In: Sternke, F., L. J. Costa and L. Eigeland (eds) in press. Non-flint Raw Material Use in Prehistory: Old Prejudices and New Directions. Proceedings of the XV. Congress of the U.I.S.P.P. Archaeopress, Oxford.

Pitted and grinding stones from Middle Palaeolithic settlements in Bohemia: a functional study

Andrea Šajnerová-Dušková, Jan Fridrich and Ivana Fridrichová-Sýkorová

Andrea Šajnerová-Dušková
Anthropo-Archaeological Laboratory
The Hrdlička Museum of Man
Charles University Prague
Czech Republic
Email: duskova@traseologie.cz

Jan Fridrich
Laboratory for Palaeolithic Research
Institute of Archaeology
CAS Prague
Czech Republic
Email: fridrich@arup.cas.cz

Ivana Fridrichová-Sýkorová
Laboratory for Palaeolithic Research
Institute of Archaeology
CAS Prague
Czech Republic
Email: sykorova@arup.cas.cz

Abstract

Recent research which systematically investigated the entire range of stone artefacts on Lower and Middle Palaeolithic settlements in the Central and Northwest Bohemia revealed surprising information about the use of raw materials, not only with regard to knapped industries, but also to artefacts assigned to process organic and inorganic materials. The form and function of these artefacts appear to be unchanged from the Lower Palaeolithic until the Neolithic period. They can be divided into two categories: active tools (hammerstones, pestles or whetstones) and passive tablets (anvils, anvil-pallets). Originally, such artefacts were considered to be a part of the *chaîne opératoire* associated with knapped lithic industries. However, it seems their function was not only limited to knapping activities.

Keywords: Middle Palaeolithic, tablets/anvils, experiment, pigments

Résumé

Le recherché récent sur les peuplements du Paléolithique inférieurs et moyens en Bohême centrale et du nord-ouest, qui étudient systématiquement l'ensemble des objets manufacturés en pierre, fournit des informations étonnantes quant à l'utilisation des matières premières, non seulement au niveau des processus de débitage, mais également pour des objets associés à la transformation de matériaux organiques et inorganiques. La forme et la fonction de ces objets façonnés semblent inchangées depuis les temps les plus reculés (Paléolithique inférieur) de la culture humaine jusqu'à la période Néolithique.
Ils peuvent être divisés en deux catégories: outils actifs (pierre de marteau, pilons ou pierres à aiguiser) et tablettes passives (enclumes, enclume-palettes). A l'origine, de tels objets façonnés ont été considérés comme participant à la "chaîne opératoire" de production des industries sur supports débités. Cependant, il semble que leur fonction n 'a été pas été limitée aux seules activités de production lithique.

Mots-clés: Paléolithique moyens, tablettes/enclumes, experience, colorants

Introduction

The region České středohoří represents a unique landscape which has not been radically geologically changed since the Brunhes/Matuyama boundary (780±10 ka). This geological stability is corroborated by frequent Lower and Middle Palaeolithic settlements, well preserved in their original positions around and above the palaeo-watercourses. All studied sites are rich in chipped stone industries made from local raw materials. However, a special group of grinding and crushing tools recently caught the archaeologists' attention. These tools can be divided into two categories: active tools (hammerstones, pestles or whetstones) and passive tablets (anvils, anvil-pallets). The tablets are made from different, but mostly coarse raw materials such as quartzite, sandstone, conglomerate, chert, quartz or lydite.

Fig. 1. Palm size palette (Bečov I).

The frequency and the size variability with which the tablets occur in these Middle Palaeolithic collections would indicate that this type of implement played an important role. Its significance was not limited to being a part of the *chaîne opératoire* of the knapped lithic industries, but the purposes of the tablets could have varied. The tablets are of different sizes; from palm size pallets for the grinding of pigments (Fig. 1) to pallets made from vast stone slabs with a diameter of over 0.5 m (Bečov IV – Upper Acheulean) (Fig. 2). These could have been used for grinding and crushing of organic and/or inorganic materials, or perhaps for the grinding of other tools made from different materials such as wood or bone. An initial experimental program was designed to verify several possible types of use of the quartzite tablets, including their manufacture, maintenance and use efficiency. The experiments were inspired by and based on the tools and materials found during the excavations of the Middle Palaeolithic settlement in Bečov I.

Fig. 2. Tablet/anvil (Bečov IV – Upper Acheulian).

Bečov I – A Middle Palaeolithic settlement

The site is situated on a natural outcrop of "Bečov-type" quartzite in North-West Bohemia, between the towns of Louny and Most in the cadastre of Bečov itself. It consists of multiple occupations on Písečný vrch (317.2 m O.D.), which is a relict of a Lower Tertiary maar – a low, long hill with three basic peaks formed by the partially excised quartzite outcrops. Písečný vrch is 55 m high, 1,300 m long and 900 m wide. Its sedimentation comprises of Middle Cretaceous, Lower Tertiary and Quaternary layers. Písečný vrch is one of the largest natural outcrops of predominantly white and yellow quartzite as well as quartzitic sandstone and sandy quartzite of pre-Miocene age (Minaříková *et al.* 1976). Its surface slopes down gently and regularly on all sides. Pleistocene layers only survive in the more advantageous conditions of natural depressions, or where they were protected by quartzite nodes.

The complex stratigraphic conditions at the site were resolved with the aid of micromorphological analyses of the soil and its derivatives, as preserved in two profiles, A and B (Fridrich and Smolíková 1973, 1976). Among the oldest soils are those of the Braunlehm type, occurring here in the form of fossil soil sediments, indicative of very intensive weathering during the warm, wet period of the Lower Pleistocene. The uppermost range of the Middle Pleistocene (the penultimate interglacial, part of the Saale complex, i.e. OIS 7a-c, upper section PK IV) matches the fossil soil termed granulated para-brown earth (the surviving base of this soil, i.e. sub-horizon B_2/C). The Upper Pleistocene is represented by para-autochthonous fossil soils of the last interglacial (Eemian, PK III), which match granulated to slightly earthified brown earths (Fig. 3).

The site, discovered in the mid-1960s, offers uniquely preserved evidence of a human settlement site of the Lower Palaeolithic, culturally belonging to the Přezletician, with evidence lasting through multiple occupations in the Middle Palaeolithic (Upper Acheulian, early Mousterian/proto-Charentian, Mousterian *s.l.*) and through most of the Upper Palaeolithic period (e.g. Aurignacian and Magdalenian; see Fridrich 1982, 1997, 2005). However, these quartzite outcrops were also of interest to the peoples of later prehistoric periods as well, as evidence from the Neolithic and Middle Bronze Age shows.

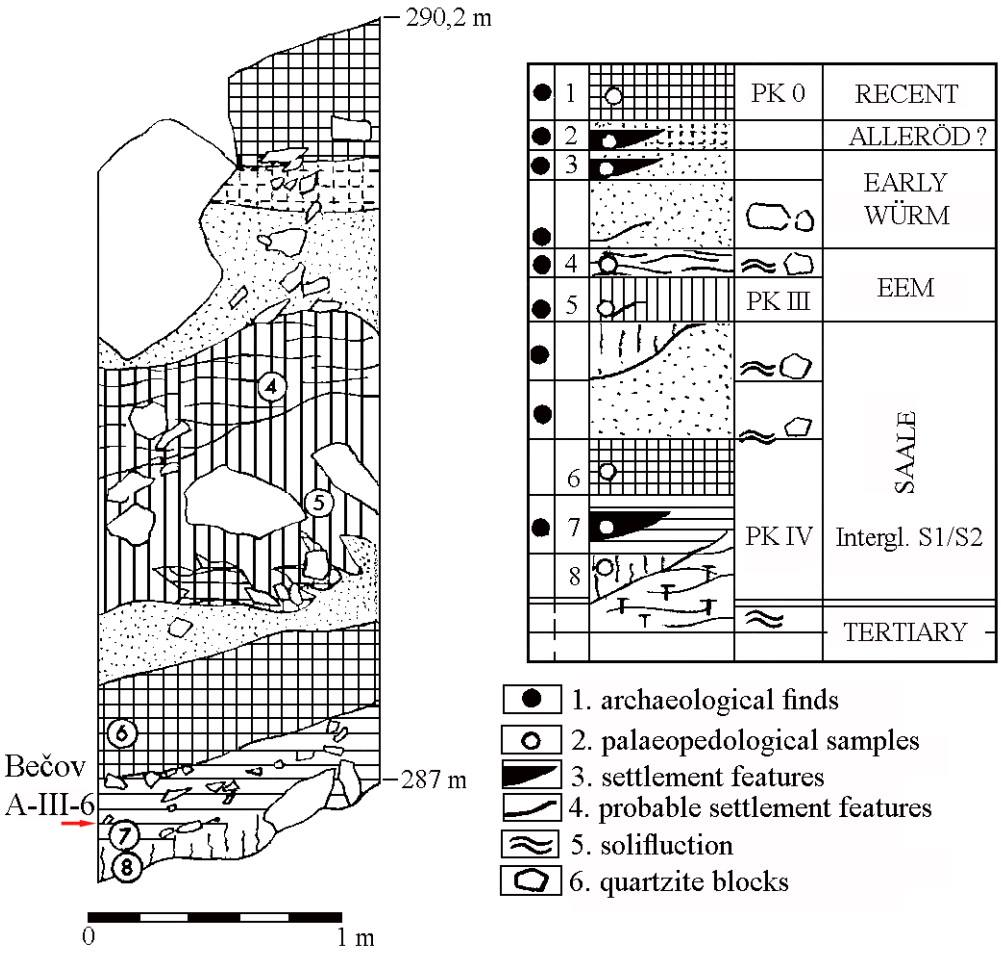

Fig. 3. Bečov I (Most district). Part of profile A and a schematic of the same section.

Undoubtedly, the most interesting part of this multiple-occupation site is the dwelling beneath overhanging rock preserved in layer A-III-6 and dated to the early phase of the Middle Palaeolithic (the proto-Charentian or early Mousterian), more specifically to the interglacial between the Drenthe and Warthe glacials, corresponding to OIS 7a-c (around 200,000 BP). The dwelling feature lay in the northern part of sector A. Its fill comprised of four microhorizons. Microhorizon 1, the uppermost, persisted both in the actual feature and in its immediate surroundings, covering an area of around 66 m^2. Microhorizons 2 and 3, the actual dwelling fill, were black-grey, heavily humic cultural layers, while microhorizon 4 comprised of a thin line of loess in the western part of the feature. The latter was artificially spread over the substrate and in the eastern part over a pile of quartzite detritus to form a small platform (the area of this microhorizon was limited to around 15 m^2) (Fig. 4).

The settlement feature comprised a sunken pit (set into brightly-coloured clayey Tertiary tuff), oval in shape with a flat base and modifications to the immediate area. The northern, western and southern edges of the pit were relatively steep cut (max. depth 0.75 m). In addition, the western edge was differentiated by a short, low wall consisting of flat, upright stones. The eastern side of the feature was formed by a low, semi-circular wall made of stones of various sizes. The feature was surrounded by several quartzite boulders on the western, southern and eastern sides. To the north, it was protected by a sizeable slab of quartzite (4 to 5 m thick), which was angled slightly and fell onto the substratum of Tertiary tuff and sand, the part of it above ground forming the overhang (abri) beneath which the feature was originally located. The dimensions of the inner, sunken part of the feature were 4.8 x 3.5 m, while the outer dimensions with the surrounding boulders measured 6.6 x 4.25 m. Other structural elements are isolated. On the eastern edge of the western wall, there was an oval pit (15 x 12 cm, 20 cm deep from the layer surface, relative depth 5 cm), while there was also a pair of shallow pits, partially surrounded by stones (17 x 23 x 7 cm; 21 x 17 x 4 cm) at the southern edge of the sunken space. These features

are interpreted as the remains of post holes. A partially embedded, rectangular block of quartzite (50 x 36 x 10 cm) was found at the edge of the north-western wall and may be regarded as a seat.

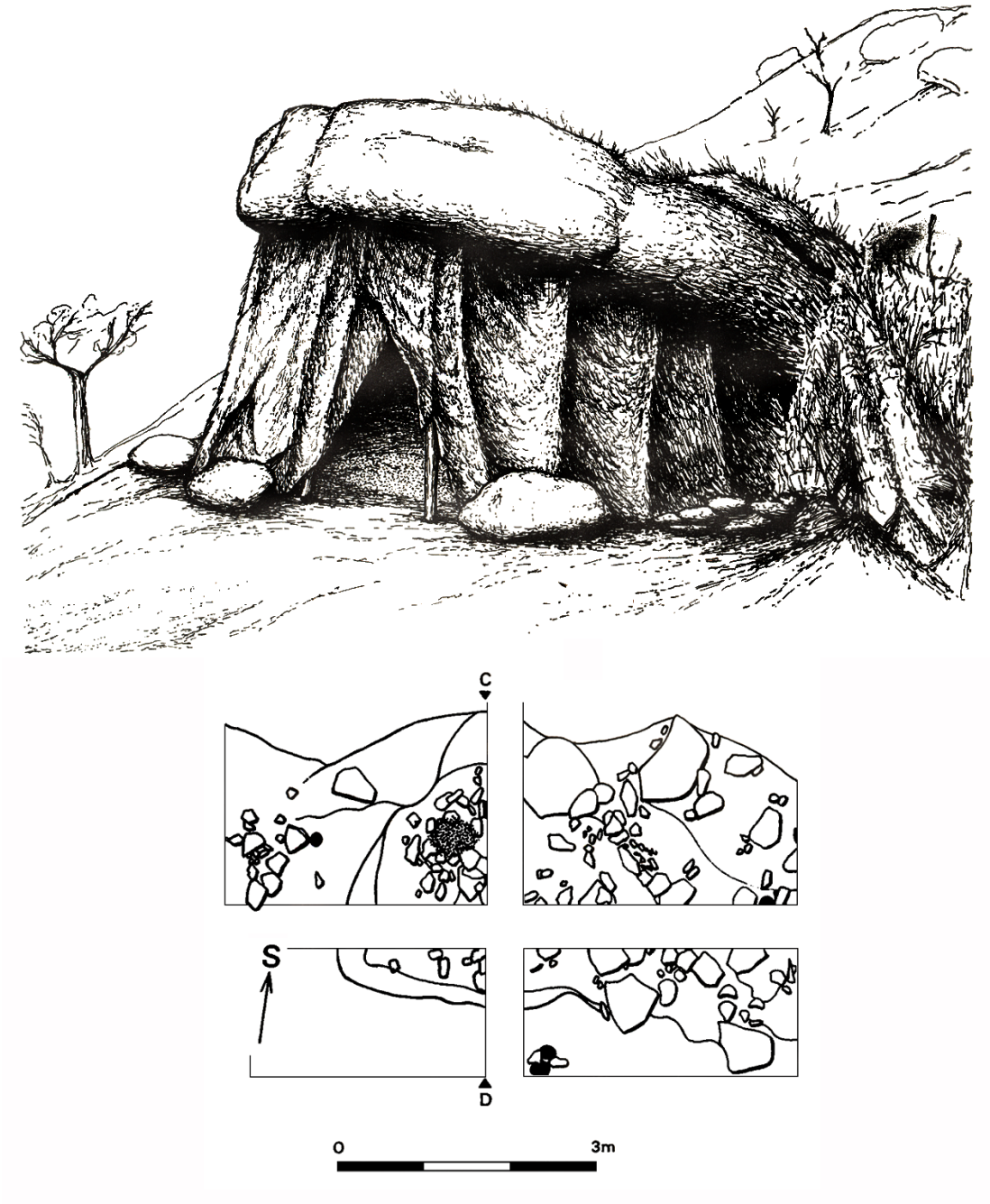

Fig. 4. Bečov I (Most district). Attempted reconstruction of a settlement feature (layer A-III-6 – Early Mousterian) (above). Drawing of a settlement feature (layer A-III-6 – Early Mousterian) (below).

The "life history" of the settlement feature can be described as three separate events: (1) foundation (excavation of the pit, raising of the floor in the eastern part, spreading loess over the western part, wall construction), (2) use (the actual fill of the feature with a central hearth, manifested through a minor concentration of medium-sized stones on the feature base, surrounding an oval, slightly charred area measuring 50 x 40 cm) and (3) post-destruction (the period after the destruction of the upright parts of the feature, the creation of a hearth on top of the walls, settlement in the hollow and its environs – microhorizon 1).

The knapped stone industry found in and around the settlement feature is white-grey or yellow-brown in colour, not aeolised and very slightly patinated. At the present time, the assemblage numbers some 50,000 pieces. The composition of this collection and the typological and technological character of the products within it confirm its dating to the Middle Palaeolithic. Various core forms are present with a dominance of amorphous types. There is also a strong presence of flake cores with an almost right angle and flake cores with an edge. The proportion of Levallois forms is surprisingly low. Naturally, a large part of the collection consists of flakes with a heavy prevalence of forms related to the production or preparatory phases of core reduction. Among the tools, scrapers with various types of retouch are dominant, the most characteristic being an abrupt (or stepped) retouch and a tooth-like (denticulate) edge treatment. Quinson and Tayac forms are the dominant types of points. Knives are present in a form with a retouched back, but they are not particularly numerous. Other tool types recorded at the site are notches, awls, choppers and a few burins. This list of finds would not be complete without mentioning the relatively regular, partially polished round shaped object made of coarse-grained sandstone (6.85 x 5.56 x 4.5cm), which has been interpreted as a human head with the neck and parts of the shoulders also represented (Fridrich 1976). Other artificially polished items are four tablets which served as pallets for mixing dyestuffs, the remains of which were found in large quantities within the feature in the form of porcellanite in a diverse range of shades (yellow, orange, red), bearing traces of heat-treatment.

Fig. 5. Pieces of porcelainite found in the Bečov I dwelling (layer A-III-6 – Early Mousterian).

Experiments

The experimental tablets were made from Bečov-type quartzite with a different level of silica matrix consolidation. The tablets were prepared in two sizes: small palm size pallets and bigger tablets, unsuitable for holding in one hand. Based on the finds from Bečov I, we tested the possible use of porcellanite as a source of pigment for dyestuffs. The utilization of this mineral for pigments is unusual, therefore, the processing procedure needed to be verified. Porcellanite is a very hard mineral (6.5 - 7.0), consisting of a mixture of SiO_2 and Al, Ca,

Fe and Mg oxides which constitute its different colours. Occasionally, it was used as a raw material in the flaked stone industry. However, the pieces of porcellanite found in the Bečov I dwelling were intensely oxidized, i.e. soft and easy to rub (Fig. 5). The question that required to be answered was: Did the Middle Palaeolithic people use the nearby source of weathered porcellanite on Písečný vrch or did they exploit the more distant outcrops of porcellanite on Verpánek hill? If fresh porcellanite was processed, it must have been artificially softened prior to the grinding process. One possible way of achieving this was to heat-treat the porcellanite in a hearth, as traces of such treatment on some pieces in the Bečov I dwelling indicate.

Fig. 6. Experimental rubbing of weathered porcelainite.

Thus, two comparative experiments were conducted: one on fresh porcellanite and a second on weathered porcellanite. Fresh porcellanites of different colours were burned in a hearth for one to six hours. The blocks of porcellanite started to fracture after half an hour, but they were left in fire for 30 minutes and more (up to six hours) to oxidize and disintegrate the core. The blocks were then cooled in cold water. The longer the block was heated, the more the original colour changed into grey or dark grey. After the blocks had cooled, they were crushed into smaller pieces (about 5 cm in diameter), which were either directly rubbed against the small quartzite palm pallets or ground on the bigger pallets using a pestle. The direct rubbing produced a fine, uniform powder, whereas the grinding produced a mixture of different sized pieces as well as powder. The pieces had sharp edges, although the size was similar to those found in the Bečov I dwelling. The working efficiency of the palm pallet rubbing and grinding was almost equal to achieve a comparable quality of powder. Grinding was only slightly more advantageous. The 30 minutes of work produced 2 to 8 g of powder suitable for use as a dyestuff. The surface of the pallets was significantly abraded after 20 to 45 minutes of work and had lost its grinding abilities.

The weathered porcellanite pieces were picked up from the soil on the slope of Písečný vrch and measured up to 10 cm in diameter. The colour scale was comparable to those found in the Bečov I dwelling. The surface was soft, allowing it to be rubbed off on the hand, and all its edges were rounded. These pieces could be easily rubbed against the palm pallet (Fig. 6) or ground on the bigger pallet using a pestle (Fig. 7). The direct rubbing produced fine powder and rounded the final hand held pieces. These were almost identical to those found in the

Bečov I dwelling. The grinding produced a mixture of fine powder and pieces of different sizes, depending on the intensity and style of grinding. The working efficiency of grinding was two times higher than the palm pallet rubbing, but less homogeneous fractions were obtained, thus the powder had to be sorted afterwards. However, the structure and the size of the porcellanite pieces found in the Bečov I dwelling suggests that both methods were used. The 30 minutes of rubbing produced about 5 to 10 g of powder and the grinding 15 to 20 g. After this period of time, the surface of the palm pallets had to be cleaned with water to remove the layer of pigment trapped within it and then the rubbing could continue as the surface was not very abraded and had not lost its grinding abilities.

Fig. 7. Experimental grinding of weathered porcelainite.

Only the powder from the weathered porcellanite can be completely rubbed onto any surface without leaving significant remains of the non colouring residues. One gram of dry powder can be used to colour 720 cm^2, when it is manually applied on a white sheet of paper. The real extent of the area coloured by the Palaeolithic people depended on the painting method and the pigment binder used. However, the powder from the fresh and the burned porcellanite contains a significant volume of non-colouring particles (over 50 percent), which remain on the paper. In addition, the general colouring ability is much lower than that of the weathered porcellanite. One gram of dry powder made from the burned porcellanite lightly coloured 345 cm^2 and the same amount of powder from the fresh porcellanite even less, only 180 cm^2. The results indicate that the fresh porcellanite is not suitable for the production of dyestuff, even after heat-treatment.

Other materials selected for grinding and milling were small millet seeds and bigger sunflower seeds. The experimental results confirmed the popularity of quartzite as a raw material used for grinding tablets or millstones until the Neolithic period. As anticipated, the bigger pallets were more efficient for this task. In addition, the presence of either, natural or artificially produced concavities makes the pallets even more suitable. After one hour of milling, about 50 to 100 g of millet flour were obtained, despite the fact that we had no previous experience in this task. The experimentally made pallets were smaller than the metates used for similar purposes (e.g. Adams 1996; David and Kramer 2001), which also may have limited the experimental flour

production. The quartzite pallet surface was barely abraded and could have been used without resharpening for several more hours.

The last experiment conducted was a replication of the manufacture of pitted stones, which are the second most frequent type of tablets found at the site (Fig. 8). Previous experiments have shown that a shallow and smooth concavity may develop on tablets/anvils as a result of long term grinding or the cracking of hard materials (Goren-Inbar *et al.* 2002). However, most of the Middle Palaeolithic pitted stones display traces of chipping (a rough and battered surface), not grinding of the pits. The size and depth of these pits vary, therefore, it is probable that slightly different manufacturing techniques might have been used to produce them. The pits can be chipped with a puncher made from the same raw material as the tablet, but the punching edge must be kept sharp through systematic resharpening. Using this technique, the pits of about 5 cm in diameter and 1 to 2 cm in depth can be produced in 30 minutes. The resulting pitted stones are comparable to some Palaeolithic examples, but several pieces have much deeper and narrower pits which we were not able to re-produce using this technique. For the time being, their technique of production remains unknown.

Fig. 8. Pitted anvil (Bečov – a new Middle Palaeolithic site – Upper Acheulian).

Conclusion

Although the interest of archaeologists focuses mainly on standard types of knapped stone tools, the presence of stone tablets in the Lower and Middle Palaeolithic collections should not be ignored. The experiments presented in this paper provided some interesting results regarding the manner of use and manufacture of such tablets. The multifunctional aspect of these types of implements cannot be doubted, although the identification of the worked materials can be difficult in Palaeolithic industries. The excavation of the Bečov I dwelling recovered evidence of activities which are possibly related to the use of such tablets. The opportunity to experimentally verify this

process and the results derived from the grinding of porcellanite may help further with the identification of the source of porcellanite used for dyestuff residues at Bečov I.

In addition, the settlement structure and activities associated with the production of tools for everyday use as well as the tablets and possible ritual artefacts constitute clear evidence of a highly evolved way of living and complex intellectual world of the bearers of the Early Mousterian during the initial phase of the Middle Palaeolithic.

Bibliography

Adams J.L. (1996) Bringing Stone Tools to Life: The People behind the Rocks, *Archaeology in Tucson Newsletter* 10 (4), 1-5.
David, N. and Kramer, C. (2001) *Ethnoarchaeology in action*. Cambridge University Press, Cambridge.
Fridrich, J. (1976) Příspěvek k problematice počátků uměleckého a estetického cítění u paleantropů, *Památky archeologické* 67, p. 5-27.
Fridrich, J. (1982) *Středopaleolitické osídlení Čech*. Archeologický ústav ČSAV, Praha.
Fridrich, J. (1997) *Staropaleolitické osídlení Čech*. Památky Archeologické-Supplementum 10, Praha.
Fridrich, J. (2005) *Ecce Homo. Svět dávných lovců a sběračů*. Krigl, Praha.
Fridrich, J. and Smolíková, L. (1973) K problematice stratigrafie paleolitického osídlení v Bečově, o. Most, *Archeologické rozhledy* 25, p. 487-499 and 591-596.
Fridrich, J. and Smolíková, L. (1976) Starý pleistocén v profilu B, Bečov I (Lounské Středohoří), *Archeologické rozhledy* 28, p. 3-17 and 109-114.
Goren-Inbar, N., Sharon, G., Melamed, Y.and Kislev, M. (2002) Nuts, nut cracking, and pitted stones at Gesher Benot Ya'aqov, Israel, *Proceedings of the National Academy of Sciences* 99 (4), p. 2455-2460.
Minarčíková, D., Růžička, M., Růžičková, E. and Valečka, J. (1976) Petrografická charakteristika archeologických nálezů – lokalita Bečov, *Památky archeologické* 27, p. 28-30.