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# Dolní Věstonice I female grave (DV3). Red colourants and other components of the burial fill up and grave floor

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***Abstract***

Red powdery and crusty concentrations from the fill-up and bottom of a female burial DV3 from the Dolní Věstonice I site, representing Pavlovian culture, as well as some red raw material from the site were examined. Burial floor and fill-up is composed of marly substrate mixed with bone powder, charcoal ash and red, rounded, relatively hard particles, composed of burnt iron bearing aluminosilicates. Red crusts, present on it (maybe also within it), applied probably as suspension, are composed of unburnt iron bearing aluminosilicates. The raw material for powders is assumed to come from the site hearths red ash. Red iron artifacts, macroscopically almost identical, occur on the site also as an assemblage of loose red lumps. They are petrographically inhomogeneous and their sources are localized up to 150 km from the site. Raw material similar to the one of some of red lumps may have been used for burial ceremony.

**Keywords***:* Dolní Věstonice I, red raw material, hematite, grave DV3.

## 1 INTRODUCTION

Red ferruginous materials are known from the oldest sites, where remains of the genus Homo were found (Rosso *et al.*, 2013). They were used for different practical purposes (eg. Audouin & Plisson, 1982; Wadley, 2005) and were also of symbolic significance (Petru, 2006; Wreschner, 1980). They play an important role in the study of emergence of modern human behavior (Henshilwood *et al.*, 2002). The red ferruginous materials may have been exploited in areas of particular importance, away from hunting and flint (and other raw materials) trails (Aboriginal customs are an example, Jercher *et al.*, 1998). Therefore, it is important to track the routes of circulation of this special resource. It is also important to document and attempt to interpret the conscious processing of red ferruginous materials (eg. Roebroeks *et al.*, 2012). Thus, specific applications of red ferruginous materials in Paleolithic communities can be pointed out.

Pavlovian communities are known for their technological advancement (eg. Soffer & Vandiver, 1997; 2005; Vandiver *et al.*, 1989) and the use of a wide range of raw materials (Valoch, 1996). The latter were searched for to the north through the valley of the river Vah, the Moravian Gate (*op. cit.*) as well as to the southwest (Svoboda *et al.*, 1996), the areas rich in red ferruginous raw materials of different origins (Cháb *et al.*, 2007). Interest in raw materials is not limited to these areas: Svoboda *et al.* (2002) emphasize that Gravettian communities penetrated vast areas of Europe. Svoboda *et al.* (1996) also underline that various Gravettian cultures likely demonstrated preferences for certain raw materials (although they did not make any remarks on red ones).

Dolní Věstonice I site, excavated by K. Absolon (Absolon 1938a; 1938b), B. Klíma (1963; 1983; 1995) and Oliva (2014; Fig. 1) belongs to an assemblage of the Pavlovian sites (Early Gravettian) of the Southern Moravia (Czech Republic), together with the Dolní Věstonice II and III, Pavlov I-VI, Milovice I and IV and the Middle Moravia Basin sites (Oliva, 2007; Svoboda *et al.*, 2009). Dolní Věstonice I as well as other Southern Moravian sites were located at the foothill of Pavlovske Vrchy, close (*ca.* 0.5 km) from the Dyje river (Oliva, 2007).

Red iron compounds occur at the Moravian Pavlovian sites in a variety of ways; as loose clumps, usually in size of few millimeters, raw and intentionally processed; in a powdery form on the surfaces of the items (grinders, palletes) and spatially connected with the remains of the dead (on the bones and their proximity); as well as red layer spatially associated with hearths (Oliva, 2007). Previous studies of colorful raw material of the Moravian Pavlovian were conducted for the Pavlov I NE (Vandiver, 1997) and Pavlov I SW (Diez & Vinagre, 2005). Features of micro-artefacts were examined at Pavlov I NW site, but exclusively to study the suitability of their raw materials for pigments (Vandiver, 1997: 378).

At the Dolní Věstonice I site, red raw materials occurred in various forms: ground on palettes and surfaces of pebbles, lumps of various size (Absolon 1938a: 39; 1938b: 68) usually of few millimeters, of irregular shape, some resembling tetragonal figures, striated or/and facetted

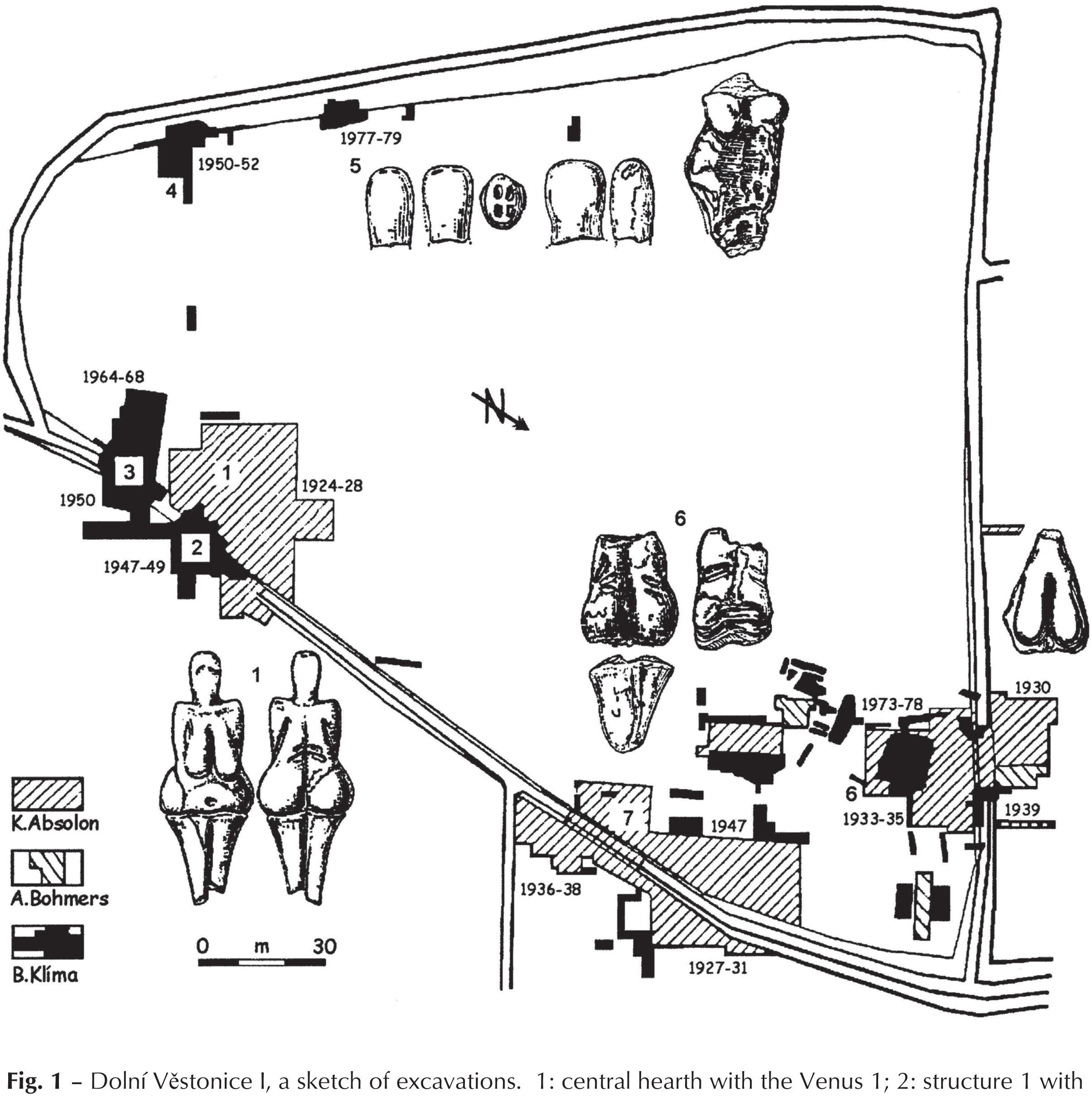


**Fig. 1** – Dolní Věstonice I, a sketch of excavations. 1: central hearth with the Venus 1; 2: structure 1 with the female burial DV 3; 3: large accumulation of mammoth bones; 4: structure 2 - “a shamanic hut”; 5: settlement of the highest floor (level?); 6: middle part of the site with numerous ceramic statuettes; 7: lower (Aurignacian) layer in the middle part of the site. After Klíma 1983, completed by M. Oliva (2007).

pieces and red burnt clay lumps (Oliva, 2007: 13, 2014: fig. 50). They were dispersed in various site areas (Klíma 1963: 178-181; Oliva 2007: 9-65). Some red concentrations (forming up to 10 cm thick layers) occurred in profiles of hearths, they covered charcoal layers (Klíma, 1963: 206-220, *fide* Oliva, 2007). They are present also within marly silt from the female grave, labeled as DV3, discovered in 1949 (area 2 in the Fig. 1). No study of origin of the Dolní Věstonice I red raw materials has been conducted so far.

The DV3 burial was found in the cultural layer of the first settlement object. The grave pit was dug into the Pleistocene marly silt mixed with limestone debris. The sediment was formed as a result of solifluxion of the nearby Tertiary sediments. Grave pit with the flexed body of a middle aged woman was covered by red coloring agent, greyish marly fill-up and two mammoth scapulae contacting tightly one with the other. They are covered by a compacted layer of calcareous debris with an ash and "dye" (as specified by Klima, 1963: 139-140). This layer was present only in the burial pit and in the immediate vicinity of it.

The upper part of the skeleton, especially the skull was covered with red material. Colouring continued in the vicinity of isolated bones. A woman's body, according to Klíma's field observations (1963: 149) probably was smeared with marly soil with immersed red powder. Staining was visible also under the temporal bone. Perhaps, after the decomposition of soft body parts the red particles infiltrated to bone surfaces tinting them (Klíma, *op. cit*).

Numerous red ferruginous pieces and lumps were present out of the DV3 grave. Klíma (1963: 179) points at the local sources (up to 1 km from the site) of red raw materials, e.g. Mn-Fe concretions from the Ždanice Middle Oligocene flysch, limonite concretions from Eocene sediments near Milovice and goethite (xantosiderite originally in the Klíma's text) from the vicinity of the Pavlovske Hills (Fig. 3, see also detailed contemporary geological map (http://www.geology.cz). Nevertheless, geology of the area in some dozen kilometers is much more complex and numerous other rocks may have been sources of red iron oxides, including, among others, terra rosa of unknown (but probably Eocene) age, variegated shales from Oligocene-Miocene and Paleocen-Middle Eocene flysh, red claystones (Ždanice-Hustopeče Formation), Cretaceous spongolite at the Dyje river, Inner Carpathian pyrite-pyrhotine with their red weathering crusts, neohercynian hematite veins and stockwerks (also along the Vah valley), red continental Lower Permian sediments and Visean flysh (culm) facies with variegated shales. In 150 km radius Považsky Inovec (Kohút, 2006) and Jeseníky Mts. metamorphosed Devonian sedimentary-volcanogenic rocks of Lahn-Dill (Tyraček, 2005; Přichystal, 2009) type were also available for Pavlovian societies (Biely *et al.*, 1966; Cháb *et al.*, 2007; Lexa *et al.*, 2004). Practically all mentioned rocks may bear fine grained, soft, red ferruginous concentrations..

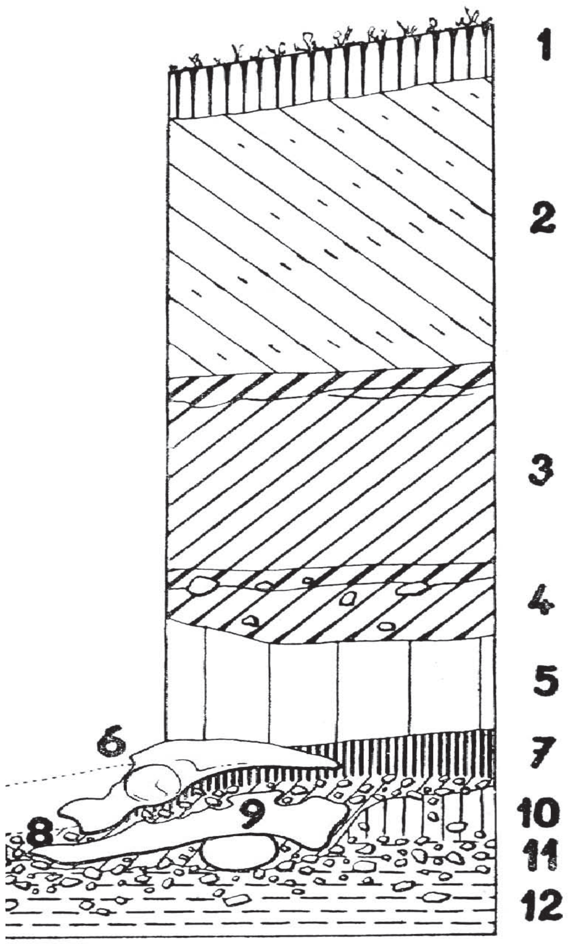


**Fig. 2** – Profile in the DV3 grave location.
1: topsoil; 2-4: earth fill (overburden) after excavations in 1927; 5: loess; 6: mammoth hip bone; 7: culture layer; 8 and 11: calcareous debris – talus; 9: mammoth shoulder blades; 10: pseudogley; 12: Pleistocene marl with limestone debris (after Klíma, 1963: 140).

Research objectives set out in this work are twofold. On the one hand we were interested in the diversity of petrographic origin and processing of red raw ferruginous red lumps found on the site beyond the grave DV3. On the other hand, we ask about the nature of red microartifacts associated with a sepulchral context: what is their composition and origin? Were they intentionally processed? Is there one or more varieties of sediments in the burial? Do the red powders of burial sediment (or sediments) have any relationship with red lumps from beyond the grave, or they are specific in origin and processing? Could they be a deliberately burnt raw material?

## 2 Material

Samples derive from a collection of the material from the Dolní Věstonice I excavations, now in the Anthropos Institute of the Moravian Museum in Brno, Czechia. The samples are of threefold origin: (a) from the female grave DV3 fill-up and floor (Klíma, 1963: 137-152) now preserved in a form of red and black stained, loose, *ca.* 2 cm large, marly pieces, (b) as above, but samples form red cherry crusts on grey, marly pieces, (c) from other areas of the site (their original position remains unknown), as some millimeters large loose pieces of red rocks. Their macroscopic fea-

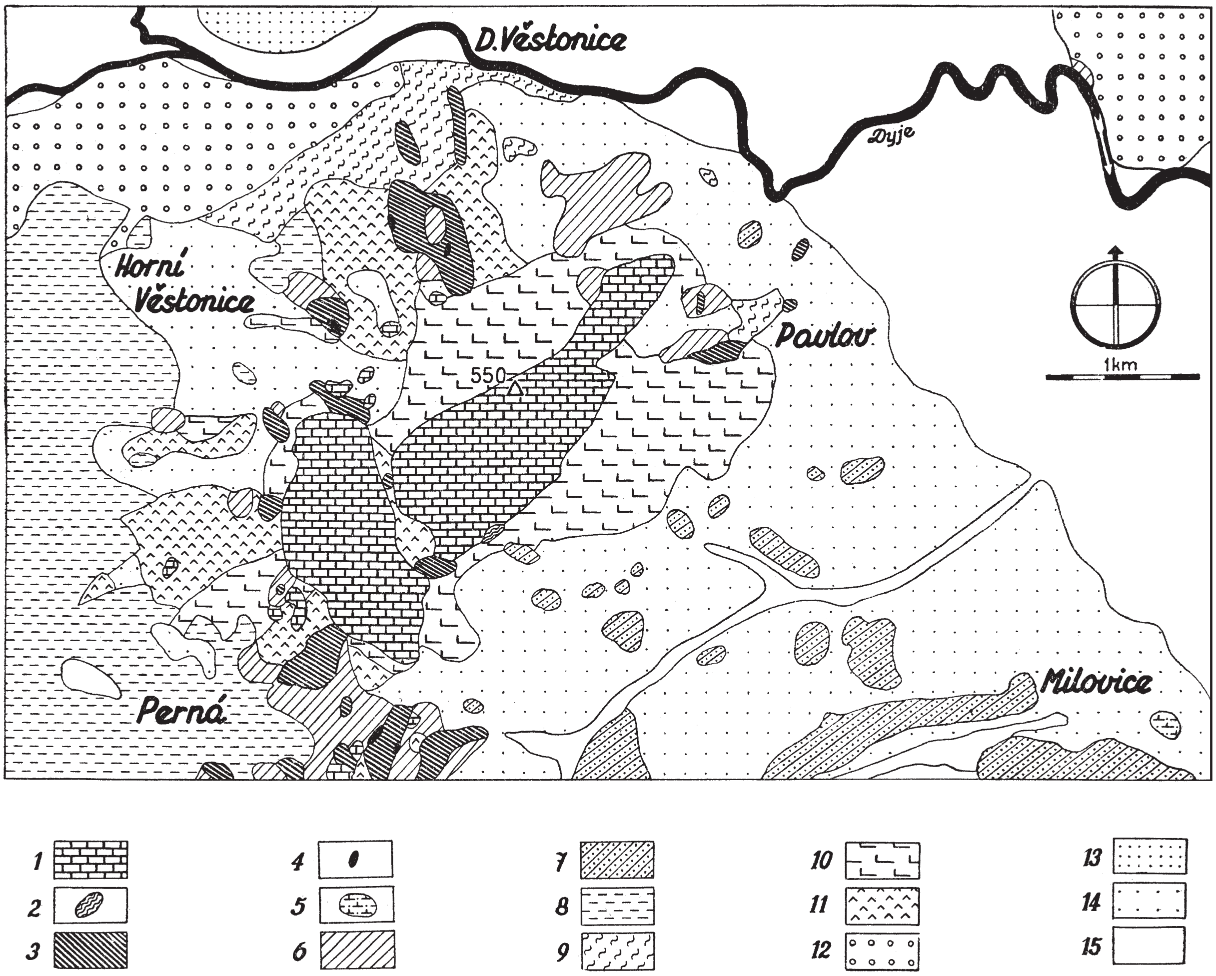


**Fig. 3** – Geological map of the site area. 1: Jurassic limestone; 2: Cretaceous white marl; 3: Eocene/Lower Oligocene variegated silt; 4: Menilite slates; 5: Palaeogene conglomerate; 6: Middle Oligocene marl with sandstone; 7: Palaeogene sandstone; 8: Neogene calcareous silt and sandstone; 9- Pleistocene gray clay, in lower parts with sand; 10: Pleistocene loess enriched in debris; 11: Pleistocene calcareous debris on silt; 12: Pleistocene sandstone rubble; 13: Pleistocene eolian sands; 14: Pleistocene loess and loessic clay; 15: Holocene sands and silts (after Klima, 1963).

tures are listed in Table 1. Samples have been selected and coded arbitrarily because no specific labels were attached to them. For this reason no spatial analysis can be performed.

## 3 Methods

Plane polarized light microscopy (PLM) was applied with an Olympus BX 51 apparatus, photographs were taken also with the camera Olympus DP 25 attached to the microscope. For one sample reflected light observation, with the use of the same microscope, was performed.

Scanning microscopy with X-ray microanalyser (SEM/EDS) with Nano Nova FEI Company/EDAX Oxford apparatus at low vacuum measurement conditions was used. Samples were coated with graphite and spectra were collected at 18 keV. In some cases the analysis were performed on surfaces of thin sections.

Micro-FTIR microspectroscopy (FTS 40 Pro f-y Digilab, with UMA 500 microscope Digilab) was applied and the reflected light focus diameter was *ca*. 10-20 micrometer.

XRD Powder diffractograms of non-oriented samples were recorded in the range $2\theta = 2$ to $73^o$ with constant step equal to $0.05^o$, using a Philips PW APD 3020 X'Pert instrument with the the $CuK_{(\alpha)}$ radiation and graphite monochromator. Phases were identified according to the data in ICDD catalogue included in the XRAYAN programme (2007). In all samples a size of hematite crystallites was measured on the basis of FWHM (Full Width at Half Maximum) of 104 (d = 2.70Å) diffraction peak, perpendicularly to (104) cell lattices, following the Scherrer method (Klug & Alexander,1954). Red material was separated from the marly surrounding by a needle to avoid, as much as possible, contamination.

## 4 Results

### 4.1 Grey marly silt with red particles and red and cherry crusts from the female grave DV3

Grey and dark grey host rock is a marly silt composed of micritic calcite, clay minerals and quartz with feldspars as skeleton grains, randomly distributed in the massive fabric (Figs 4-5). Some parts of the rock are enriched in rectangular and lense-shaped micritic grains as well as scarce rounded sparite grains, producing more blocky texture. The fines fabric is here more turbated (Figs 9-10). Sediment must have been bioactive (due to roots or faunal movement) which is pointed out by channels and rounded or ellipsoidal

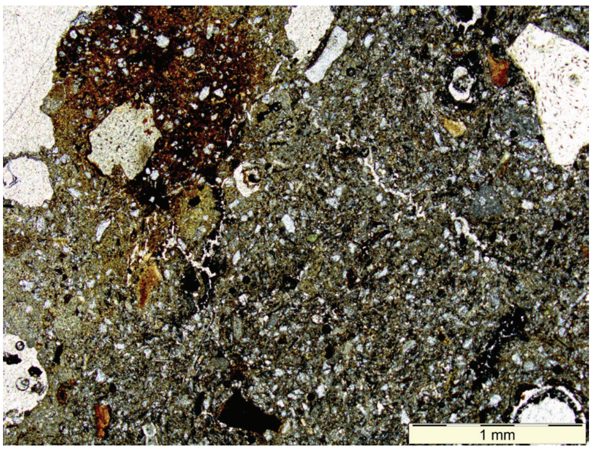


**Fig. 4** – Marly silt with a natural concentration of iron compounds or a red particle (labelled in the text as „a"), with a bone piece inside. Bone particles, both colourless and opaque, are dispersed also in the marly surrounding (DVI 15, // nicols).

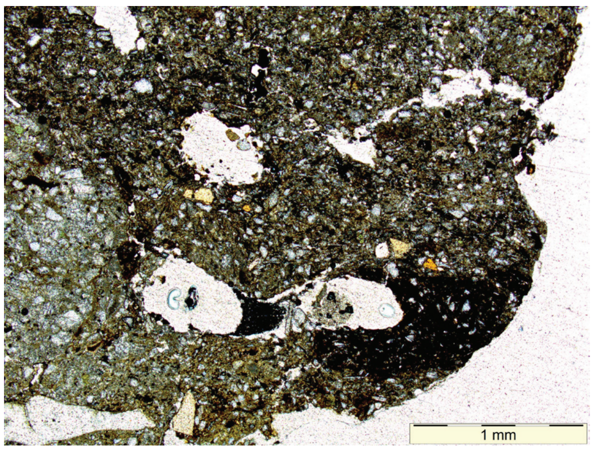


**Fig. 5** – Marly, vesicular silt with embedded red powder (labeled in the text as "b"; lower hand-right quadrant) partially destroyed by microorganisms. Faecal pellet and bone fragments are visible (sample DVI 9, X nicols).

| *Sample code* | Character of red concentrations | *Macroscopic descriptions of samples* | *Research methods* |
|---|---|---|---|
| DVI 3 | A lump | Cryptocrystalline, homogeneous red substance, resembling weathering crust | PLM, XRD, SEM/EDS |
| DVI 4 | A lump | Fine-grained, psammitic, homogeneous, of ferruginous weathering crusts shape | PLM |
| DVI 5 | A lump | A fragment of calcitic-haematite rock, the red component is cryptocrystalline and homogeneous | PLM |
| DVI 7 | A lump | Cryptocrystalline, homogeneous red substance, resembling weathering crust | PLM, SEM/EDS |
| DVI 8 | A lump | Cryptocrystalline, homogeneous red substance, resembling weathering crust | PLM, XRD, SEM/EDS |
| DVI 9 | Red powder and crust from the grave | Dark grey marly silt with white micritic lenses up to 7 mm, charcoal particles up to 2 mm, red rounded particles and bone particles up to 1 mm and continuous, thin (*ca.* up to 1mm thickness) crust. Texture is chaotic | PLM, SEM/EDS |
| DVI 10 | A lump | Red brownish, cryptocrystalline with parallel texture, moderately soft, ca. 3 in the Mohs' scale | PLM |
| DVI 11 | Red powder and crust from the grave | Dark grey marly silt with charcoal and bone particles up to 2 mm. Cherry iron compounds form a crust and infiltrate into the marly substrate | PLM, μFTIR |
| DVI 13 | A lump | Cryptocrystalline, homogeneous red substance, resembling weathering crust. The object is 5 mm long, spindle-like | XRD, SEM/EDS |
| DVI 14 | A lump | Like the DV13 sample, of rectangular shape, *ca.* 6/6/6 mm. | XRD, SEM/EDS |
| DVI 15 | Red crust and powder from the grave | Dark grey and dark red (with brownish shade) intermixture with charcoal up to *ca.* 1 mm as well as white bone grains, red rounded particles of *ca.* 1 mm and micritic lumps, up to 4 mm. Red component is fine grained, cryptocrystalline, soft. It constitutes a compact, uneven layer *ca.* 2 mm thick on a grayish underneath and penetrates into it in a cloudy manner | PLM, XRD, SEM/EDS |
| DVI 16 | Red crust and powder from the grave | Like the DV15 sample but with scarce charcoal. This one was supposedly an edge of a certain structure | PLM, SEM/EDS |
| DVI 17A | Powder from the grave | Chaotic intermixture of dark red, fine grained, homogeneous substance, forming a rectangular, compact lump of ca. 17/12/10 mm immersed in a dark grey, fine grained porous matrix with charcoal and a dark grey slate, both up to 8 mm. White bone powder up to 1 mm and white, elongated calcareous lumps up to 13 mm are present. Beside well defined red brownish lumps irregular concentrations of cherry pinkish areas of blurred shape are present. Dark grey substance bear traces of negatives of some vascular plants | PLM, XRD, SEM/EDS |
| DVI 17B | Cherry crust from the grave | Like the DV15 sample but with scarce charcoal | PLM |
| DVI 18 | Several lumps | Like the DV13 sample (all lumps are macroscopically identical) | PLM, SEM/EDS |
| DVI 19 | A lump | Silvery, hard, needle-like haematite rock of Lahn-Dill type | SEM/EDS, XRD |

Tab 1 – A list of examined samples of red ferruginous material from the Dolní Věstonice I site.

voids up to *ca*. 3 mm of diameter. In the miccro-aggregate areas the fabric becomes more porous: the pores are irregular, more or less rounded, long and narrow, likely due to dessication (comp. Todisco & Bhiry, 2008).

In microscopic image marly silt contains anthropic admixtures of: (a) sharp edged black particles of vesicular plants of various size (from 1 mm to 5 mm), (b) white, sharp, irregularly edged particles of calcined bones, *ca*. 2 mm size (Figs 4-5, Fig. 8), (c) reddish and black (the latter cracked) bone particles, up to 1 mm. The nature of white and black bone particles was confirmed by micro-FTIR. Crystallinity of apatite in the white ones was higher than in the black, (d) red particles of sharp or dizzy edges, from around 0,3 to 1 mm. Occasionally they are rectangular, larger to 10 mm. The particles are randomly distributed within the rock volume. Some powders have been partially deformed by burrowing organisms, producing voids with foecal pellets in some of them (Fig. 5), and movements of the ground, deshaping primary structures and resulting in red and cherry infiltrations.

In the PLM image two types of red powders are discernible: (a) translucent, light-red-brown, slightly fuzzy, almost devoid of detritic grains (Fig. 4), (b) opaque, with sharp boundaries, rounded, with detritic grains, sometimes without them (Fig. 5, Fig. 8). Iron compounds form in both cases cryptocrytalline concentrations (Fig. 6).

Bright red powders consist almost exclusively of potassium, magnesium, iron, manganese, and calcium aluminosilicates. Calcium compounds may have permeated from the ground. In a group of opaque powders detritic grains usually occur, which are: sericite, quartz, fibrous dolomite, calcite. XRD analysis revealed presence of quartz, illite, hematite, albite, clinochlore and stilbite (Tab. 2, Fig. 12). Here, low concentrations of phosphorus and sulfur were detected.

Within red powders some other microartefacts may be present: bone and some organic substances. In both powder types ("a" and "b") bone particles were observed (Fig. 4, Fig. 8): they are characterized by varying degrees of combustion (Fig. 4-5, Fig. 8).

Some dark red powder (sample DVI 9) concentrate irregular organic matter (Fig. 7). It is not supposed to be a resin used to manufacture the thin section because such evidences were not observed anywhere else except the sample DVI 16 (Wesełucha-Birczyńska *et al.*, 2012).

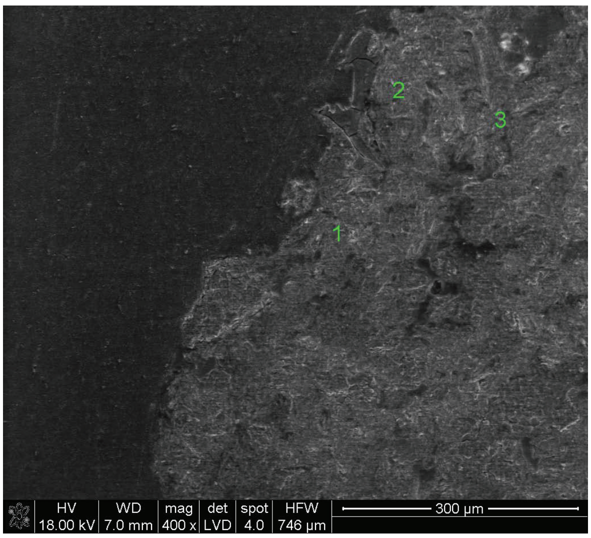


**Fig. 6** – Cryptocrystalline particle „b".
Si, Al, Fe, Mn in the 1 and 2 points, elevated concentrations of Mn and C are present in the 3 (DVI 9).

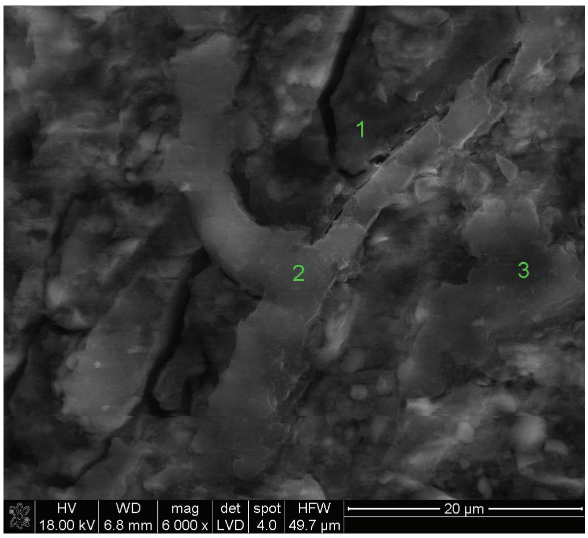


**Fig. 7** – Organic substance of unknown origin within a particle „b". C, Si, Al, Ca, Fe, Mn, Mg occur in the points 1, 2, 3, with the highest carbon concentration in the 2 (DVI 9).

Coccoliths were observed in some powders but their plates likely penetrated from marly surroundings.

In the “a” and “b” powders there were no morphological evidences of heating discernible under PLM or SEM microscopes - except the contextual information: presence of bone ash particles. However, phase analysis revealed (sample DVI 17a, type “b”, see Fig. 10) stilbite (Fig. 12).

Klíma (1995, pp.104-105), describing the grave sediment, writes about pine resin remnants. Our observations revealed particles of vesicular plant charcoal. Nevertheless, no plant resins were found within red powders (Wesełucha-Birczyńska *et al.*, 2012). Irregular concentration in the particle of the opaque powder (Fig. 4) is of unknown origin.

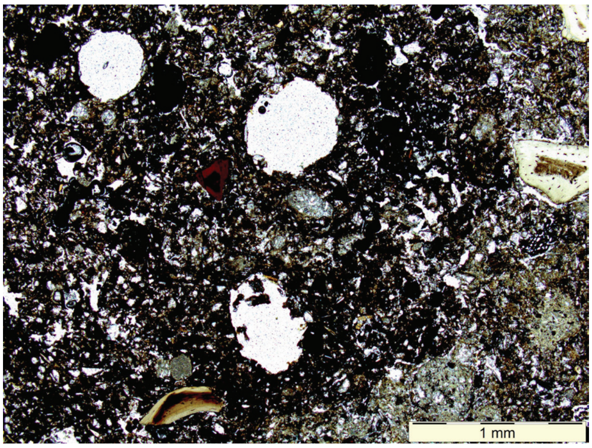


**Fig. 8** – Red particle, labeled as “b”, with vesicles and burnt (in a various degree) bones within and outside. Boundary between marly silt and the powder is sharp (DVI 17a, X nicols).

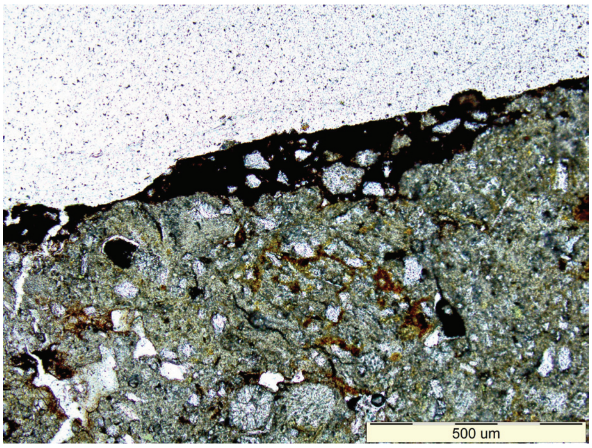


**Fig. 9** – A fragment of red crust on a marly underneath, with a smooth surface. The crust is enriched in rectangular grains, detached from the underlying sediment. Marly silt is slightly porous, the pores are elongated, cross-cutting the crust. Groundmass is non-homogeneous, unsorted (DVI 15, //nicols).

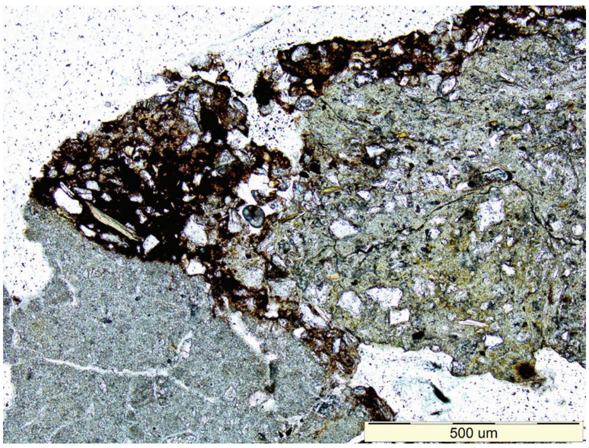


**Fig. 10** – Red crust (liquid?) forming an intergrain microinjection marly-micritic microaggregate (DVI 17a, //nicols).

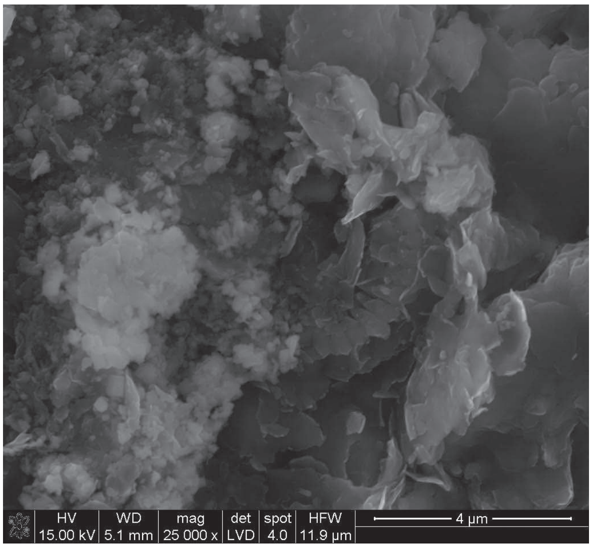


**Fig. 11** – Red crust. Coccolith (present also in marly silt), flaky aluminosilicates and irregular lumps of iron compounds (DVI 17a).

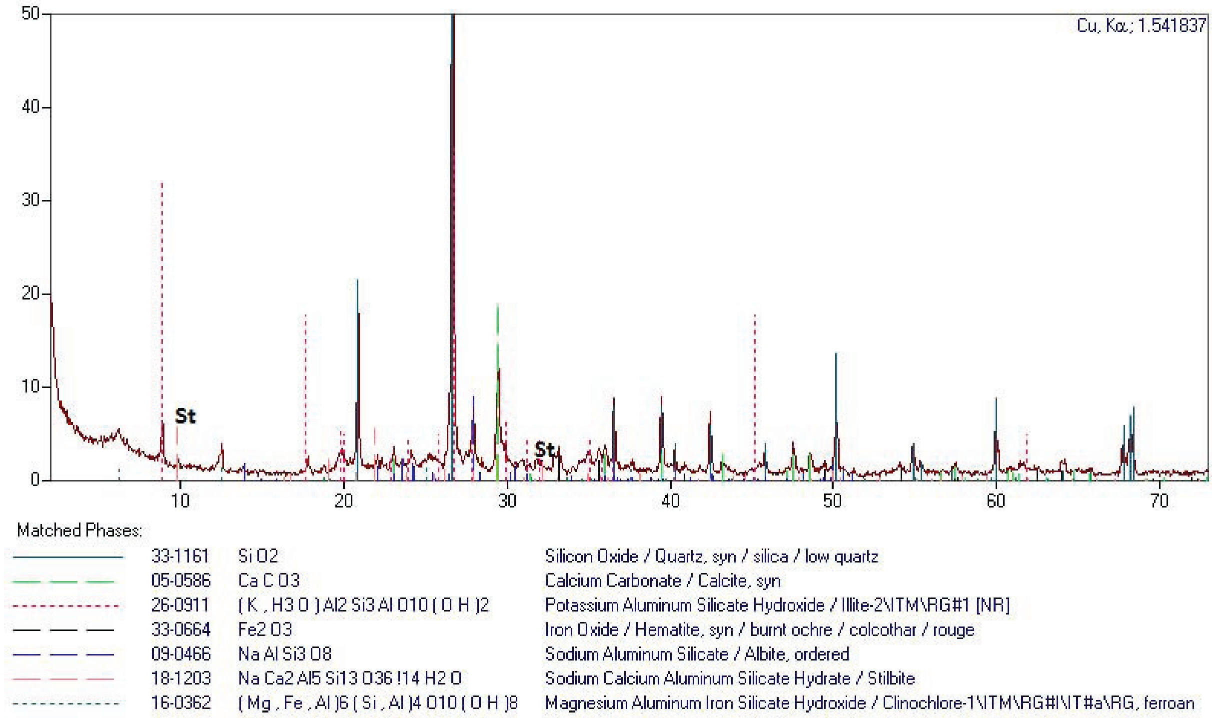


**Fig. 12 –** Diffractogram of the red powder sample (DVI 17a) from the female grave DV3.
St: the most intense diffraction peaks of stilbite.

The crust, macroscopically red or light cherry, is composed of iron bearing alumino-silicates (terra rosa, limonite, ferruginous crust, other weathered rocks) (Fig. 9 and 10, Table 2). The crusts are uneven, up to 2 mm thick, in some areas with smooth surfaces (Fig. 9). Their contact with the marly underneath vary from sharp to warped, fuzzy, infiltrating (Fig. 10). Some areas are cut by thin, thread-like cracks (Fig. 9). EDS spectra revealed low concentration of phosphorus and sulfur within the red crust, sulfur also within the marly silt. Coccoliths were identified within both, originating likely from the marly silt (Fig. 11).

| *Sample* | *Phase composition* | *Size of hematite crystallites [nm]* |
|---|---|---|
| DV I 11 crust | Quartz, hematite, calcite, plagioclase, K-feldspar, illite, kaolinite | 130 |
| DVI 11 powder | Montmorillonite (heated?), quartz, carbonates, lignite | (-)<br>µFTIR |
| DV I 15 crust | Quartz, calcite, hematite, illite, albite (ordered), microcline, clinochlore | 76 |
| DVI 16 powder | Hematite, traces of goethite, maghemite, epothin resin | Ordered hematite<br>(Raman spectroscopy) |
| DV I 16 crust | Quartz, hematite, calcite, plagioclase, kaolinite | 130 |
| DV I 17a powder | Quartz, calcite, illite, hematite, albite (ordered), stilbite, clinochlore | 30 |

**Tab. 2 –** Phase composition and haematite crystallite size in powder and crust samples (Trąbska, 2015 ; Wesełucha-Birczyńska *et al.*, 2012).

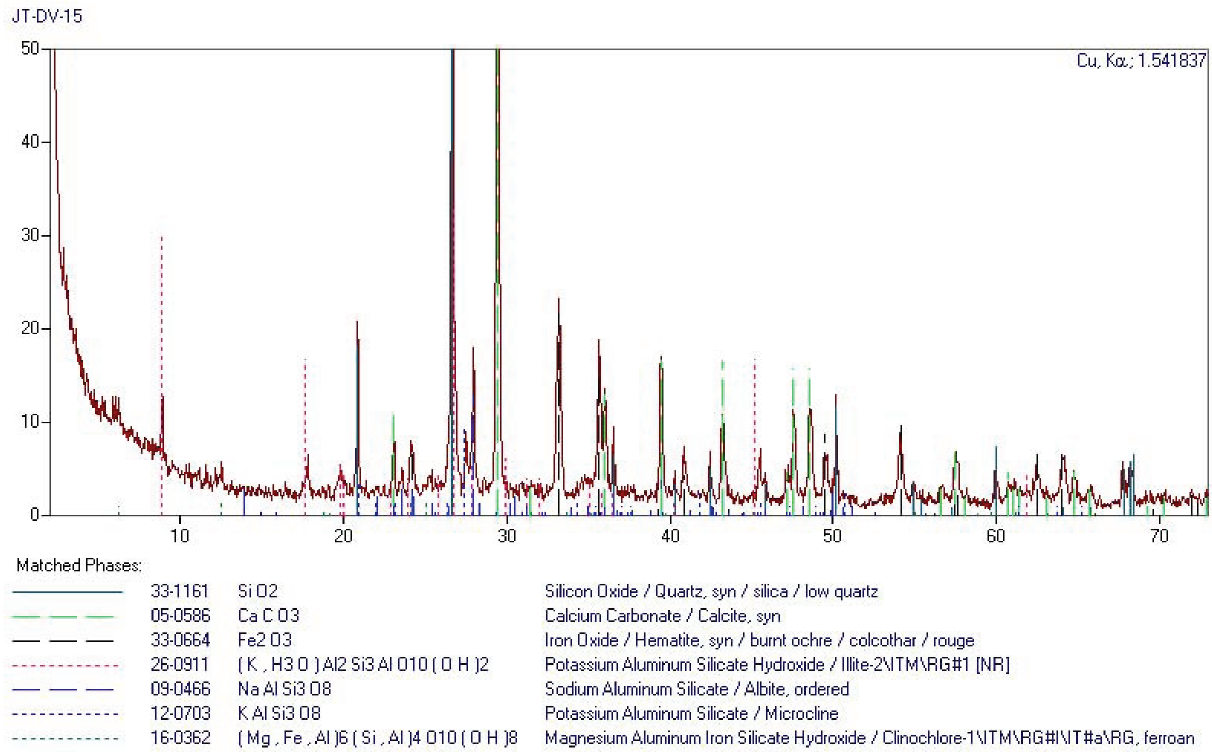


**Fig. 13** – Diffractogram of the red crust from the grave DV3 (sample DVI 15).

### 4.2 Loose red lumps from the outside of the grave

Selected loose red lumps were analysed to test the petrographic features of the assemblage and to examine a likely relationship between raw ferruginous material dispersed in the site and the red substance applied for the burial ceremony (Tab. 3). Samples DVI 3 and DVI 19, due to very large hematite crystallite size as well as macro- (Tab. 1) and microstructure features (Fig. 14) most likely represent, respectively weathered and unweathered Lahn-Dill type rocks. DVI 3 is composed predominantly by hematite and quartz accompanied by illite and moderately ordered kaolinite (Fig. 20), in DVI 19 a rare phase $Ca_3SiO_5{\cdot}1{,}5H_2O$ was detected.

Some other samples (DVI 4, 7, 8, 10) represent cryptocrystalline, weathered iron oxides/hydroxide concentrations (Fig. 15, Fig. 17). Some are enriched in detritic grains of various size (Fig. 15). The red rock DVI 5 is a hematitised calcite (Fig. 16), the DVI 18a represents a ferruginised spongolite (Fig. 18).

Sample DV 13 bears features of sinter: it is composed of uneven grains of various shapes, very closely adhering one to another. Parental rock is hard to define (Fig. 19). Sanidine was detected by XRD (Fig. 21). Phosphorus was detected within sample 3, 7, 8, 13, 14 and sulfur in sample 13.

## 5 Discussion

### 5.1 Marly silt with brick-red powders and red or cherry crust from the female grave DV3

Suggestion of Klima (1963: 149) that the Pleistocene marly silt explored from the grave pit may have been used as a fill-up seems very probable, but it must be confirmed by the comparison with a field reference material, not available in this project. Marly silt was, according to the results of our study, mixed with ashes consisting of a powdery bone, charcoal and red powder. Their co-occurrence suggests that they originate from a layer (or several layers) of hearths. Indeed, on the site there were documented hearths with red layers, black charcoal and ash bone (e.g. Oliva, 2007). Bone dust from the fill-up is characterized by various shape, size (not exceeding 1 mm) and degree of burnout. These are typical features of bone ash observed also in other sites (Marquer *et al.*, 2010).

A substrate of the grey fill-up is composed basically of marly silt, which consists of calcite, detrital quartz, feldspars and single grains of glauconite. Macroscopically grey and compacted, it seems to be the same both in a host rock for red powder ash as well as co-occurring with red crusts. In all examined samples from the grave the mixture has occurred, although in the samples DVI 16 and 17b the content of ash is much more lower. Whether it is a rule or an accident, it must be examined on a larger set of samples.

Brick-red, cryptocrystalline powders are of aleuritic-pelitic fabric. They are rounded, of sharp or, less frequently, blurred boundaries. The

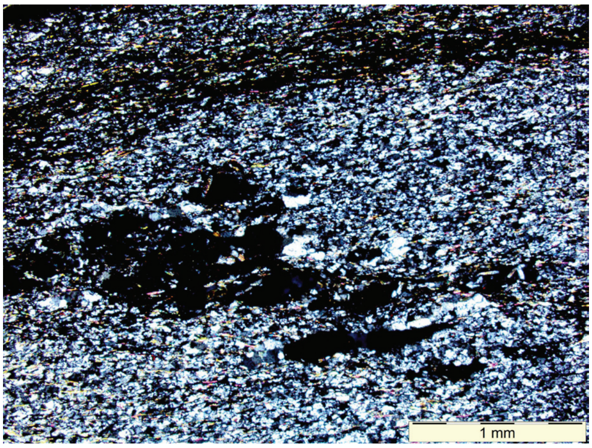


**Fig. 14 –** Micrograph of a weathered Lahn-Dill type raw material. Dark patches: weathered concentrations of macroscopically cherry hematite. White ones: crystalline hematite with quartz (DVI 3, X nicols).

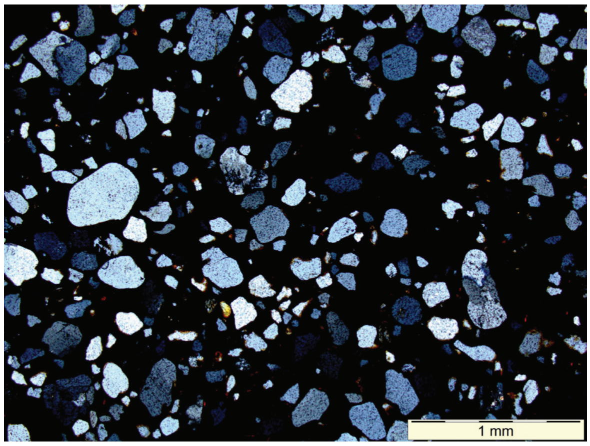


**Fig. 15 –** Micrograph of iron weathering crust with variably rounded detritic grains (DVI 4, X nicols).

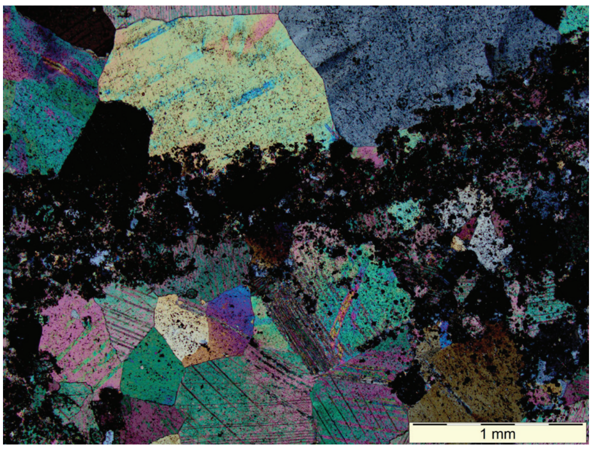


**Fig. 16 –** Coarse grained calcite with fuzzy patches of hematite (DVI 5, X nicols).

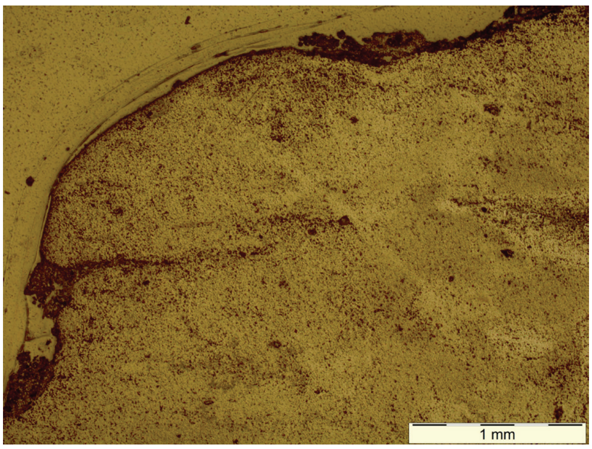


**Fig. 17 –** Extremely cryptocrystalline raw material, with Si, Al, K, Fe, sometimes Mg and P. Scarce platy crystals concentrate Fe (DVI 7, reflected light).

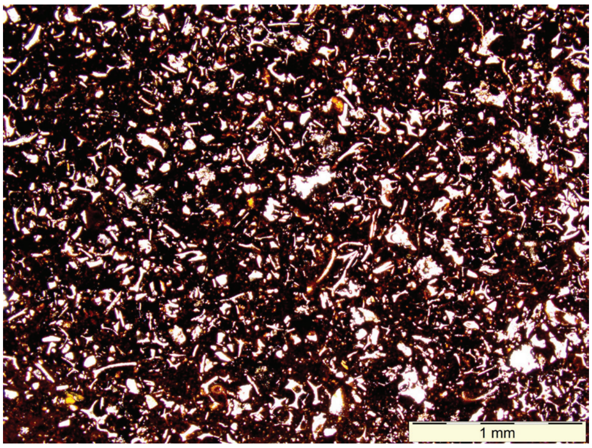


**Fig. 18 –** Fragment of spongolite: spicula are immersed in cryptocrystalline iron compounds (DVI 18a, // nicols).

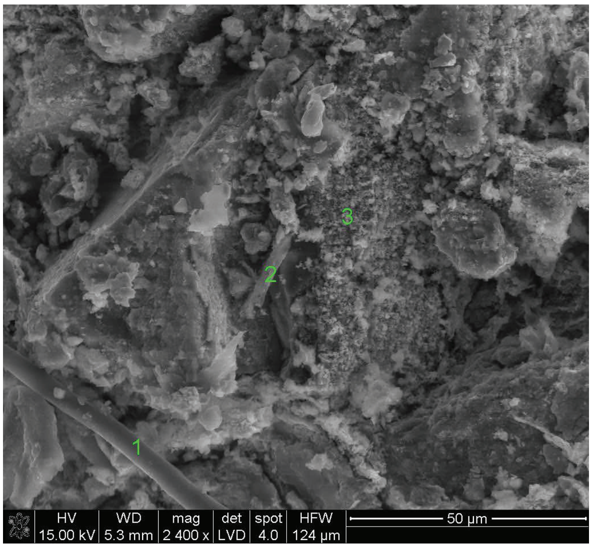


**Fig. 19 –** Probably burnt lump of iron-aluminosilicate raw material. 1: C, Fe with minor Si, Al, K, Ca; 2: Si with minor Al, Fe, K, Ca; 3: Fe with minor Si, Al (DVI 13).

latter are probably clusters of migrant iron compounds of natural origin (Todisko & Bhiry, 2008). In a powder with sharp borders (only they will be discussed further) stilbite was identified. It is the zeolite group mineral, stable between approx. 60 and 470°C at high vapor pressure (Bolewski & Manecki, 1993; Rykl & Pechar, 1985; www.iza-online.com). Here it can be anthropogenic. Stilbite was identified in the porcelaine-like sinters from cremation stacks (Trąbska, 2003). Anthropogeneity of this phase is also suggested by a lack of parageneses characteristic for this mineral (eg. Paulis *et al.*, 2011) (although in weathering crusts accompanying phases may not appear) and small crystallite size of accompanying hematite (30 nm). In volcanogenic rocks (a common stilbite environment, Bolewski & Manecki, 1993; Rykl & Pechar, 1985; www.iza-online.com) and their weathering crusts this parameter is much larger, 100 nm and more (Trąbska, 2015). Precursors of low crystalline hematite were likely aluminosilicates enriched in iron. They could come from loess used to extinguish or moderate fire, as suggested by one of us (MO). In some cases it might be a "pellet sand", loess with clasts generated by solifluction (Svoboda *et al.*, 1996). Nevertheless, a size of hematite crystallites in experimentally heated loess (900°C, 13h) reached only 9 nm and no pebble-like concentrations appeared (Trąbska & Gaweł, 2007). So that, also another variety of an aluminosilicate raw material should be considered.

In the chemical composition of red powders, beside aluminosilicates a small amount of sulfur (sample DVI 9, 16) and phosphorus (sample DVI 9) was observed. P and S may result from the breakdown of bones and the tissue, Statheropoulos *et al.*, 2005).

Examinations of hearths layers composition, not performed up to now, could reveal whether: (a) ash described by us corresponds to the ash from hearths, (b) hearths ash was directly applied to a funeral ceremony, or the ashes from the grave DV3 were deliberately prepared or processed, (c) stilbite is in hearths ashes regularly present, indicating their "wet" nature, or a presence of the mineral in the fill-up ash is a consequence of certain funeral rites?

Red crusts form uneven but not exceeding a few mm thick film. Their surface is generally strongly corrugated, only rarely smooth. Features of crusts (the fact that this is an incrustation penetrating deep into the marly silt) indicate that red ferruginous material could be used in a form of a suspension. Their contact with an uneven ground is either sharp and horizontal or (more often) infiltrative. It is difficult to determine a nature of their spatial relationship with the body of the deceased.

| *Sample* | *Phase composition* | *Size of hematite crystallites [nm]* |
|---|---|---|
| DV I 3 | Hematite, quartz, illite, kaolinite | 300 |
| DV I 8 | Hematite, quartz, illite, goethite | 9 |
| DV I 13 | Quartz, hematite, albite (ordered), sanidine (disordered) | 25 |
| DVI 14 | Quartz, hematite, calcite, illite, albite (ordered), stilbite, dolomite, sanidine (disordered), Fe-clinochlore | 104 |
| DV I 19 | Hematite, quartz, plagioclase, illite, chlorite, $Ca_3SiO_5{\cdot}1{,}5H_2O$ phase | >400 |

**Tab. 3 –** Phase composition of loose red lumps out of burial (Trąbska, 2015).

Mineral composition of red crusts is similar to red ash powder (except for the presence of stilbite), but a crystallite size of hematite differs (Tab. 2-3). Phase composition indicates the origin of the raw material from a weathering zone (or zones). Unfortunately, there are no indicative minerals that may precise a ground rock. Also hematite habit in the SEM image is non-specific. Calcium carbonate may result from the genesis of raw material (eg. terra rosa) or from contamination.

High crystallite size of hematite (130 nm, crust samples DVI 11, 16) is common in the mineral from volcanic, hydrothermal or metamorphic rocks and their weathering crusts (Trąbska, 2015). A sample of 76 nm hematite crystallite size (DVI 15) may have been collected from the above mentioned environments but also from certain varieties of terra rosa or variegated shales (Trąbska, 2015). The two latter occur in the immediate vicinity of the site and a distance of several kilometers (Cháb *et al.*, 2007).

Within red crusts and surrounding marly silt phosphorus and sulfur of low concentration (not higher than 2%) occur. Probably these elements come from the decay of the body of the dead woman (cf. comments above).

Coccoliths observed within red crusts and powders as well as within marly silt probably originate from Pleistocene marly silts and clays. However, an exact attribution must be performed by a specialist.

The marly ground was not subjected to high-temperature impact, as indicated by the intact coccoliths plates and features of fabrics. The fill-up was touched by bioturbation processes, which is proved by presence and shape of vesicles as well as presence of foecal pellets. Both, intentional action and criogenic processes may have influenced a chaotic arrangement of fabric (Todisco & Bhiry, 2008).

### 5.2 Loose lumps from the site outside of the grave DV3

Loose red lumps (without inventory numbers) are similar to each other macroscopically in terms of red color and cryptocrystallinity. The exceptions are dark-cherry weathering crust on a Lahn-Dill type rock (sample DVI 3), silvery, needle-like (due to crenulated hematite plates) sample DVI 19 and cherry, hard hematite-calcite rock (sample DVI 5). A larger part of materials collected by a Dolní Věstonice community is formed by macroscopically cryptocrystallinic concentrations of red iron oxides and hydroxides (DVI samples 4,7,10,13,14,18). Among them there is a ferruginous spongolite (sample DVI 18a). In a cryptocrystalline sample DVI 14 hematite is characterized by large crystallites (about 100 nm). It indicates an area of weathering of rocks with a large size crystallite hematites. Sanidine in this sample (Tab. 3) suggests a provenance from volcanogenic areas (Huang & Willie, 1974). The assemblage is therefore petrographically diversified, though raw materials could have come from not distant areas. Some of these materials occur and occurred in the site vicinity (terra rosa, spongolite, weathered iron oxides). Weathered volcanic rocks are more distant - about 50 km from the site. The most distant is the rock type Lahn-Dill, a minimum of about 150 km from the site (Cháb *et al.*, 2007).

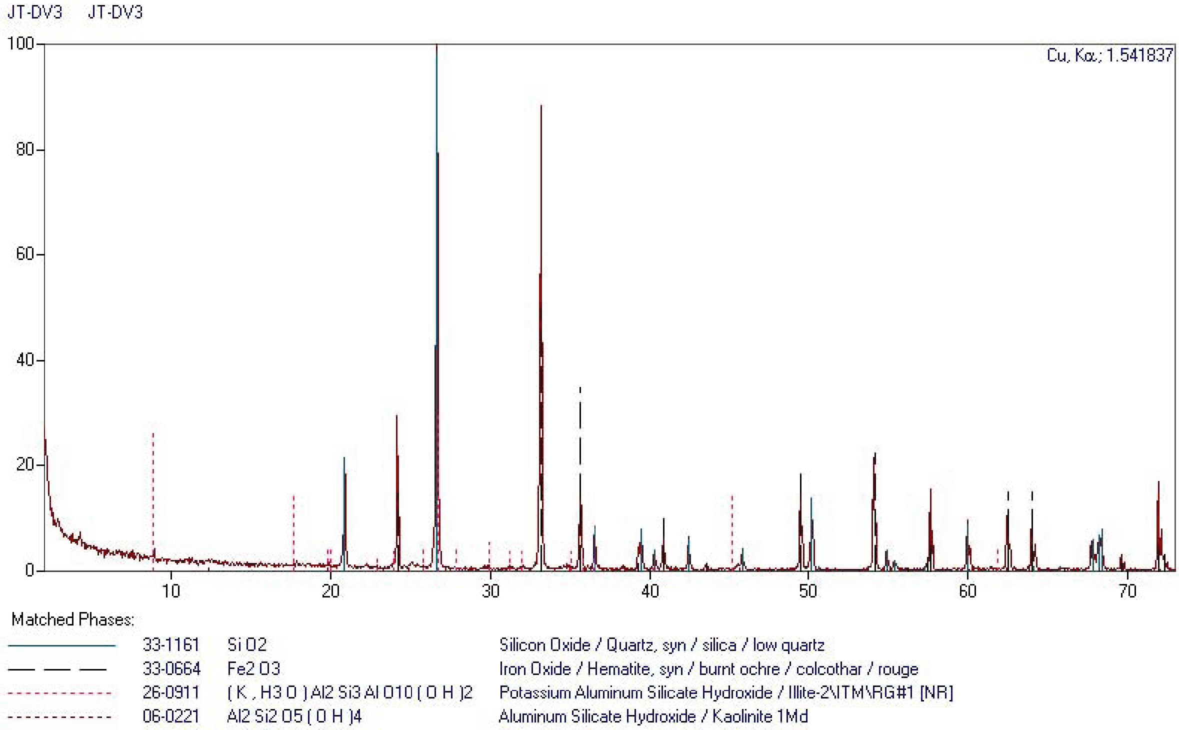


**Fig. 20** – Diffractogram of the red lump, sample DVI 3 (Trąbska, 2015).

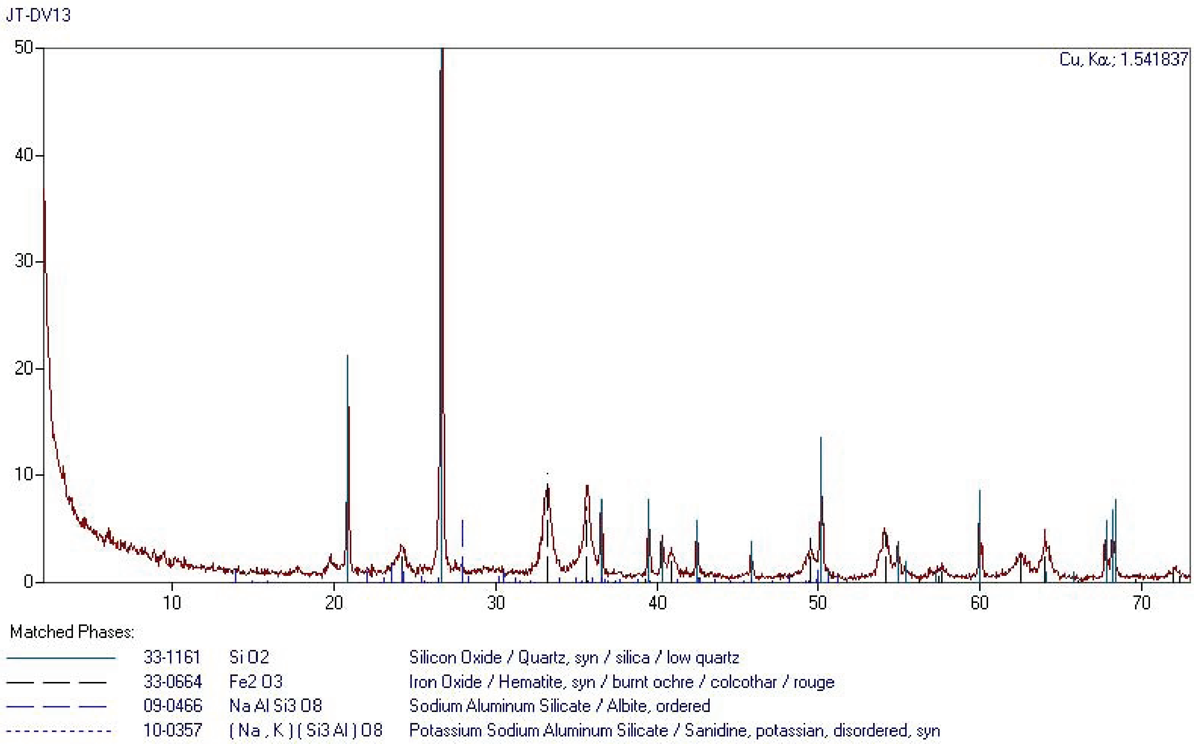


**Fig. 21** – Diffractogram of the red lump, sample DVI 13 (Trąbska, 2015).

In a DVI 14 sample coccolith, morphologically similar to other ones, above mentioned, was detected. Its presence may be also a result of contamination by Pleistocene marly silt.

At least one of the examined samples was burnt (DVI 13): in the SEM image it resembles sinter. A size of hematite crystallites is here low: only 25 nm. Hematite crystallite size is significantly higher in sanidine-bearing rocks (Trąbska, 2015) but it decreases when the mineral is heated below 600°C (Cornell & Schwertmann, 2003: 108). TEM observations of hematite would allow to precise a nature of heating (Pomiès *et al.*, 1999). Low hematite crystallinity may be a result of heating but anthropic origin of sanidine cannot be excluded as well. Anthropic felspatoids (though not feldspars) were detected by one of us in porcelain-like sinters from cremation burials (Trąbska, 2003).

A rare phase [$Ca_3SiO_5(1.5H_2O)$], detected in a sample DVI 19 (Tab. 3), resembles hatrurite (www.mindat.org/hatrurite), a mineral occurring in, among others, calcareous scarn (which might precise the area of origin of the raw material) but on the other hand, the phase was identified in anthropogenic ashes (Filippidis & Georgakopoulos, 1992). However, macroscopically and under SEM image no heating evidences or ash presence could be proved.

Within all samples, except sample 5 DVI, phosphorus (DVI 3, 7, 8, 14) or sulfur (DVI 13) was observed. Unfortunately, a primary location of samples on the site is not known, so that no unambiguous explanations can be proposed.

Some of this (or similar) material could have been used for the funeral ceremony, both to prepare red powder and a suspension. No specific raw materials connected with the burial context were identified.

### 5.3 Reconstruction of the burial ceremony in the aspect of the use of red raw materials

The bottom of the grave could have been prepared as follows: after digging the burial niche substrate has been (or was) partly moistened and plastified at least in some places. Moisture could be intentional, it could also be caused by rain. Pulverised unburnt terra rosa or another iron-bearing, red aluminosilicate, would be mixed with a liquid (probably water) and spilled over the corpse and over the grave floor. Then ash from hearth(s), containing red powders, charcoal, bone ash, would be mixed with marly silt exploited from the grave niche. This substance would be used to cover the corpse and mammoth pelvis.

## 6 CONCLUSIONS

Two different red material concentrations occur in the context of the female grave DV3: (a) red powder dispersed in marly silt of a fill-up, together with charcoal and variably burnt bone particles, (b) red crusts adhering to marly underneath. Marly substrate is the same in the both cases. The two red raw materials differ in hematite crystallite size and probably a way of processing: the suspension material was not heated. Red powders may originate from the ashes of the neighbouring hearth(s). Thorough examination of layers of hearth(s) should be conducted to explain their exact nature and answer a question whether they vary from an ash from the burial context. Red powders are natural mixtures of aluminosilicates and iron compounds, i.e. their raw materials may have been iron crusts, limonite, terra rosa, variegated shale or loessy silt. It is possible that some (less numerous) red concentrations appeared due to iron migration. Red-cherry ferruginous crust likely covered some parts of the floor surface or parts of female body. Red material was applied probably in a form of suspension. The raw materials of the loose lumps may orginate from various sources and distances: they may be local, from about 50 km, and even about 150 km radius.

## Bibliography

ABSOLON K., 1938a. Die Erforschung der diluvialen Mammut-jäger-Station von Unter-Wisternitz an den Pollauer Bergen in Mähren. Arbeitsbericht über das erste Jahr 1924, *Palaeoethnologische Serie*, **5** (7). Brünn: Verlag Barvic & Novotny.

ABSOLON K., 1938b. Die Erforschung der diluvialen Mammut-jäger-Station von Unter-Wisternitz an den Pollauer Bergen in Mähren. Arbeitsbericht über das zweite Jahr 1925, *Palaeoethnologische Serie,* **6** (9). Brünn: Verlag Barvic & Novotny.

AUDOIUN F. & PLISSON H., 1982. Les ocres et leurs témoins au Paléolithique en France: enquête et expériences sur leur validité archéologique. *Cahiers du Centre de Recherches Préhistoriques*, **8** : 33-80.

BIELY A., BUDAY T., DUDEK A., FUSÁN O., CHLUPÁČ I., KAISER T., KODYM O., KOPECKY L., KUTHAN M., MALECHA A., MALKOVSKY M., MATĚJKA A., PEŠEK J., SENEŠ J., SOUKUP J., SVOBODA J., TÁSLER R. & ZOUBEK V., 1966. *Geological Map of Czechoslovakia, 1:1 000 000 000*. Praha: Česká Geologicka Služba.

BOLEWSKI A. & MANECKI A., 1993. *Mineralogia szczegółowa* (Detailed Mineralogy, in Polish). Warszawa: Wydawnictwa Geologiczne.

CHÁB J., STRÁNIK Z. & ELIÁS M. (ed.), 2007. *Geologická Mapa České Republiky*. Praha: Česká Geologicka Služba.

CORNELL R. M. & SCHWERTMANN U., 2003. *The Iron Oxides. Structure, Properties, Reactions, Occurrences and Uses*. Weinheim: Wiley-VCH.

DIEZ G. M. & VINAGRE A. T., 2005. Mineral dyes. In: SVOBODA J. (ed.), *Pavlov I Southest. A Window into the Gravettian Lifestyle*. Brno: The Academy of Sciences of the Czech Republic: 167-186.

FILIPPIDIS A. & GEORGAKOPOULOS A., 1992. Mineralogical and chemical investigations of fly ash from the Main and Northern lignite fields in Ptolemais, Greece. *Fuel*, **71** (4): 373-376.

HENSHILWOOD C. S., D'ERRICO F., YATES R., JACOBS Z., TRIBOLO C., DULLER G. A. T., MERCIER N., SEALY J. C., VALLADAS H., WATTS I. & WINTLE A., 200. Emergence of Modern Human Behavior: Middle Stone Age Engravings from South Africa. *Science*, **295**: 1278.

HUANG W. L. & WYLLIE P. J., 1974. Melting relations of muscovite with quartz and sanidine in the K2O-Al2O-SiO2-H2O system to 30 kilobars and an outline of paragonite melting relations. *American Journal of Science*, **274**: 378-395.

JERCHER M., PRING A., JONES P. G. & RAVEL M. D., 1998. Rietveld X-Ray diffraction and X-Ray fluorescence analysis of Australia Aboriginal ochres. *Archaeometry*, **40** (2).

KLÍMA B., 1963. *Dolní Věstonice. Výzkum tábořiště lovců mamutů v letech 1949-1952*. Praha: Československa akademie věd.

KLÍMA B., 1983. *Dolní Věstonice, tábořiště lovců mamutů*. Praha: Academia.

KLÍMA B., 1995. *Dolní Věstonice II. Ein Mammutjägerrastplatz und seine Bestattungen*. The Dolní Věstonice studies. Liège: Études et Recherches Archéologiques de l'Université de Liège (ERAUL). Liège, **73**: 183 p.

KLUG H. P. & ALEXANDER L. E., 1954. *X-ray diffraction procedures for polycrystalline and amorphous materials*. London: J. Wiley and Sons Inc., New York: Chapman and Hall, Ltd.

KOHÚT M., 2006. Do we have a remnant of the hanseatic Terrane and/or Rheno-Hercynian Ocean in the Western Carpathians? A case study from the Devonian of the Považsky Inovec Mts. *GeoLines*, **20**: 67-68.

LEXA J., BAČO P., CHOVAN M., PETRO. M. & ROJKOVIČ I., TREGER, A.M., 2004. *Metallogenetic Map of Slovakia, 1:500 000*. Bratislava: Štátny geologický ústav.

MARQUER L., OTTO T., NESPOULET R. & CHIOTTI L., 2010. A new approach to study the fuel used in hearths by hunter-gatherers at the Upper Palaeolithic site of Abri Pataud (Dordogne, France). *Journal of Archaeological Science*, **37**: 2735-2746.

OLIVA M., 2007. *Gravettien na Moravě*. Disertationes archaeologicae bruneneses/pragensque 1. Praha- Brno: Masaryk University-Charles University.

OLIVA M., 2014. *Dolní Věstonice I (1922-1942) Hans Freising - Karel Absolon - Assien Bohmers.* Brno: Moravské Zemské Muzeum.

PAULIŠ P., HEŘMÁNEK J., JEBAVÁ I. & ZAHRADNIČEk L., 2011. Stilbite-Ca z amfibolitového kamenolomu Markovice u Čáslavi (Česká Republika). *Bulletin minerologicko-petrologického odděleni Národniho muzea v Praze*, **19**: 52-55.

POMIÈS M.-P., MENU M. & VIGNAUD C., 1999. Red palaeolithic pigments: natural hematite or heated goethite? *Archaeometry,* **41**: 275-285.

PETRU S., 2006. Red, black or white? The dawn of colour symbolism. *Documenta Praehistorica,* XXXIII, 1-6.

PŘICHYSTAL A., 2009. *Kamenné suroviny v pravěku. Východní časti střední Evropy*. Brno: Masaryk University.

ROEBROEKS W., SIERK M. J., NIELSEN T. K., DE LOECKER D., PARES J. M., ARPS C. A. S. & MUCHER H. J., 2012. Use of red ochre by early Neandertals. *PNAS*, **7**: 1889-1894.

ROSSO D. E., D'ERICCO F. & ZILHAO J., 2013. Stratigraphic and spatial distribution of ochre and ochre processing tools at Porc Epic Cave, Dire Dawa, Ethiopia. *Quarternary International*, **343**: 85-99.

RYKL D. & PECHAR F., 1985. Thermal decomposition of the natural zeolite stilbite. *Zeolites*, **5** (6): 389-392.

SOFFER O. & VANDIVER P., 1997. The ceramics from Pavlov I – 1957 excavation. In: *Pavlov I northwest*. Brno: Academy of Sciences of the Czech Republic: 383-401.

SOFFER O. & VANDIVER P., 2005. Ceramic fragments. In: *Pavlov I southeast. A Window into the Gravettian Lifestyles*. Brno: Academy of Sciences of the Czech Republic, Institute of Archaeology at Brno, Polish Academy of Sciences, Institute of Systematics and Evolution of Animals: 415-431.

STATHEROPOULOS M., SPILIOPOULOU C. & AGAPIOU A., 2005. A study of volatile organic compounds evolved from the decaying human body. *Forensic Science International*, 153: 147-155.

SVOBODA J., LOŽEK V. & VLČEK E., 1996. *Hunters between East and West. The Paleolithic of Moravia*. New York and London: Plenum Press: 307.

SVOBODA J., HAVLÍČEK P., LOŽEK V., MACOUN J., MUSIL R., PŘIHYSTAL A., SVOBODOVÁ H. & VLČEK E., 2002. Paleolit Moravy a Sležska. *Dolni Vestonice Studies*, **8**.

SVOBODA J., KRÁLÍK M., ČULÍKOVÁ V., HLADILOVÁ S., NOVÁK M., NYVLTOVÁ-FIŠÁKOVÁ M., NYVLT D. & ZELINKOVÁ M., 2009. Pavlov VI: an Upper Palaeolithic living unit. *Antiquity*, **83**: 282-295.

TODISCO D. & BHIRY N., 2008. Micromorphology of periglacial sediments from the Tayara site, Qirkitaq Island, Nunavik (Canada). *Catena*, **76**: 1-21.

TRĄBSKA J.,2003. Pęcherzykowata substancja z grobów ciałopalnych z cmentarzyska z okresu wpływów rzymskich w Chmielowie Piaskowym (Porous porcelanie-like substance from cremation burials, Roman Period, Chmielów Piaskowy site). *Materiały Archeologiczne,* **XXXIV** (summary in German).

TRĄBSKA J., 2015. *Mikrostrukturalne przesłanki do oceny pochodzenia i przetworzenia czerwonych surowców żelazistych ("ochr") na przykładzie wybranych stanowisk górno paleolitycznych* (Microstructural evidences to assess the origin and processing of the raw materials of the red ferruginous artifacts („ocher") based on selected Upper Paleolithic sites. Rzeszów: Wydawnictwo Uniwersytetu Rzeszowskiego.

TRĄBSKA J. & GAWEŁ A., 2007. Microstructural features of powdered hematite as a promising factor in provenance studies. *Sprawozdania Archeologiczne (Archaeological Reports),* **59**: 41-48.

TYRAČEK J., 2005. Geologický a geomorfologický vývoj širšího okolí lokality Bečov IV. In: FRIDRICH J. & SYKOROVÁ I., *Bečov IV – sídelní areál středopaleolitického člověka v severozápadních Čechach*. Praha: The Academy of Sciences of the Czech Republic: 141-156.

VALOCH K., 1996. Le Paléolithique en Tchéquie et Slovaquie. *Collection L'Homme des Origines, Série „Préhistoire d'Europe" **3***, Grenoble: Édition Jérôme Million.

VANDIVER P., 1997. Pavlov I pigments and their processing. *In*: KLIMA B., SVOBODA J. (éds), Škrdla P. (assistant ed.), *Pavlov I - Northwest. The Upper Palaeolithic burial and its settlement context.* Brno: The Academy of Sciences of the Czech Republic: 373-381.

VANDIVER P., SOFFER O., KLIMA B. & SVOBODA J., 1989. The Origins of Ceramic Technology at Dolni Vestonice, Czechoslovakia. *Science*, **246** (4933): 1002-1008.

WADLEY L., 2005. Putting ochre to the test: replication studies of adhesives that may have been used for hafting tools in the Middle Stone Age. *Journal of Human Evolution,* **49**: 587-601.

WESEŁUCHA-BIRCZYŃSKA A., TRĄBSKA J. & OLIVA M., 2012. Composition of a floor from an Upper Palaeolithic skeletal grave – a case from Dolní Věstonice (Moravia, Czechia, Central Europe). *Vibrational Spectroscopy,* **60**: 129-132.

WRESCHNER E., 1980. Red Ochre and Human Evolution: A Case for Discussion. *Current Anthropology*, **21** (5).

XRAYAN, 2007. *Powder Diffractometry Data Handling System*, version 4.0.5.

http://www.geology.cz/app/ciselniky/lokalizace/show_map.php?mapa=g50&y=599183&x=1194957&r=10000&s=1&legselect=0 (access 10.02.2015).

http://www.iza-online.org/natural/Datasheets/Stilbite/Stilbite.html (access 14.03.2015).

http://www.mindat/org/hatrurite (access 14.03.2015).

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