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"Ceramics" from the Zaraysk Upper Paleolithic Site*

Zaraysk is one of the best-studied and best-known Russian Upper Paleolithic sites of the Kostenki-Willendorf type. One of the most intriguing finds of excavations at that site concerns an unusual group of artifacts, tentatively interpreted as ceramics. This article gives a detailed description of these, and addresses their spatial distribution. The items have been subjected to firing, but the chemical and mineralogical analysis suggests that they were made of ocher or highly ferruginized clay unsuitable for manufacturing ordinary ceramics. Poor preservation caused by taphonomic processes precludes a reliable reconstruction of the original morphology and function of the items. Their shape, however, is rather standard and is paralleled by the "non-figurative" ceramics of Pavlov and Dolní Věstonice, whose function is not clear either. It appears that the Zaraysk people tried to reproduce the Central European prototypes in terms of form and function, but, intentionally or not, used a raw material suitable for making a red pigment rather than ceramics. Formally, the Zaraysk pieces can barely be described as ceramics proper, possibly evidencing unsuccessful copying. The final answer, then, hinges on the true purposes of the manufacturers.

Keywords: *Upper Paleolithic, Gravettian, ceramics, ocher, Zaraysk, Pavlov, Dolní Věstonice.*

Introduction

The Upper Paleolithic is the most dramatic period in the history of human evolution. Quite a number of new activities, including the onset of ceramic manufacturing, emerged during this period. Study of the most ancient ceramics represents a comparatively new and quite promising field of Paleolithic research.

The earliest ceramics have been found at some Gravettian sites, and primarily at the Moravian sites of Pavlov and Dolní Věstonice (Soffer, Vandiver, 1994, 1997, 2005). In Russia, one of the earliest Paleolithic sites with ceramics is the Zaraysk site (Amirkhanov, 2000; Amirkhanov et al., 2009), which is located within the historical part of Zaraysk in the Moscow Region. This area represents a group of Paleolithic sites that partially

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overlap each other. Zaraysk A is the best-studied stratified site. Currently, its excavation area has reached 270 m^2, and its age is described as in the range of 16–23 thousand years. In 1998–2004, a set of artifacts was found at Zaraysk A that was tentatively interpreted as "ceramics". References to these finds can be found in the literature (Soffer et al., 2000; Garkovic, 2005; Budja, 2006; Kuczyńska-Zonik, 2014), yet no comprehensive study of the artifacts has yet been carried out. The only exception is a comparatively short article about data obtained via binocular microscopic analysis of six samples from the excavation seasons of 1995 and 1998, by Y.B. Tsetlin (2000). That paper states that the samples are products of low-temperature firing of clay that is intermixed with fatty organic materials.

We provide here more detailed analytical data on the materials that were initially studied by Tsetlin. We have analyzed 54 samples that were selected in 1998–2004 during excavations at Zaraysk A, and were preliminarily described as "ceramics", "ceramics with ocher", and "ocher". At the initial stage of analysis, these samples represented lumps of isometric shape, heavily contaminated with soil from the cultural horizon. After cleaning, the samples did not look like typical archaeological ceramic pieces. Rather, they resembled ocher, metallurgical waste, or slag. Therefore, the major task of our research has been to describe the essence of the Zaraysk "ceramics", and to determine if they were indeed ceramics proper.

General description of the samples

All "ceramics" samples were found in a cultural layer as separate objects, and in this respect they didn't differ from other finds. Their color-palette showed a combination of red and gray shades. However, the red was too bright for ceramics, and corresponded rather to the color of the ocher, while the gray demonstrated unusual iron-gray and bluish shades. All samples left on paper vivid traces of grayish-green, and reds of various shades.

The samples have been classified into three groups by size, state of preservation, and some other parameters. "Ceramics" of the first group are either completely bright red, or exhibit a red exterior surface and light gray interior. Their texture is crumb and fissured, as if the raw material was poorly milled and barely kneaded (Fig. 1, *a*, *b*).

The texture of samples of the second group, in contrast, looks well-ground and kneaded. The samples show mostly a combination of red and gray. Their distinct feature is rounded pores-"bubbles" morphologically similar to the pores in keramzit, pumice, or slag (Fig. 1, *c*, *d*). Some samples are completely composed of porous mass (these are mostly dark gray). Other specimens show pores either on some portions, or within rounded inclusions. Still other specimens do not contain any pores at all. Porous samples are naturally lighter than others in weight.

The third group represents mass mixed with sand. The color of all samples is red. The sand is quartz,

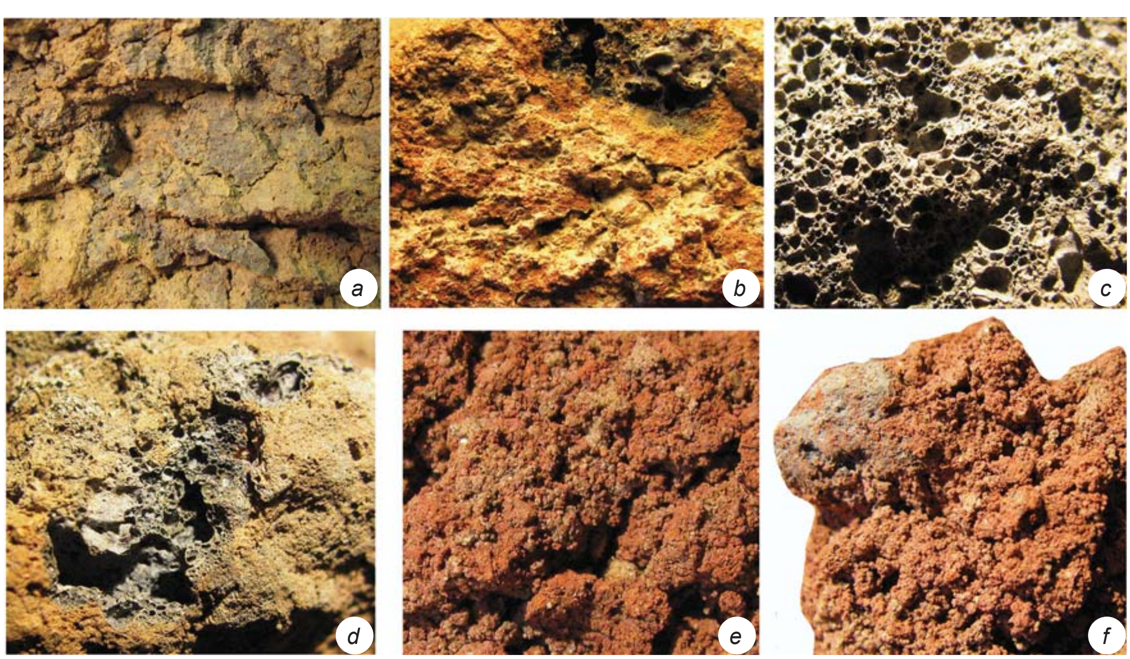

Fig. 1. Samples of "ceramics" of various groups (portions 2 × 2 cm are shown).
a, *b* – first group (sample *b* shows large oolite inclusion with expanded dark gray core); *c*, *d* – second group (expanded areas with pores-"bubbles"); *e*, *f* – third group (sample *f* shows comparatively large inclusion of the light gray mass of the second group).

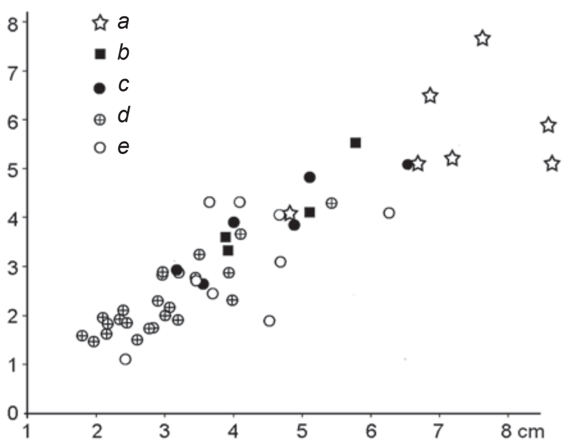

Fig. 2. Correlation of sizes and shapes of samples.
a – lumps; *b* – tablets; *c* – cones; *d* – vague; *e* – vague intact.

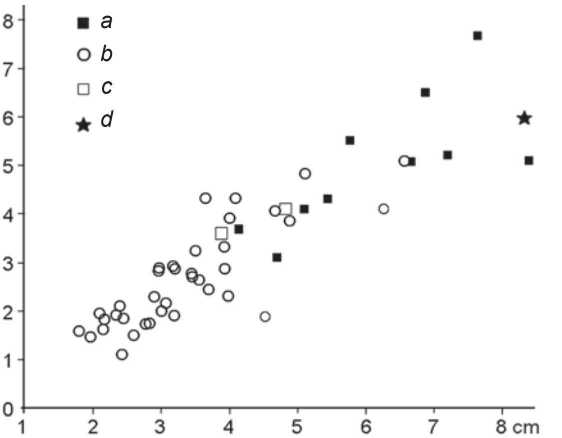

Fig. 3. Correlation of sizes of samples with the group of "ceramics".
a – first group; *b* – second group; *c* – third group; *d* – clay.

fine-grained (the grains are up to 1 mm), well-rounded, and is identical to that from the cultural layer of the site. Aside from the bright color of the binding agent, these samples resemble in their appearance highly tempered and very poorly fired ceramics (Fig. 1, *e*, *f*). Their bodies may include small (up to 1.5 cm) nodules of dense, fine, homogeneous, bright-red mass, which concretions, if found in another context, would resemble incompletely ground lumps of red ocher mixed with sand.

The morphology of the Zaraysk "ceramics" is not clear. The largest samples can be roughly classified into three stable forms, which may be defined as lumps, cones, and tablets (Fig. 2). In contrast, small samples are mostly irregular in shape, therefore can barely be classified (in Fig. 2, they are indicated as vague). This may be a result of their poor preservation. Correlation of sizes and properties of the bulk of samples is provided in Fig. 3.

Lumps are clearly identified in the collection. They are either thick or flattened in cross-section, slightly elongated in plan; one surface is flat, another is slightly convex. Some of them look like simple lumps of raw material (Fig. 4, *2*, *3*), while others resemble artifacts (Fig. 4, *4–6*), and still other specimens show undestroyed areas of smoothed surface and some grooves of unclear morphology (Fig. 4, *1*; 5, *2*).

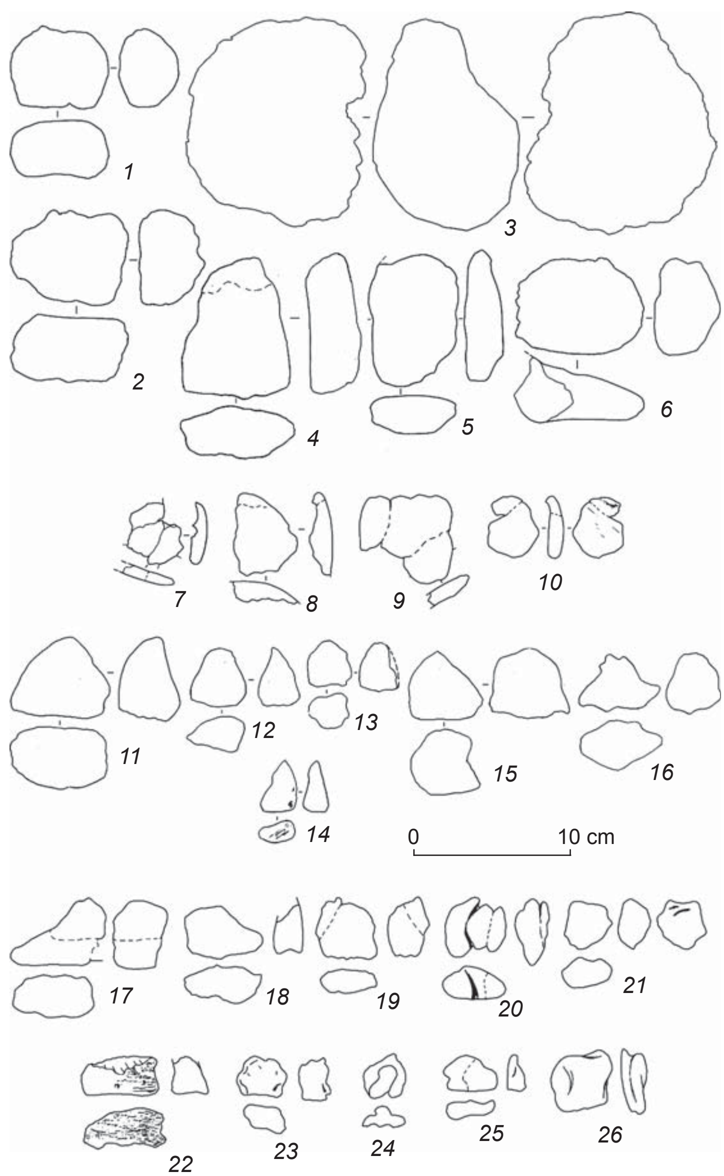

Fig. 4. Shapes of Zaraysk "ceramics".
1–6 – lumps; *7–10* – tablets; *11–16* – cones; *17–26* – intact articles with vague shapes.

Tablets are noteworthy for their apparently artificial shapes (see Fig. 4, *7–10*). They are flat in cross-section and sub-rectangular in plan, with one flat surface and one slightly convex surface. The only intact specimen (see Fig. 4, *10*) shows imprints on its flat surface, resembling those of wood (Fig. 6, *a*). The other two tablets (see Fig. 4, *8*, *9*; 5, *3*) have damaged flat surfaces; however, these surfaces look like fractured interface or fractured surface of contact with unknown materials (see, e.g., (Kostyleva, 2014)).

Cones have flattened bases and narrow tops. Their surfaces usually bear small vague indentations (see Fig. 5, *1*). The uneven bases are irregular in shape. The base of one specimen (see Fig. 4, *15*) looks as if it was damaged as a result of fracture, or like a fractured surface of contact with unknown materials. One cone has a depression in its base, which, after cleaning, revealed subparallel straight grooves (see Fig. 4, *14*; 7, *a*, *b*).

Some samples with irregular shapes are undoubtedly intact or almost intact (see Fig. 4, *17–26*). They are mostly large in size. Two samples in this category deserve special attention. One of them was described as having preserved the imprints of thin leather folds (Tsetlin, 2000) or of creased net with knots of vague shape (Soffer et al., 2000). This sample is subrectangular in plan and subtriangular in cross-section (see Fig. 4, *22*). The imprints occupy one surface completely, and the adjoining surface partially, and represent sub-parallel grooves running along the long edges of the sample, or at slight angle to them (see Fig. 6, *b*). The general outlines of the images are so vague as to make possible many different speculations concerning their origins.

Another specimen in this set is smaller, but generally similar in shape to the former one. The imprints represent sub-parallel grooves on the flat surface, located at a

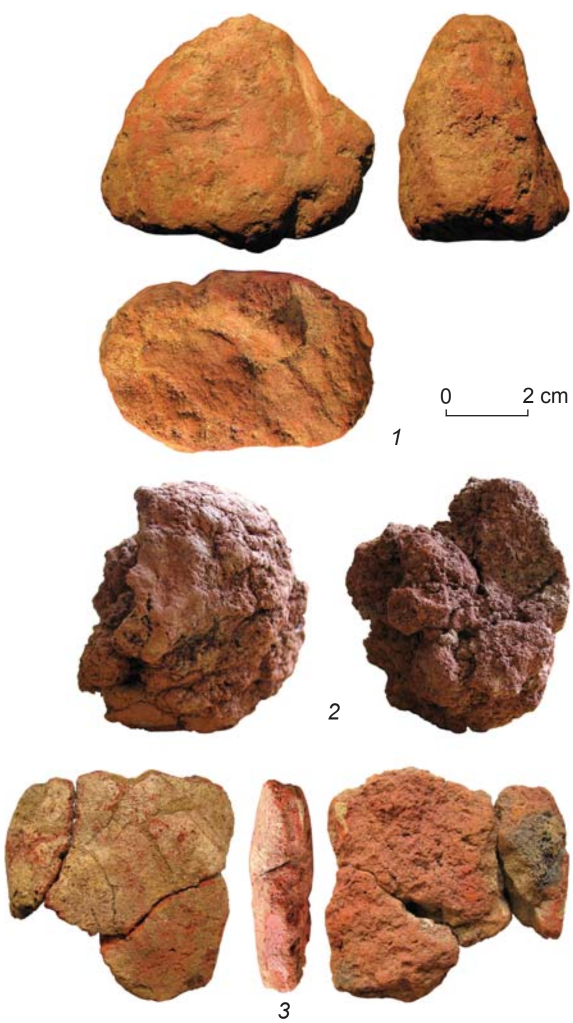

Fig. 5. Zaraysk "ceramics": cone (*1*), lump (*2*), and tablet (*3*).

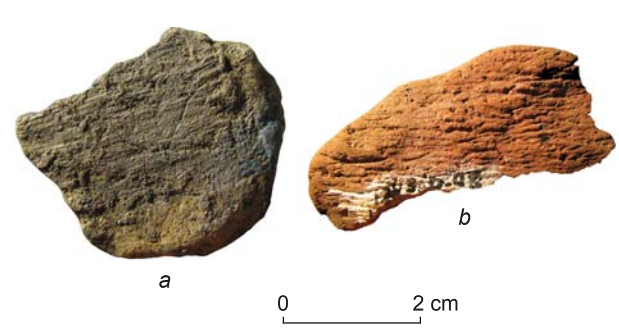

Fig. 6. Imprints of unidentified materials on the Zaraysk "ceramics".

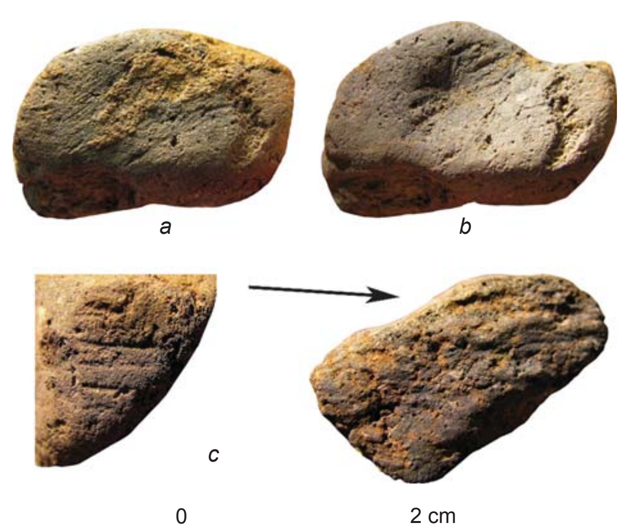

Fig. 7. Linear traces on the Zaraysk "ceramics".
a, *b* – on the base of the cone (view of the surface before (*a*) and after (*b*) cleaning); *c* – on the intact article of vague shape (arrow indicates the surface with grooves).

small angle to its long edges; the relief is smoothed, the general design is indistinct (see Fig. 7, *c*). One of the long lateral surfaces is flattened, and also shows sub-parallel, scratched, thin, and sparse grooves; these are apparently artificial, but their origin is not clear.

To our regret, we did not notice any signs of intentional shaping, either finger imprints or traces of working tools, on the Zaraysk "ceramics" samples.

Spatial distribution

The Zaraysk A site revealed the remains of at least four interstratified habitation layers (Fig. 8). These layers differ from one another in structure, spatial distribution, and types of the objects; yet all belong to a single archaeological culture referred to as the Kostenki-Avdeyevo (Amikhanov et al., 2009: 12). The uppermost cultural layer (the fourth) was related to the buried soil; "ceramics" were absent there. The underlying generally homogeneous lithological horizon of reddish (sometimes brown) sandy soils and sandy loams reached up to 30 cm thick in the areas between pits. By its archaeological and stratigraphic characteristics, this horizon was subdivided into three cultural layers. The youngest layer (the third) in this stratum was dated to a range of 19–17 ka BP. It was separated from the two first layers by a developed system of permafrost cracks.

Deposits of the first cultural layer yielded seven samples* aggregated in pits. These were typical storage-pits containing lenses of ocher. Four additional samples were found in the immediate vicinity of the partially excavated hearth, which continued the line of five hearths overlapped by ocher lenses (Fig. 9, I).

The second layer yielded three samples unassociated with any objects, five samples in different pits, and the remaining 37 samples in small semi-subterranean dwelling constructions (*poluzemlyankas*) surrounding the line of hearths (Fig. 9, II). This is an example of the typical arrangement of living-space at the sites of the Kostenki-Avdeyevo culture. The greatest number of "ceramics" has been collected from the *poluzemlyankas* B and E, and several samples in each of *poluzemlyankas* A and C. The specimens were recovered both *in situ* (in the bottom of pits), and in the middle of the pits' fillings (owing to the cultural layer's being washed off).

Samples from the third layer were associated mostly with three rounded and slightly depressed objects that have been identified as above-ground dwellings (Fig. 9, III). These objects are of the same area and depth. Their area contains numerous clusters of mammoth-bones, whose composition suggests selectiveness of these accumulations. The bottoms and walls of these three dwellings show spots pigmented with ocher (Ibid.: 27–33).

Thus, the second layer yielded the greatest amount of "ceramics". The collections of samples from various layers don't show any clear distinctions in shape, size, preservation state, or properties of the fabric. However, it should be noted that the first layer lacks conical forms and is dominated by samples of the third group, which, in turn, are absent in the third layer.

Of great importance is the association of "ceramics" with dwelling and utility structures, and their remoteness from hearths. This last feature is not so prominent in the first layer, where utility structures are generally located closer to hearths. In contrast, in the second and third layers, this trend is very distinct. Such spatial distribution of finds is very important, because it precludes the possibility of their unintentional firing.

Material composition

The mineral composition of the ten most typical samples of the Zaraysk "ceramics" has been established with XRD, DTG, and petrographic analysis, and showed the presence of quartz, dolomite, hematite, and feldspar. Clay minerals (such as kaolinite, smectite, illite, and illite-smectite) have been traced by the XRD analysis (though their origin is not clear, as these minerals might have been secondary).

The Zaraysk "ceramics" have shown a specific chemical composition (see *Table*). Their iron-content is close to that in ocher, which term in geology means loose, fine-grained, highly ferruginized rocks suitable for production of red pigment. Below, average values are given of proportions (%) of silica and iron oxide in the Zaraysk "ceramics" and in ocher from the best known deposits of Russia (after (Tolstikhina, 1963: 15–134)):

	Fe_2O_3	SiO_2
Zaraysk "ceramics"	13.46–26.61	36.82–49.01
Baranovsky ocher, Primorye	8.14–20.76	37.14–88.0
Zhuravka ocher, Voronezh Region	3.10–29.88	60.80
Clay pigments, Moscow Region	7.02–11.66	28.72–66.48
Iron oxide pigments, Moscow Region	23.48–39.56	23.38–54.32

In addition, the Zaraysk "ceramics" contain a significant proportion of phosphorus (in clays, this value does not exceed several tenths of one percent, see

*During analysis of spatial distribution, not only samples of "ceramics" were taken into account, but also indistinct lumps of cultural layer, which fell to pieces when brought into contact with water, turning into sand, small particles of "ceramic" fabrics, little bones, charcoals, etc.

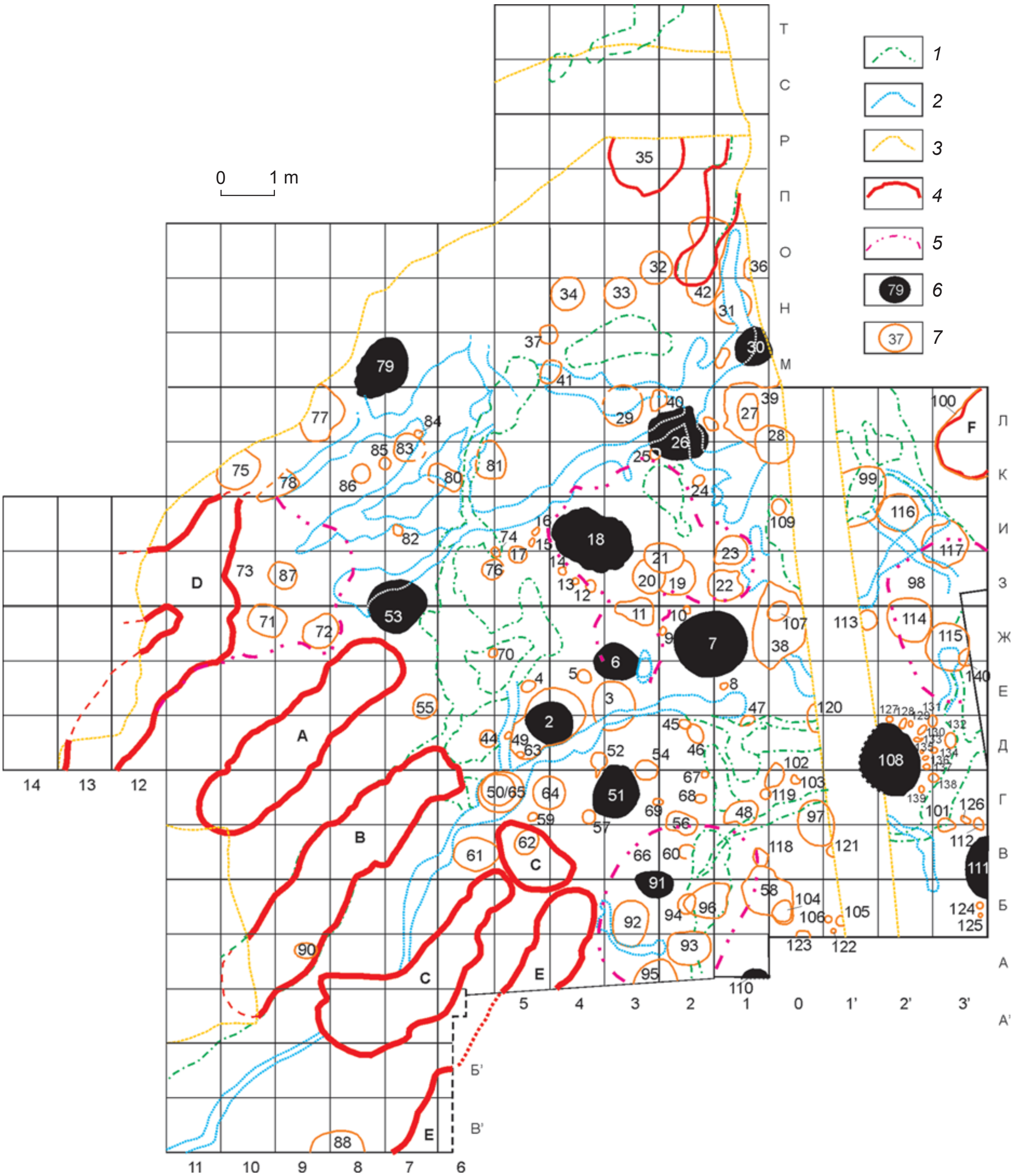

Fig. 8. General map (all layers) of the excavation area at Zaraysk A.
1 – permafrost cracks of the first generation; *2* – permafrost cracks of the second generation; *3* – trenches that damaged the layer; *4* – boundaries of large pits (*poluzemlyanki*) in the second cultural layer; *5* – boundaries of large slightly deepened objects in the third cultural layer; *6* – hearths; *7* – pits.

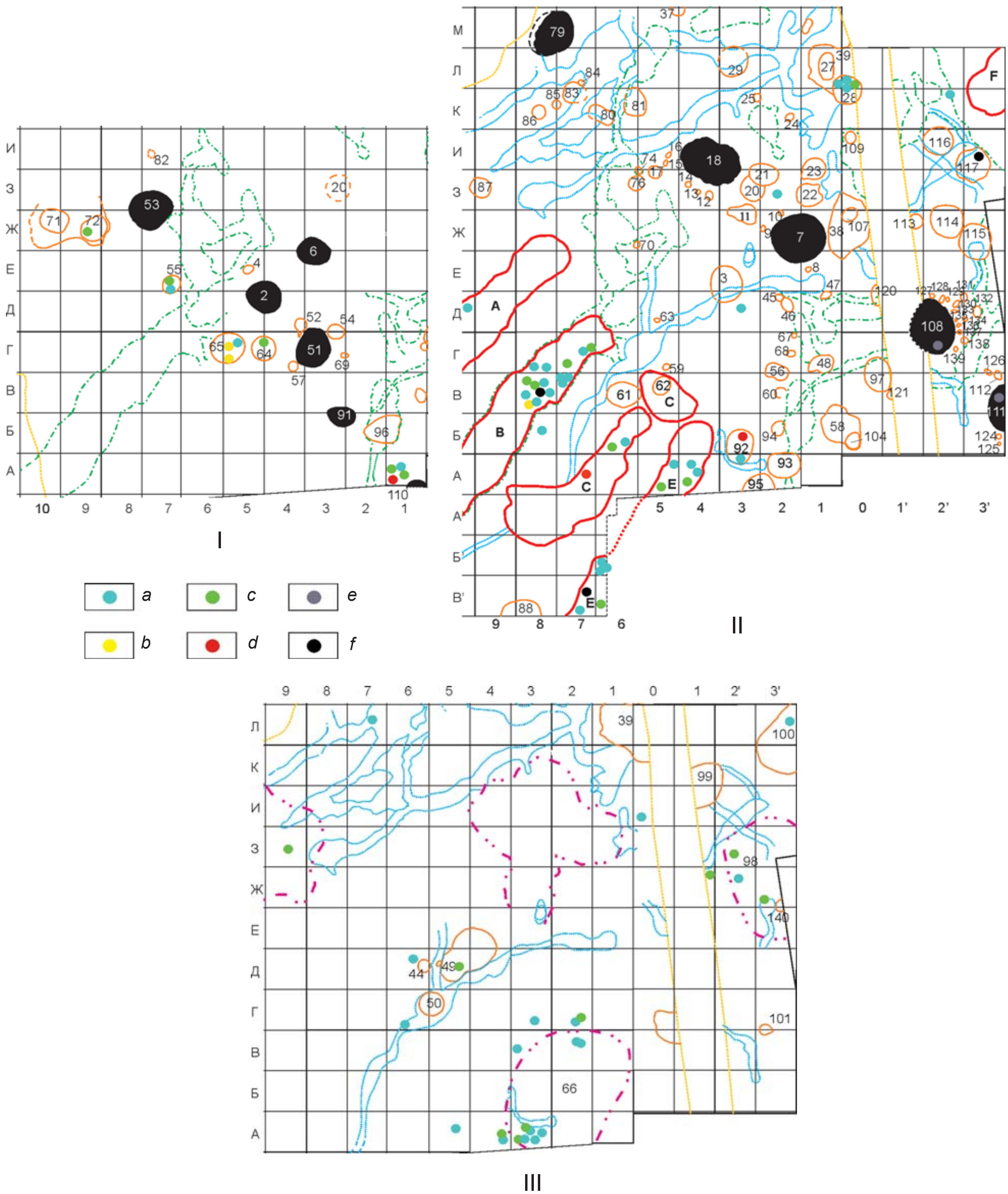

Fig. 9. Excavation areas with "ceramics".
I – first cultural layer; II – second cultural layer; III – third cultural layer.
a – "ceramics", group 1 and 2; *b* – "ceramics", group 3; *c* – vague lumps; *d* – clay; *e* – dolomite; *f* – wood. Other legend same as on Fig. 8.

Chemical composition of samples of various types, % (mean values)

Samples	IL*	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO	MnO	Fe_2O_3	P_2O_5
Ocher (*n* = 1)	14.69	0.23	0.55	13.91	28.02	1.67	3.16	1.07	0.021	27.94	7.39
“Ceramics”											
Group 1 (*n* = 7)	10.41	0.29	1.78	19.15	36.26	1.83	1.44	0.85	0.03	22.86	4.34
Group 2 (*n* = 5)	8.14	0.26	1.87	18.06	43.29	1.57	1.49	0.94	0.03	20.22	3.86
Group 3 (*n* = 3)	5.6	0.27	1.10	12.92	62.24	1.75	2.14	0.63	0.03	10.55	1.77
Concretion (*n* = 1)	5.07	0.05	0.12	2.91	34.69	0.35	0.44	0.22	0.017	54.39	0.50
Clay (*n* = 2)	5.56	0.18	0.60	12.61	72.6	1.79	1.84	0.90	0.02	2.9	1
Cultural layer (*n* = 3)	3.82	0.22	0.56	7.2	77.3	1.01	2.7	0.43	0.08	4.3	2.3
Loess loam (*n* = 3)	3.96	0.52	1.8	11.62	71.77	2.12	1.11	0.75	0.06	5.82	0.23

Notes. Samples of the cultural layer were taken from the *poluzemlyanka* B: one sample from the area with “ceramics”, another from the opposite side of the dwelling without “ceramics”. Loess loams samples were collected beyond the Zaraysk site. A dense lump of bright-red mass from a ceramic sample of group 3 was designated as ocher. Clay is from two accumulations in the cultural layer (see Fig. 9).

*Ignition losses.

(Tolstikhina, 1963: 136–166; Samofalova, 2009: 24–47; Golieva, Turova, 2015: 156–162)). Such cases are usually interpreted to be a result of admixture of special additions (bones) to the fabric, or as a result of cooking special types of food in the pottery (Bobrinsky, 1978: 105; Demkin, Demkina, 2000; Fiziko-khimicheskoye issledovaniye…, 2006: 33; Yanshina, Garkovik, 2008). However, these interpretations are not applicable to the Zaraysk “ceramics”. Bone admixtures are absolutely excluded, because Zaraysk samples demonstrate very fine-grained fabric; it would clearly show admixtures of foreign particles of the size to which bones could have been ground in the Paleolithic**.**

Pairwise correlation of particular chemical compounds in the composition of the Zaraysk “ceramics” (Fig. 10) demonstrates a nearly direct relation between alumina, phosphorus, and iron, suggesting their common origin. Marsh ores, containing a comparatively small proportion of iron and a high proportion of phosphorus (1–5 to 10–22 %), can be considered the most probable source of these elements. It is also known that marsh ores may contain high proportions of clay components (Tolstikhina, 1963: 15–24; Dyachkov, 2002: 63).

Notably, the chemical composition of the Zaraysk “ceramics” is quite different from that of the samples from the cultural layer, especially in its proportions of alumina, iron, and phosphorus (Fig. 10). Hence, these “ceramics” could not have been formed naturally in the cultural layer’s soil. This is supported by the high concentration of alumina in the “ceramics”. By way of comparison, in iron concretions, which are typical in the cultural layer at Zaraysk site, the proportion of alumina is six times smaller than that in the “ceramics” (see *Table*).

Firing

Ordinary tests have been carried out in order to identify the features of thermal processing of the Zaraysk “ceramics”. Small pieces and fragments were submerged in water for several days, after which, their strength was tested. The “ceramics” samples of the first and the second groups retained their integrity and did not crumble. However, upon retrieving the samples from water, they were easily crushable with a knife, and the wet crumbs could have been modeled into a sausage-shape. Ceramics of the third group diffused in water immediately, while the small lumps of bright-red homogeneous mass from them retained their integrity.

Re-firing (samples were fired in the muffle at temperatures of 400, 500, 600, 700, 800, and 900 ºC, for 30–45 minutes at each temperature) has shown that the samples retained their red color, while the gray color changed into faded grayish-brown shade at a temperature of 500 ºC, and disappeared at 600 ºC. At the end of testing, the originally red and gray spots in the samples became reds of various shades, suggesting differences in the raw material’s composition.

The test results show that the Zaraysk “ceramics” might indeed have been fired. In this case, firing should have been carried out at a temperature of about 500 ºC for over 30 minutes. “Ceramics” of the third group were

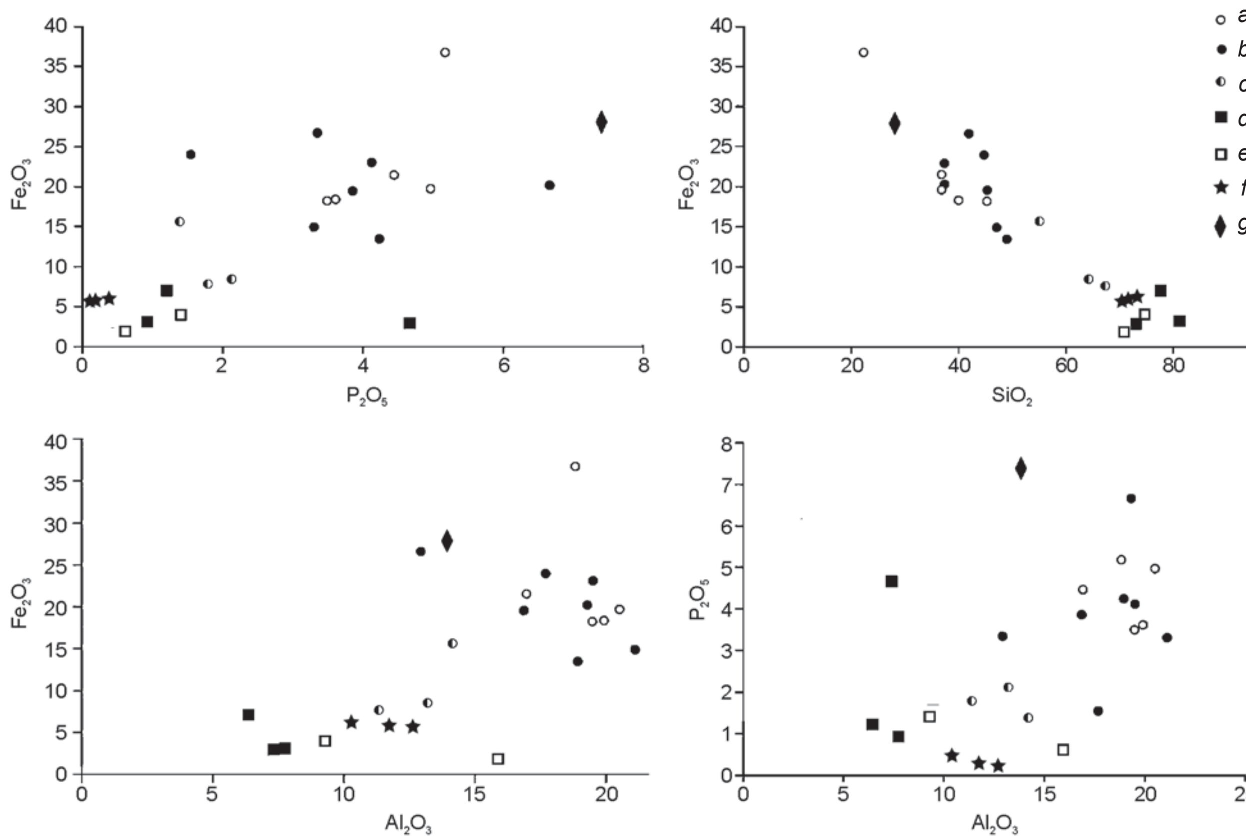

Fig. 10. Diagrams of correlation of chemical compounds in samples of various groups (%).
a – "ceramics" of the first group; *b* – "ceramics" of the second group; *c* – "ceramics" of the third group; *d* – cultural layer; *e* – clay; *f* – loess loams; *g* – ocher (?). Each point at the diagrams corresponds to one sample (locations of taking samples for comparison are provided in the note to the *Table*).

either not fired at all, or required longer firing under higher temperatures to gain the same degree of sintering (understandably, given their coarse texture).

The obtained data would be quite appropriate to ordinary ceramics, but they do not explain some specific features of the Zaraysk specimens. These data are not consistent with the presence of pores ("bubbles") in the texture. Explanation of a mechanism for the formation of "bubbles" presents a considerable problem. The "bubbles" look like the pores that are formed at high temperatures in bloom, slag, volcanic rocks, and keramzit (Fig. 11). Given the established chemical and mineralogical composition of the Zaraysk "ceramics", the "bubbles" seem to have been formed owing to the clay's bloating during firing (Onatsky, 1971: 44–84; Khimicheskaya tekhnologiya…, 1972: 414–418; Worrall, 1975). However, the results of re-firing and tests of residual ductility suggest that the firing of the Zaraysk "ceramics" was carried out under low temperatures, which contradicts the theory that clay cannot bloat under such conditions.

Additional evidence of thermal treatment has been obtained during a more detailed XRD analysis of the "ceramics" samples in the first and the second groups. The obtained data have shown the presence in these of fine-crystalline hercynite—a mineral representing a product of firing of ferruginized clays under the high temperatures (≥ 800–850 ºC), and in one case, mullite. It should be noted that hercynite is formed under such conditions as high iron-content and the reducing environment of firing, which also benefit clay-bloating (Malysheva, 1969: 22–40; Avgustinnik, 1975: 36–37; Maniatis, Simopoulos, Kostikas, 1983: 781).

The results of radiographic analysis suggest two more interesting ideas. Firstly, not only samples of the second group with porous texture were fired, but also ceramics of the first group. Secondly, the semiquantitative analysis of the mineral composition of the samples has shown that in the gray portions of the ceramics, the content of hematite was several times less than in the red portion, while the proportion of quartz was greater. This correlates well with the assumption that "bubbles" were formed owing to the clay's bloating, while their uneven distribution in the fabric may indicate properties of the raw material. Apparently, the used raw material was not homogeneous with respect to its proportions of clay and iron oxides.

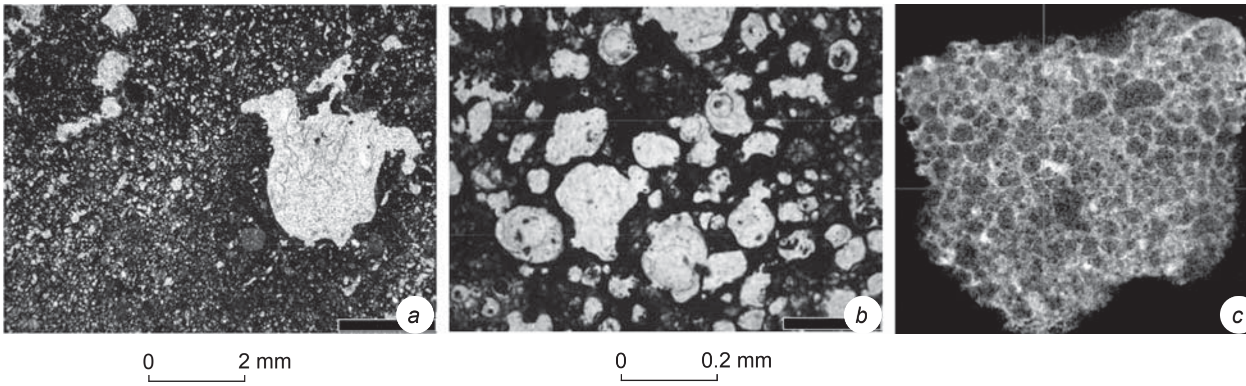

Fig. 11. Heavily expanded dark gray sample of the Zaraysk "ceramics" (pictures were taken in transmitted light without analyzer).
a, *b* – pictures of a slice with various magnification degrees; *c* – picture made using SkyScan 2011 microtomograph.

Thus, the portions with higher clay-content bloated. This is confirmed by the color variations in the samples that have been subjected to re-firing.

So, the Zaraysk "ceramics" seem to have been fired, but the available data are not sufficient to establish the firing temperature. The performed studies also did not explain the reasons for the preservation of residual ductility in the samples. Perhaps the explanation lies in the properties of the raw material: for example, its highly fine structure in combination with the increased iron-content. It is known that ocher mixed with water also produces a ductile substance, which can maintain a fashioned form. The role of post-depositional processes leading to secondary formation of certain minerals, including clay and iron minerals, cannot be excluded either.

Conclusions

The data described in this paper add to our understanding of the nature of the Zaraysk "ceramics". As of present state of knowledge, the origin of these pieces may, with a certain degree of confidence, be regarded as artificial. This hypothesis is supported by their specific material composition, the spatial association of the "ceramic" pieces with dwellings and utility structures, and (to a certain extent) the morphology of the samples. The data on the thermal processing of the Zaraysk ceramics represent an additional reliable argument in favor of the proposed determination; while the fact that the samples were found mainly at a certain distance from fireplaces and hearths excludes the possibility of their unintentional firing.

The question of whether the samples under study really represent ceramics is much more complicated. In their material composition, they are mostly close to ocher and low-ferruginous marsh-ores. In such a case, their firing could have been aimed at the production of red pigment from the rocks containing iron hydroxides. This is particularly true for the southern part of the Moscow Region, since the region is poor in outcrops of high-quality red pigment, while the Zaraysk site demonstrates its broad use. However, it is hard to say if the exclusive purpose of the Zaraysk inhabitants was to obtain the pigment.

Comparisons of the Zaraysk "ceramics" with ocher pigments from other Upper Paleolithic sites in Europe have shown certain distinct features of the former. The European ochers are represented by three groups of finds: 1) raw material (mostly pieces of various rocks that served as sources of pigments); rarely, stocks of ocher powder; 2) painted objects and materials (usually spots of cultural layer, covered with ocher powder; tools and bone artifacts bearing traces of pigment); and 3) ocher "pencils". Among these finds, parallels with the Zaraysk "ceramics" can barely be established, excluding the ocher "pencils". It is believed that the latter served as both the painting tool and the individual stock of pigment, because (unlike the powder) the "pencils" were easily transportable and always ready for production of colorant. "Pencils" were made mostly of solid hematite ores, possibly previously fired (two such "pencils" were found at the Zaraysk site). Deposits of such ore have not been discovered in the southwestern part of the Moscow Region; which might have served as a stimulus for artificial hardening and shaping of the available unconsolidated rocks. However, in this case, it is not clear why the majority of the Zaraysk "ceramics" are not red, but gray. It can be hypothesized that such specimens are by-products of ocher firing. But then, it remains unclear why the Zaraysk "ceramics" were found far from hearths, in dwelling and utility pits, and in a context without any traces of pigmenting. At the least, this means that the "ceramics" played some special role, other than that played by the red paint in the life of the Zaraysk inhabitants.

Comparison of the Zaraysk samples with ceramics from other European Upper Paleolithic sites is not helpful either. It is generally accepted that the Gravettian and post-Gravettian ceramics were primarily used as a basis for zoo- and anthropomorphic images (Soffer, Vandiver, 1994, 1997, 2005; Hachi et al., 2002; Vandiver, Vasil'ev, 2002; Händel et al., 2009; Bougard, 2010; Farbstein et al., 2012), which are either absent or undetectable in the Zaraysk "ceramics". However, archaeological materials from Dolní Věstonice and Pavlov also include a series of ceramic lumps of unclear morphology and function (*non-figurative ceramics*) (Soffer, Vandiver, 1994, 1997, 2005), and these artifacts exhibit certain parallels to the Zaraysk "ceramics", except for their raw material.

Quite few "non-figurative" ceramics samples have been interpreted as fragments of coating, some of which bear images believed to be wickerwork imprints (Adovasio, Hyland, Soffer, 1997; Soffer et al., 2000; Soffer, Vandiver, 2005). All these samples are very small (up to 1.5–2.0 cm), and the imprints are so vague as to provoke uncertainty in the proposed interpretations. The typology and purpose of other finds have not been reliably established. However, exactly in this group of artifacts we see items close to those from Zaraysk. They demonstrate similar morphology; and the Pavlov lumps often show imprints similar to those on the Zaraysk specimens. Noteworthy also is the presence, in the Zaraysk collection, of samples that can be interpreted as fragments of appliqué elements of certain more elaborated objects (see, e.g., Fig. 4, *7–10*, *20*, *24*). In their functionality, these samples are well correlated with the Moravian "non-figurative" ceramics.

Analysis of the Zaraysk "ceramics" has unfortunately not produced any reliable arguments in favor of their interpretation as real ceramics. Such arguments could be based on the signs of intentional shaping, which are not typical for ordinary ocher samples; yet no such traces have been reliably established. The intentional shaping may be evidenced indirectly by the repeated configuration of some samples: abundant cone-shaped specimens and pieces with trihedral cross-section in general, nearly invariable presence of at least one flat surface, etc. Besides, some samples demonstrate clearly artificial shapes that can barely occur among natural objects (see, e.g., Fig. 4, *7–10*, *22*; 5, *1*, *3*).

Analysis of the raw material does not make the situation clear either. It is not known whether the Zaraysk population used ocher or clay as their basic material. If iron was intentionally added to clay, it might have suggested the desire to have red-colored products. It would mean that, when manufacturing the Zaraysk "ceramics", manufacturers relied primarily on clays and wanted to produce articles of particular form and strength through firing. However, according to our observations, the original raw material contained iron. Furthermore, archaeological materials from the site include one typical lump of pure, unfired clay, and two small accumulations of clay that was brought to the site from elsewhere. This means that the inhabitants of the site did recognize clay as a separate raw material.

It is also noteworthy that close association of clay and ocher has been reported from many European Paleolithic sites (Vandiver, 1997; Hradil et al., 2003: 227–231; Gomes et al., 2015; Bougard, 2010: 68–69). The assumption was even made that people might have gained knowledge about clay's properties in the course of production of ocher pigments, because many mineral ores, used for pigment production, naturally contained clay (see, e.g., (Weinstein-Evron, Ilani, 1994: 467)).

Moreover, many Upper Paleolithic European sites contain not only artifacts painted with ocher, but also those manufactured of various colorful raw materials including hematite (Jennett, 2008: 9, 17–25; Lander, 2005: 65–68), which is suggestive of the practice of using such raw materials in the manufacture of articles with special function, but not only to obtain colorants. These materials also include some articles with unclear morphology and function, like the Zaraysk samples (see, e.g., (Bougard, 2010: 68–69)).

Taking into account all these findings, we can put forward a hypothesis that the Zaraysk inhabitants attempted to produce certain articles, whose shape and function are as yet unclear to us, and used, either intentionally or accidentally, raw material combining the properties of clay and ocher. Formally, the Zaraysk samples can barely be referred to as ceramics in the strict sense of this word. However, they may represent the result of an attempt, not very successful from our point of view, to produce articles that are close in their morphology and function to the ceramic artifacts from the sites of Dolní Věstonice and Pavlov in Moravia.

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References

Adovasio J., Hyland D., Soffer O. 1997
Textiles and cordages: A preliminary assessment. In *Pavlov I – Northwest: The Upper Paleolithic Burial and*

Settlement Context. Brno: Inst. of Archaeol., pp. 403–424. (The Dolni Vestonice Studies; vol. 4).

Amirkhanov H.A. 2000
Zarayskaya stoyanka. Moscow: Nauchnyi mir.

Amirkhanov H.A., Akhmetgalieva N.B., Buzhilova A.P., Burova N.D., Lev S.Y., Mashchenko E.N. 2009
Issledovaniya paleolita v Zarayske. 1999–2005, H.A. Amirkhanov (ed.). Moscow: Paleograf.

Avgustinnik A.I. 1975
Keramika. Leningrad: Stroyizdat.

Bobrinsky A.A. 1978
Goncharstvo Vostochnoi Evropy: Istochniki i metody izucheniya. Moscow: Nauka.

Bougard E. 2010
The Use of Clay in the Upper Paleolithic of Europe: Symbolic Applications of a Material. Oxford: BAR. (BAR Intern. Ser.; No. 2069).

Budja M. 2006
The transition to farming and the ceramic trajectories in Western Eurasia: From ceramic figurines to vessels. *Documenta Praehistorica*, No. 33: 183–201.

Demkin V.A., Demkina T.S. 2000
Vozmozhnosti rekonstruktsii pogrebalnoi pishchi v keramicheskikh sosudakh iz kurganov bronzovogo i rannego zheleznogo vekov. *Etnograficheskoye obozreniye*, No 4: 73–81.

Dyachkov I.V. 2002
Prirodnye zhelezooksidnye pigmenty dlya stroitelnykh materialov. Cand. Sc. (Engineering) Dissertation. Kazan: Kazan. Gos. Arhit.-Stroit. Akad.

Farbstein R., Radić D., Brajković D., Miracle P.T. 2012
First Epigravettian ceramic figurines from Europe (Vela Spila, Croatia). *PLoS ONE*, vol. 7 (7). URL: htpp://journals.plos.org/plosone/article?id=10.1371/journal.pone.0041437

Fiziko-khimicheskoye issledovaniye keramiki (na primere izdeliy perekhodnogo vremeni ot bronzovogo k zheleznomu veku). 2006
V.V. Boldyrev, V.I. Molodin (eds.). Novosibirsk: Izd. SO RAN.

Garkovik A.V. 2005
Nekotorye osobennosti perekhodnogo perioda ot paleolita k neolitu. In *Rossiyskiy Dalniy Vostok v drevnosti i srednevekovye: Otkrytiya, problemy, gipotezy*. Vladivostok: Dalnauka, pp. 116–132.

Golieva A.A., Turova I.V. 2015
Fosfor v arkheologicheskikh obyektakh: Formy, kolichestvo, ustoychivost. In *Arkheologia Podmoskovya: Materialy nauch. seminara*, iss. 11. Moscow: Izd. IA RAN, pp. 155–164.

Gomes H., Collando H., Martins A., Nash G., Rosina P., Vaccaro C., Volpe L. 2015
Pigment in Western Iberian schematic rock art: An analytical approach. *Mediterranean Archaeology and Archaeometry*, vol. 15 (1): 163–175.

Hachi S., Fröhlich F., Gendron-Badou A., Lumley H., Roubet C., Abdessadok S. 2002
Upper Palaeolithic cooked clay figurines from Afalou Bou Rhummel (Babors, Algeria): First infra-red absorption spectroscopic analyses. *L'Anthropologie*, No. 106: 57–97.

Händel M., Simon U., Einwögere T., Neugebauer-Maresch C. 2009
New excavations at Krems-Wachtberg – approaching a well-preserved Gravettian settlement site in the middle Danube region. *Quartär*, vol. 56: 187–196.

Hradil D., Grygar T., Hradilova J., Bezdicka P. 2003
Clay and iron oxide pigments in the history of painting. *Applied Clay Science*, No. 22: 223–236.

Jennett K.D. 2008
Female Figurines of the Upper Paleolithic. San Marcos: Texas State Univ.

Khimicheskaya tekhnologiya keramiki i ogneuporov. 1972
P.P. Budnikov, D.N. Poluboyarinov (eds.). Moscow: Stroyizdat.

Kostyleva A.A. 2014
Kompleksnyi analiz glinyanoi obmazki s poseleniya Serteya II, sloi α. In *Kamennyi vek: Ot Atlantiki do Patsifiki: Zamyatninskiy sbornik*, iss. 3. St. Petersburg: Izd. MAE RAN, pp. 340–359.

Kuczyńska-Zonik A. 2014
Gravettian ceramic firing techniques in Central and Eastern Europe. *Analecta Archaeologica Ressoviensia*, vol. 9: 79–88.

Lander M.L. 2005
From Artifact to Icon: An Analysis of the Venus Figurines in Archaeological Literature and Contemporary Culture. Durham: Durham Univ.

Malysheva T.Y. 1969
Petrografiya zhelezorudnogo aglomerata. Moscow: Nauka.

Maniatis Y., Simopoulos A., Kostikas A. 1983
Effect of reducing atmosphere on minerals and iron oxides developed in fired clays: The role of Ca. *Journal of the American Ceramic Society*, vol. 66 (11): 773–781.

Onatsky S.P. 1971
Proizvodstvo keramzita. Moscow: Stroyizdat.

Samofalova I.A. 2009
Khimicheskiy sostav pochv i pochvoobrazuyushchikh porod: Uchebnoye posobiye. Perm: Izd. Perm. Gos. Sel.-Khoz. Akad.

Soffer O., Adavasio J., Ileingworth J., Amirkhanov H., Praslov N., Street V. 2000
Palaeolithic perishables made permanent. *Antiquity*, vol. 74: 812–821.

Soffer O., Vandiver P. 1994
The ceramics. In *Pavlov I: Excavation 1952–1953*. Liege: Univ. of Liege, pp. 163–173. (The Dolni Vestonice Studies; vol. 2).

Soffer O., Vandiver P. 1997
The ceramics from Pavlov I – 1957 excavation. In *Pavlov I – Northwest: The Upper Paleolithic Burial and Settlement Context*. Brno: Inst. of Archaeol., pp. 383–403. (The Dolni Vestonice Studies; vol. 4).

Soffer O., Vandiver P. 2005
Ceramic fragment. In *Pavlov I – Southeast: A Window into the Gravettian Lifestyles*. Brno: Inst. of Archaeol., pp. 415–432. (The Dolni Vestonice Studies; vol. 14).

Tolstikhina K.I. 1963
Prirodnye pigmenty Sovetskogo Soyuza, ikh obogashcheniye i primeneniye. Moscow: Gosgeoltekhizdat.

Tsetlin Y.B. 2000
Zaklyucheniye o nakhodkakh predmetov iz gliny na Zaraiskoi verkhnepaleoliticheskoi stoyanke. In *Amirkhanov H.A. Zarayskaya stoyanka*. Moscow: Nauchnyi mir, pp. 240–243.

Vandiver P. 1997
Pavlov I pigments and their processing. In *Pavlov I – Northwest: The Upper Paleolithic Burial and Settlement Context*. Brno: Inst. of Archaeol., pp. 373–383. (The Dolni Vestonice Studies; vol. 4).

Vandiver P., Vasil'ev S. 2002
A 16,000 year-old ceramic human-figurine from Maina, Russia. In *Materials Issues in Art and Archaeology VI: Symposium Held November 26–30, 2001, Boston, Massachusetts, USA*. Warrendale: Materials Res. Soc., pp. 421–431.

Weinstein-Evron M., Ilani S. 1994
Provenance of ochre in the Natufian layers of El-Wad Cave, Mount Carmel, Israel. *Journal of Archaeological Science*, No. 21: 461–467.

Worrall W.E. 1975
Clays and Ceramic Raw Materials. New York: Wiley.

Yanshina O.V., Garkovik A.V. 2008
O rezultatakh petrograficheskogo issledovaniya drevneishei keramiki Primorya. In *Radlovskiy sbornik: Nauchnye issledovaniya i muzeinye proekty MAE RAN v 2007 g*. St. Petersburg: Izd. MAE RAN, pp. 244–249.

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