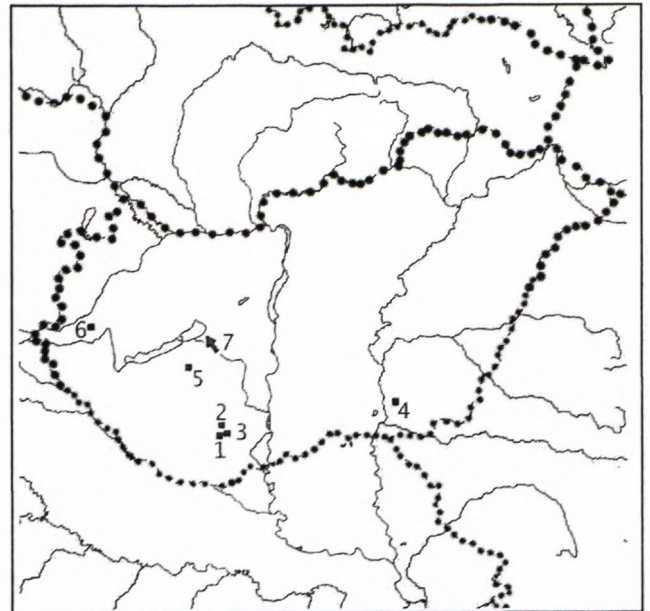


Fig. 2 Known distribution of phonolite polished stone tools on Hungarian archaeological sites.

Key: Sources – 1. Hosszúhetény-Kövestető; 2. Kisújbánya-Szamárhegy; Workshop – 3. Zengővárkony (LN Lengyel culture); Archaeological sites: 4. Hódmezővásárhely – Gorzsa (LN Gorzsa group); 5. Zics – Szükszür dűlő (MN, LN, CA); 6. Győr-vár (unknown), 7. + further than Mezőkomárom (unknown)

Zics-Szükszürdűlő

Surface collected material by I. Sipos.

The „suspect piece“ is the edge fragment of a medium size axe in fairly corroded state. The piece was renewed and pierced at some period of its existence (Fig. 4)

The site associated with the polished stone tool contains the remains of several prehistorical cultures including Early/Middle Neolithic Oldest LBC, Classical LBC, Late Lengyel/Balaton, Baden cultures.

Győr-vár

Surface collected piece by Zs. Farkas. The artefact used to be a bulky shaft-hole axe, with oval transsection, the butt half remaining to us.

Hódmezővásárhely-Gorzsa (Fig. 5)

This piece is especially valuable to us as it is coming from controlled excavation with micro-stratigraphical method. The site is one of the key settlements of the Alföld Late Neolithic, its connections with the Lengyel culture has been demonstrated by the archaeological evidence in general (Horváth F. 1986) and the chipped stone industry, specifically (Biró 1998). There are important connections shown by the regular presence of Mecsek radiolarite on this site.

The suspect piece is the broken butt end of a shaft-hole rounded axe, a type which is frequently met at Zengővárkony. The distance from the outcrop is at least



Fig. 3. Phonolite axe half-product from the Zengővárkony workshop site



Fig. 4. Zics-Szűkszür dűlő. Fragment of polished stone tool. Phonolite (?)



Fig. 5. Hódmezővásárhely-Gorzsa. Fragment of polished stone tool. Phonolite (?)



Fig. 6 Phonolite artefacts from the Mihály collection (6/1) and petrographical thin section of item inv. No.55.1239. with 1 N (6/2) and X N (6/3), respectively. Courtesy of J. Füri.

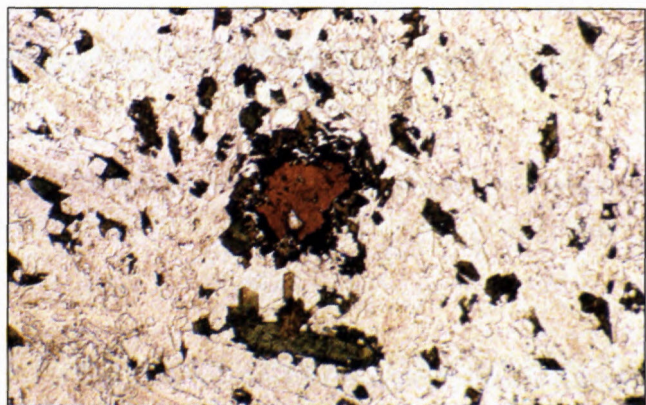


Fig. 6/2

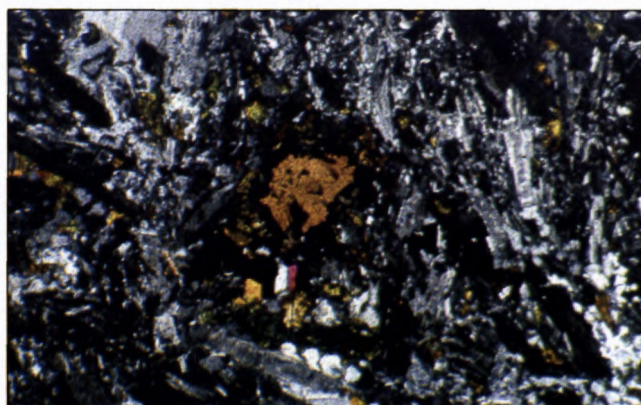


Fig. 6/3

100 km as the crow flies and the trader must have surpassed severe geographical obstacles like the course of the rivers Danube and Tisza. We are currently checking this piece; the presence of phonolite at Gorzsa indicates a wider, at least regional distribution of phonolite on Hungarian archaeological sites and chronologically supports our view that the acme of phonolite axe exploitation and production was probably in the Late Neolithic.

Mihálydy collection: Two samples have been determined as phonolite (Fig. 6/1). Inventory numbers: 55.1239 (Szamár-hegy type on the basis of thin section (Fig. 6/2-3.), it is sure that it is it), and 55.875 (only macroscopic data) The exact site for both pieces is unknown. The Mihálydy collection, stored in the Veszprém County Museum and elaborated in details by T. Horváth (1999) has unfortunately lost most of the provenance data due to hasty re-inventarisation in the early 50-is. Nearest to the quarry site we find site nr. 96 (Mezőkomárom), published by S. Mithai (1978), some 60 kms minimal distance from the outcrop. The phonolite items from the Mihálydy-collection were petrographically identified by the archaeometry study team of the ELTE Petrography and Geochemistry Dept. (Szakmány et al. 2000, Szakmány et al. in press)

Analytical studies on phonolite artefacts

There were so far only limited studies by analytical methods on phonolite artefacts. The specimens investigated by, at least petrographical microscopy include pieces from the Mihálydy collection and Zengővárkony. Several more items are currently under investigation and we hope to serve details by the Udine meeting.

Tasks and directions of research

As it is apparent from our paper, tracing phonolite in the archaeological record in Hungary (and probably the regions lying to the south of our borders) is a current field of research. The recognition of phonolite in the archaeological material started fairly recently, the study of the quarry area and the workshop is in its initial phase as yet. It is very difficult to estimate the actual significance of phonolite (as well as related rocks, phono-tephrite and tephrite) in the archaeological material. Its significance lies primarily in the fact that being a very specific raw material relatively easy to identify and rare concerning geographical / geological occurrences, it will be probably an excellent marker for ancient trade routes.

Acknowledgements

This study was prepared in the frames of IGCP-442 project, Raw materials of Neolithic Artifacts as well as thematical projects of the Hungarian National Science Foundation, theme T-025086 „Prehistoric raw material atlas of the Carpathian Basin“.

References

- Antoni J., 1990: Neolitikus eszközkészítés és használat. Budapest. PhD.Thesis
- Biró K., 1992: Adatok a korai baltakészítés technológiájához. (Data on the technology of early axe production) Acta Musei Papensis 3-4, 33-80.
- Dobosi V. & Biró K., 1998: Prehistoric and classical stone quarries („mines“) in the Carpathian Basin In: Biró K.-Horváth T. (eds.), 31st International Symposium on Archaeometry. Program and Abstracts Budapest, p.55
- Dobosi V. & Biró K., in press: Prehistoric and classical stone quarries („mines“) in the Carpathian Basin. In press for the 31st ISA conference volume.
- Dombay J., 1939: A zengővárkonyi őskori telep és temető (The prehistoric settlement and cemetery at Zengővárkony) ArchHung 23, 1-.
- Dombay J., 1960: Die Siedlung und das Gräberfeld in Zengővárkony. Arch. Hung. 37, 1-235.
- Harangi Sz., 1994: Geochemistry and petrogenesis of the Early Cretaceous continental rift-type volcanic rocks of the Mecsek Mts., South Hungary. Lithos 33, 303-321.
- Harangi, Sz. – Árva-Sóós, E., 1993: A Mecsek hegység alsókréta vulkáni közei. I. Ásvány és közetan. (Early Cretaceous volcanic rocks of the Mecsek Mountains [South Hungary] I. Mineralogy and petrology). Földtani Közöny 123/2, 129-165.
- Harcos T., 1997: Kőszerszámkészítés a neolitikumban és a Savaria Múzeum Velem-Szent Vid-i kőszerszámgyára. In Hungarian and in English. Pannicvlvs Szombathely, 9 – 41
- Horváth F., 1986: Aspects of Late Neolithic changes in the Tisza-Maros Region. BBÁME 13, 89-102.
- Horváth T., 1999: Polished stone tools of the Mihálydy-collection, Laczkó Dezső Museum, Veszprém. Archaeological investigation. 2nd Workshop of the IGCP/UNESCO 442 project, Veszprém, 1999. Oct. 11-13.
- Judik K., Biró K. & Szakmány Gy., in press: Petroarchaeological research on the Lengyel culture polished stone axes from Aszód, Papi földek. In press for Lengyel'99 Conference Volume.
- Kasztovszky Zs. & Szakmány Gy., 1999: Prompt gamma activation analysis of neolithic greenschist polished stone tools (poster), 2nd Workshop of the IGCP/UNESCO 442 project, Veszprém, 1999. Oct. 11-13.
- Kraft J., Biró, K. & Gábor, O., 2000: A mecseki bányászat története a honfoglalás koráig. Pécsi Szemle.
- Lech J., (ed.) 1995: Catalogue of flint mines. Archaeologia Polona 33 (Warszawa)
- Mithai S. 1978: Mihálydy István régészeti gyűjtőtevékenysége (1833-1901) - VMMK 1978., (XIII), 7-15.
- Schléder Zs. & Biró K., 1999: Petroarchaeological studies on polished stone artifacts from Baranya county, Hungary. Janus Pannonius Múzeum Évk. 43, 75-101
- Szakmány Gy., Fűr J., Szolgay Zs., & Horváth T., 2000: Petrographical studies of polished stone tools of the Mihálydy-collection, Laczkó Dezső Museum, Veszprém (Hungary) 3rd Workshop of the IGCP/UNESCO 442 project, Eggenburg, Austria September 27th-29th, 9-11
- Szakmány Gy., Fűr J. & Szolgay Zs., in press: Outlined petrographical results of the raw materials of polished stone tools of the Mihálydy-collection, Laczkó Dezső Museum, Veszprém (Hungary), Veszprém kötet.
- Szakmány Gy. & Biró K., 1998: Field trip No. 3. Lithic raw material tour. In: Jerem E. (ed.) – Excursion Guide of the 31st International Symposium on Archaeometry Budapest, 93-152
- Weisgerber G. (ed.), 1980: 5000 Jahre Feuersteinbergbau Bochum Deutschen Bergbau-Museum, 1-670
- Weisgerber G. (ed.), 1999: 5000 Jahre Feuersteinbergbau Bochum Deutschen Bergbau-Museum 1999 3rd (ed.) 1-.
- Zalai-Gaál I., 1991: Die chronologische und soziale Bedeutung der Mitgabe von Steinäxten in den spätneolithischen Gräbern Südtransdanubiens. Saarbrücker Beiträge zur Altertumskunde (Bonn) 55, 389-399.