УДК *902.004.68*

Vita Antiqua,
№ 10, 2018, p. 165-175

Andrey Mazurkevich[1], Ekaterina Dolbunova[1], Luca Ottonello[2]

Archaeological excavations and reconstructions of disappeared archaeological heritage (based on excavations in North-Western Russia)

Archaeological excavations allow us to investigate archaeological heritage, but at the same time they lead to its destruction. Multi-layer archaeological sites, which were settled during multiple stages of occupation and include several cultural horizons, represent a number of events. Their "decoding" is possible only by application of various methods – archaeological, natural-scientific, as well as the use of virtual modelling. Archaeological excavations allow tracing of different stages of people inhabitation, whereas digital reconstruction gives the possibility to visualize these stages and reconstruct disappeared archaeological heritage, destroyed in the course of people activity during long time. In this case archaeological field documentation, precise recording, further researches and reconstructions based on them are tightly interrelated. Such a combination of methods was applied during researches of Neolithic sites in North-Western Russia, in Dnepr-Dvina region.

Key words: *virtual reconstructions, digital archaeology, North-Western Russia, 3D modelling, archaeological excavations*

Introduction

Archaeological site appears to be a combination of different events which are studied through different destructive and non-destructive methods. Non-destructive methods allow describing archaeological site and its surrounding without penetrating deep into the body of the site. Archaeological excavations allow reconstructing material culture of ancient communities by both analysis of cultural layer and artefacts and getting materials for further natural scientific analysis. However, inevitably they result in a destruction of the part investigated. Big data is another issue – excavations result in a huge amount of data which is to be digitized, including field inventory, data about constructions, plans, information about the analysis taken etc. All of this gives the possibility to "re-excavating" the site and making reconstruction of initial state of the site and different stages of its occupation, based on various proxies. The destruction of archaeological sites due to many reasons (including excavations themselves) has resulted in the increased need for digital techniques to be implemented as a saving mechanism. Combination of different methods gives the potential of preserving and telling the stories in a way that was never possible before; creating time pictures of explorable areas with an unprecedented level of detail by using animation and reconstruction methods, which could finally contribute a lot to interpretation of the sites. Computer-based visualisation seeks to represent the existing state, an evidence-based restoration or a hypothetical reconstruction of a cultural heritage object or site, and the extent and nature of any factual uncertainty (London Charter Initiative, 2009).

Area under investigation

The area under investigation is located in North-Western Russia – in a Dnepr-Dvina basin (fig. 1). The region lies near to the Central Russian Upland, adjacent to the European watershed of three catchments: the Baltic Sea, the Black Sea and the Caspian Sea. The main watercourse of the area is the Western Dvina River, but the main axis of the studied region is Serteyka River, a left tributary of the Western Dvina River about 40 km long.

Paleoecological researches conducted in Serteya microregion allowed making reconstruction of paleoenvironmental conditions (Mazurkevich, 2003; Mazurkevich *et al*., 2009a, 2009b; Dolukhanov *et al.,* 2004; Kulkova *et al.,* 2001; Zaiceva *et al.*, 2003). The three main palaeolake basins with traces of ancient settlements were studied: the Great Serteya Palaeolake Basin, the Rudnia Palaeolake Basin and the Nivniki Palaeolake Basin. The cores of organic deposits were studied in order to enable a palaeoenvironmental reconstruction with the use of pollen, diatom and geochemical analyses.

The archaeological research in the chosen area has been conducted systematically since the 1970s (Dolukhanov and Miklyaev, 1986; Miklyaev *et al*., 1987; Dolukhanov *et al.,* 1989; Mazurkevich, 1995; Mazurkevich and Miklyaev, 1998,

[1] The State Hermitage Museum
[2] University of Reading

Mazurkevich *et al.,* 2009b). Over the last 30 years remains of numerous archaeological sites, mainly Neolithic settlements (Subneolithic (Mazurkevich *et al.,* 2017)), were discovered in the lower course of the Serteyka River Valley and surrounding areas. They date from the Late Palaeolithic up to Middle Ages. The long-standing archaeological research, including underwater surveys, resulted in the documentation of seasonal and permanent Neolithic and also Mesolithic settlements (Kul'kova *et al.,* 2001; Mazurkevich *et al.,* 2009a,b; 2012). The sites are situated both on mineral basement and within organic deposits of biogenic plains formed in the area of a few palaeolake basins. In the latter case, the organic artefacts and ecofacts remained in a very good state of preservation.

Methods

Excavations with precise recording (including 3D recording, photogrammetry application), analysis of artefacts, cappametric surveys (on sandy soils), sampling of materials and further analysis of soils, geochemical, antracological, paleozoological, paleogeological, radiocarbon analysis were acquired before the application of digital techniques. Digitizing and analysis of all the information gained in the course of these analyses allowed making a precise 3D modelling. Two major cases will be represented in this article – reconstruction of a single kurgan near Serteya village and a pile-dwelling Serteya II.

For the reconstructions design program Blender was applied. This is an overall graphic design program, it has the ability to both enable for the user to create objects, texturize them and program animations (Blender 2017). It allows basically any 3D tool function, to sometimes a higher level of flexibility on model-ling, animation, bone rigging, simulation, compositing, video animation and motion tracking, game design and video editing. Python programming language can be used to modify the basic programming of Blender to customise its functions for more personal designs and write personalised tools; which is always included in new versions. The choice of this tool was made on the fact that it is a constantly developing free-ware tool, which makes it the prefect cheap but highly professional tool for a scientific project with low cost impact.

The method used for the reconstruction was based on visualization and interpreting scientific information, using 3D graphics software (Blender). Thus, the excavation environment was built in a virtual reconstruction by hand, adding details and changing them as time passed in the stratigraphical timeline. Once several photograms were created (around 500), a dynamic video using Windows Media Maker, was made, that showed the different transitions in the timeline.

For ancient relief reconstruction Surfer software was applied based on the analysis of excavated areas. Finds distribution was made with the help of Autocad 3D software, which allowed tracing even thin sterile interlayers and particularities of sites organization.

Single kurgan near village Serteya

The site is located on a right shore of the Serteyka River on a sandy part 330 m wide between two post-lake basins, where lakes were located in the Past (fig. 2). Intensive agricultural activity on this place led, probably, to disappearance of most of such kurgans which were located here (according to Shmidt, 1982). Agricultural activity was finished in the beginning of the 1960s and then pine forest grew here.

The kurgan is about 19 m in diameter. Its height is 80 cm above modern surface. The upper part is flat, about 8 m in diameter. Ditch about 1.5 m width and 10 cm depth was traced on the edge of the mound. This site appeared to be a multi-phased site with several events reconstructed based on the results of excavations.

This place was first used during the 6^{th} mill BC. It was one of kame elevations, where usually traces of seasonal sites or flint knapping places dated to early Neolithic (Subneolithic) are recorded. It might have been used several times. More than 6000 flint debris were found here in a low layer, deposited on a natural elevation and in two pits (fig. 3). Also fragments of early Neolithic vessels were found here. Ground layer was formed above this cultural layer, which was recorded as a buried podzolic sod soil. In the middle of the 3^{rd} mill BC (3743±50 (SPb-1194)) this natural elevation was used for kurgan, and a mound 10–11 m in diameter, 0.35 m in height with a flat top platform 8.5 m in diameter was created. Sand was taken around the mound and thus ditch 1.30 m width with a passage in the south-western part appeared (fig. 4). The remains of cremation, consisted of burnt animal bones, were buried here. They were put in some container buried near the passage, on the south-western edge of the mound. Bones were lying densely, 5 cm thick, with a roundish upper part. Traces of dark-green patina were recorded on part of the bones, which appeared to be bronze oxide (determined in the Department of scientific-technical analysis of the State Hermitage museum). Also small fragments of charcoals were found among burnt bones, which appeared to be the only one from the whole site attributed to oak (determination was made by A. Aleksandrovsky). Charcoals of oak found within a cremation allow suggesting that cremation was made in another microregion or in another part (southern) of Serteysky microregion. The area where broad-leaved forests were distributed, might have located six km to the south, where contemporaneous sites were

ISSN 2519-4542

found. Some activity was conducted on the platform traced by the remains of pits, which can be left afterwards or at the same time. Further on soil was formed on the surface of the mound and the forest grew.

Around 3485±80 (SPb-1203) the platform was burnt, and further on covered by sand. It can be clearly traced in stratigraphy by podzolic sod with traces of fire. Spatial distribution of finds made by 3D modelling shows that there was no flint debris traced in a thin ash layer, whereas it was traced in under and above lying layers. During this stage or slightly beforehand fireplaces were made, and burnt spots can be traced on the slopes of the mound and beyond external contour of the ditch. The mound was detaching and the remains of fire-places on its slopes and the ditch were partly buried.

Later on a new conical shape mound was created and the height of the construction became approximately 1.3 m above the surface. Small fireplaces were made in the ditch after the mound was created, traced by red spots of sand. Such lenses were recorded in the northern part; the biggest fireplace was located in the eastern part in the ditch. It is complicated to date precisely this complex. Due to stratigraphical and sedimentological analysis the mound was created after a while when the platform was burnt, as the soil was not formed above this place. Spatial analysis show several horizons of flint artefacts in the mound. It allowed us to suggest that the mound was created within several stages, and the ground was taken from different places, thus gradually destroying cultural layer of early Neolithic site (fig. 5).

Probably, this kurgan could have been used by bearers of Long barrows culture, which is testified by the finds of pottery in the ditch. The upper part of this construction might have been destroyed later on, when at the end of the XIXth c. the mound was burnt (charcoal found here was dated to 120±25 (SPb-1196)), and then upper part was cut, a flat platform was made 8 m in diameter, and ground was put around. Afterwards podzolic soil was formed on the top of this construction.

After all the analysis applied, including precise recording of all the finds (fig. 3), objects, geochemical analysis, geophysical prospections, further virtual reconstructions of all the stages were applied in Blender that concerned visualization of the digitized information, represented by different proxies (see, for ex., fig. 4).

Site Serteya II

Site Serteya II has a rather vast chronology for pile-dwelling settlement, even taking into account a wide period provided by radiocarbon dates, which can evidence both rather long inhabitation of this site and multiple visits of this place (Mazurkevich *et al.*, 2017; Mazurkevich and Dolbunova, 2011; Mazurkevich *et al.*, 2011). The most ancient dwelling is dated to about 2900–2570 mill BC. After this the site could have been uninhabited for some time. Next construction period could be dated to 2570–2330 mill BC. The settlement was the most actively populated during 2470–2270 mill BC. We might suppose that during this time period a small society lived here and constructed successively pile dwellings and/or reconstructed them on the same place. Site Serteya II (period of the dwellings 1/6–3 existence) might have been the only inhabited site in the middle of the 3rd mill BC in the Serteysky archaeological microregion. The remains found on the site are attributed to Zhizhitsa culture which was formed at the turn of the 4th – 3rd mill BC on the basis of different cultural components (Mazurkevich *et al.*, 2017).

More than 200 sq.m. were investigated on the site with several inhabitation areas, including area with skeletons attributed to Middle – Late Neolithic on site Serteya II (fig. 6–9). Dwelling constructions with raised floors were found in 70 m from the top end of the cape. The remains of several constructions were found at the Serteya II site, which became the major point for the reconstruction. The pile-dwellings were situated along the shore, and were joined by pathways (Miklyaev, 1971; Mazurkevich, 1998a). The platforms were encircled by rubbish dumps full of kitchen waste located along one of the short walls and adjacent parts of long walls. There was probably a doorway here. This distribution of overlying dumps from different constructions makes it difficult to determine exactly which finds belong to which construction. These are common platforms that could have joined two synchronous dwellings, as a result of which their dumps were intermixed.

Several building horizons were distinguished in the central part, within dwelling №1, the best preserved. Construction №1 was consisted of rectangular platforms of about seven by 4.5 metres, attached to piles with the aid of ropes (pieces of rope made from bilberry rhizome are often found pressed in the piles) and supported from below by 'horned' piles. The basis of the platform consisted of logs 9 to 12 centimeters in diameter, oriented west-east. Poles five to eight centimeters in diameter were densely laid on the logs in transverse position. Treated piney slabs about six centimeters thick were placed above at right angles to the poles. A layer of moss lay above, strewn with coarse-grained white sand eight centimeters thick. A hearth situated on sand was formed, with big stones laid out in a circle about 53 centimeters in diameter.

Some of the piles were pillars serving as the basis of the walls. These pile-pillars were made of tree trunks eight, nine, ten, 12, 14, 16, 18 and more than 20 centimeters in diameter. The walls could have been made of branches cleaned from lateral branches. A large amount of the latter was found in the cultural layer, generally lying near rows of piles. Pile-pillars large in diameter were installed mainly at the corners of the platform; pairs of pile-pillars smaller in diameter were placed between them along the perimeter. Parts with sandy filling for hearths were strengthened with pile-pillars and supports. Spruce and ash were generally used to make the piles, more rarely pine, elm, maple, oak, willow, birch and poplar (Kolosova *et al.*, 1998). Also, fragments of eaves and slabs with a lateral support for floors, and beams with holes, were found. Several piles are located near dumps forming a semicircular construction that could have been a pen.

Reconstruction of piles distribution (made in Blender) allowed their visualization and more clear representation of modern river and a shoreline position and ancient piles, located partly under water and in a peat-bog (fig. 7). 3D modelling of finds' distribution allowed tracing different levels of occupation within underwater and peat-bog part. Shallow water (up to 2 m) allowed recording by total station of all the finds located both under water and in a peat-bog. Recording of all the finds allowed tracing thin levels of washing away (traced by small eroded pottery fragments) and the process of materials depositing on a part remoted from the major dwelling area.

Conclusion

Methods of digital reconstructions are based on the results of preceding stages of researches, including archaeological excavations with a precise recording, materials analysis, results of geochemical, radiocarbon, paleozoological and paleoenvironmental analysis. From one side, digital reconstructions allowed visualization of the excavated sites establishing connections between archaeologists and society, representing the results of researches for the latter and promoting the preservation of cultural heritage. From another side, digital reconstructions may serve as well as a method of scientific analysis that allows the checking of the proposed reconstructions and interpretations. Analysis made in Dnepr-Dvina area allowed making virtual reconstructions of several sites, tracing particularities of artefacts deposition and cultural layers formation, identifying particularities of paleoenvironmental situation during different periods of time and finally visualization of ancient sites.

References:

Mazurkevich A.N., Dolbunova E.V., Kul'kova M.A., 2012, Dynamics of landscape developing in early-middle Neolithics in Dnepr-Dvina region, in *Geomorphic Processes and Geoarchaeology: from Landscape Archaeology to Archaeotourism*. International conference held in Moscow-Smolensk, Russia, August 20-24, 2012. Moscow-Smolensk: "Universum", 192–194.

Mazurkevich A., Dolbunova E., Zaitseva G., Kulkova M., 2017, Chronological timeframes of cultural changes in the Dnepr-Dvina region (7th to 3rd millennium BC), *Documenta Praehistorica* **XLIV**.

Zaiceva G.I., Vasil'ev S.S., Dergachev V.A., Mazurkevich A.N., Semencov A.A., 2003, Novye issledovaniya pamyatnikov basseina Zapadnoi Dviny i Lovati: raspredelenie radiouglerodnyh dat, korrelyaciya s izmeneniem prirodnyh processov, primenenie matematicheskoi statistiki, in Mazurkevch A. (ed.), *Drevnosti Podvin'ya: istoricheskii aspekt*, 140-154. Saint-Petersburg. (in Russian)

Kul'kova M.A., Mazurkevich A.N., Dolukhanov P.M., 2001, Chronology and palaeoclimate of prehistoric sites in Western Dvina-Lovat area of North-western Russia, *Geochronometria* **20**: 87–94.

Dolukhanov P.M., Miklyayev A.M., 1986, Prehistoric lacustrine pile dwellings in the north-western part of the USSR, *Fennoscandia Archaeologica* **III**: 81–89.

Dolukhanov P.M., Gey N.A., Miklyayev A.M., Mazurkiewicz A.N., 1989, Rudnya-Sertey a, A stratified dwelling-site in the upper Duna basin (a multidisciplinary research), *Fennoscandia Archaeologica* **VI**: 23–27.

Dolukhanov, P. M., Shukurov, A., Arslanov, K., Mazurkevich, A. N., Savel'eva, L. A., Dzinoridze, E. N., Kulkova, M. A. and Zaitseva, G. I., 2004, The Holocene environment and transition to agriculture in Boreal Russia (Serteya Valley case study). *Internet Archaeology* **17**. http://intarch.ac.uk/journal/issue17/dolukhanov_index.html.

Miklyaev A. M., Mazurkevich A. N., Doluhanov P. M., Zaiceva G. I., 1987, O rannem neolite severa Smolenskoi i yuga Pskovskoi oblastei, in Shilov V. P. (ed.), *Zadachi sovetskoi arheologii v svete reshenii XXVII s'ezda KPSS*, 169–170. Moscow. (in Russian).

Miklyaev A.M., 1971, Neoliticheskoe poselenie na Usvjatskom ozere, *Arheologicheskij sbornik Gosudarstvennogo Jermitazha* **13**: 7–29.

Kolosova M. I., Mazurkevich A.N., 1998, Identifikacija derevjannyh predmetov po priznakam anatomicheskogo stroenija drevesiny iz neoliticheskih torfjanikovyh pamjatnikov Lovatsko–Dvinskogo mezhdurech'ja, in *Poselenie, Sreda, Socium,* 52–65. St Petersburg.

Shmidt E.A., 1982, *Drevnerusskie arheologicheskie arheologicheskie pamyatniki Smolenskoi oblasti.* Chast' 1. Moscow. (in Russian).

Андрій Мазуркевич, Катерина Долбунова, Лук Оттонелло

Археологічні розкопки та реконструкції втраченої археологічної спадщини (на основі досліджень в Північно-Західній Росії)

Археологічні розкопки дозволяють досліджувати археологічну спадщину, але в той же час вони призводять до її руйнування. Багатошарові археологічні пам'ятки, які заселялись протягом декількох етапів і включають кілька культурних горизонтів, представляють собою цілий ряд подій. Їхнє «розкодування» можливе тільки шляхом застосування різних методів – археологічних, природничо-наукових, а також шляхом використання віртуального моделювання. Археологічні розкопки дозволяють простежити різні стадії заселення пам'ятки, а цифрова реконструкція дає можливість візуалізувати ці стадії і відтворити зниклу археологічну спадщину, що була втрачена внаслідок тривалої людської діяльності. У цьому випадку археологічна польова документація, ретельна фіксація, подальші дослідження та реконструкції на їхній основі є жорстко взаємопов'язані. Саме така комбінація методів була застосована під час досліджень неолітичних стоянок Дніпровсько-Двінського регіону у Північно-Західній Росії.

Методи цифрової реконструкції базуються на результатах попередніх етапів досліджень, у тому числі археологічних розкопок з точною фіксацією, обробкою отриманих матеріалів, результатів геохімічних, радіовуглецевих, археозоологічних та палеоекологічних аналізів. З одного боку, цифрові реконструкції дозволяють візуалізувати досліджені пам'ятки, що налагоджує зв'язки між представниками археології та громадськістю. Вони демонструють суспільству результати археологічних досліджень та сприяють збереженню культурної спадщини. З іншого боку, цифрові реконструкції являються методом наукового аналізу, який уможливлює перевірку запропонованих реконструкцій та інтерпретацій. Так, проведений аналіз дозволив розробити віртуальні реконструкції декількох об'єктів, відстежити особливості відкладення артефактів та формування культурних шарів, визначити особливості палеоекологічної ситуації протягом різних періодів та, врешті, створити візуалізацію стародавніх пам'яток.

Ключові слова: *віртуальна реконструкція, цифрова археологія, Північно-Західна Росія, 3D моделювання, археологічні розкопки*

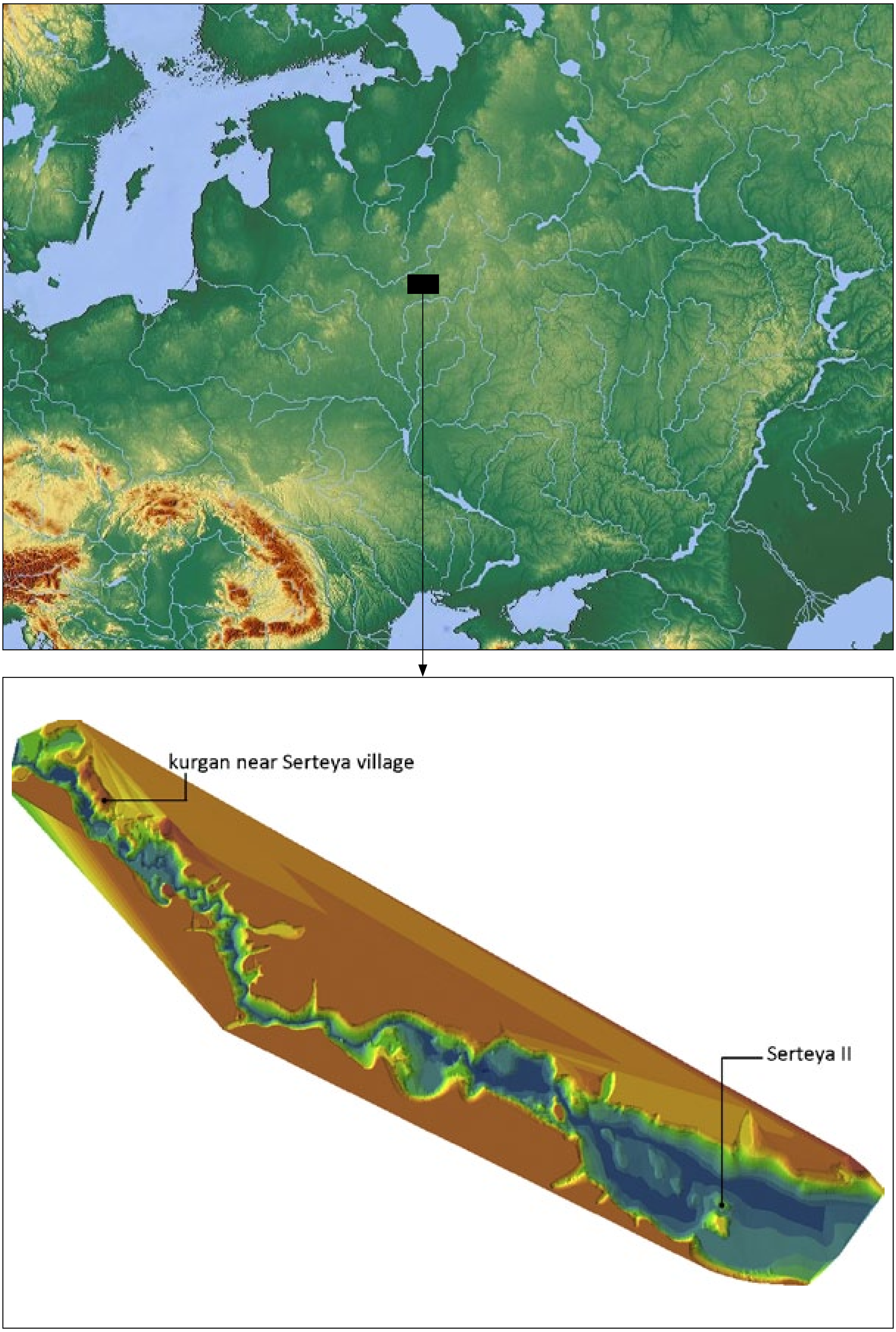

Fig. 1. Dnepr-Dvina region with indication of Serteya II and kurgan near Serteya village position.

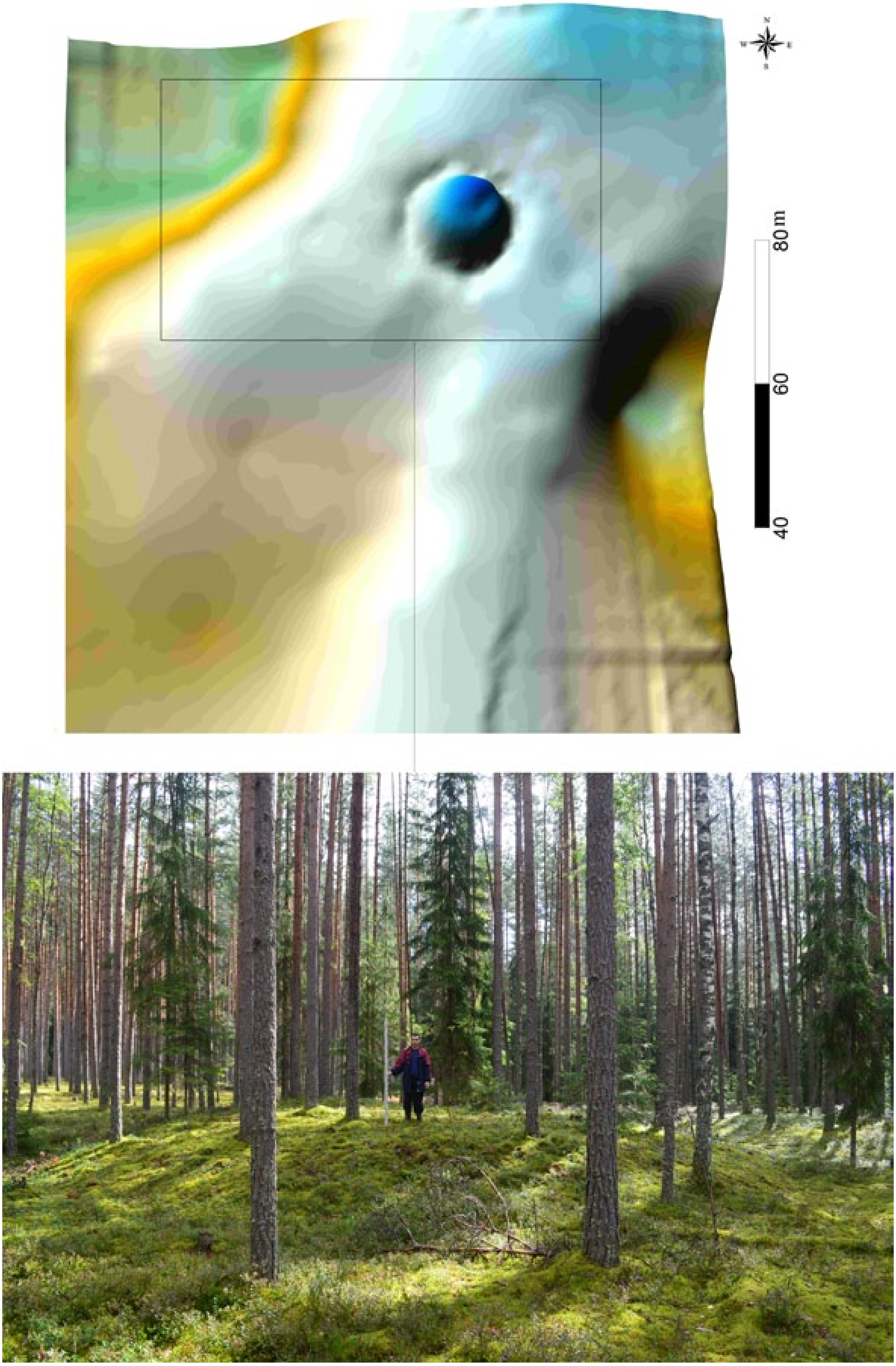

Fig. 2. Single kurgan near Serteya village (view before excavation and surface relief reconstruction).

ISSN 2519-4542

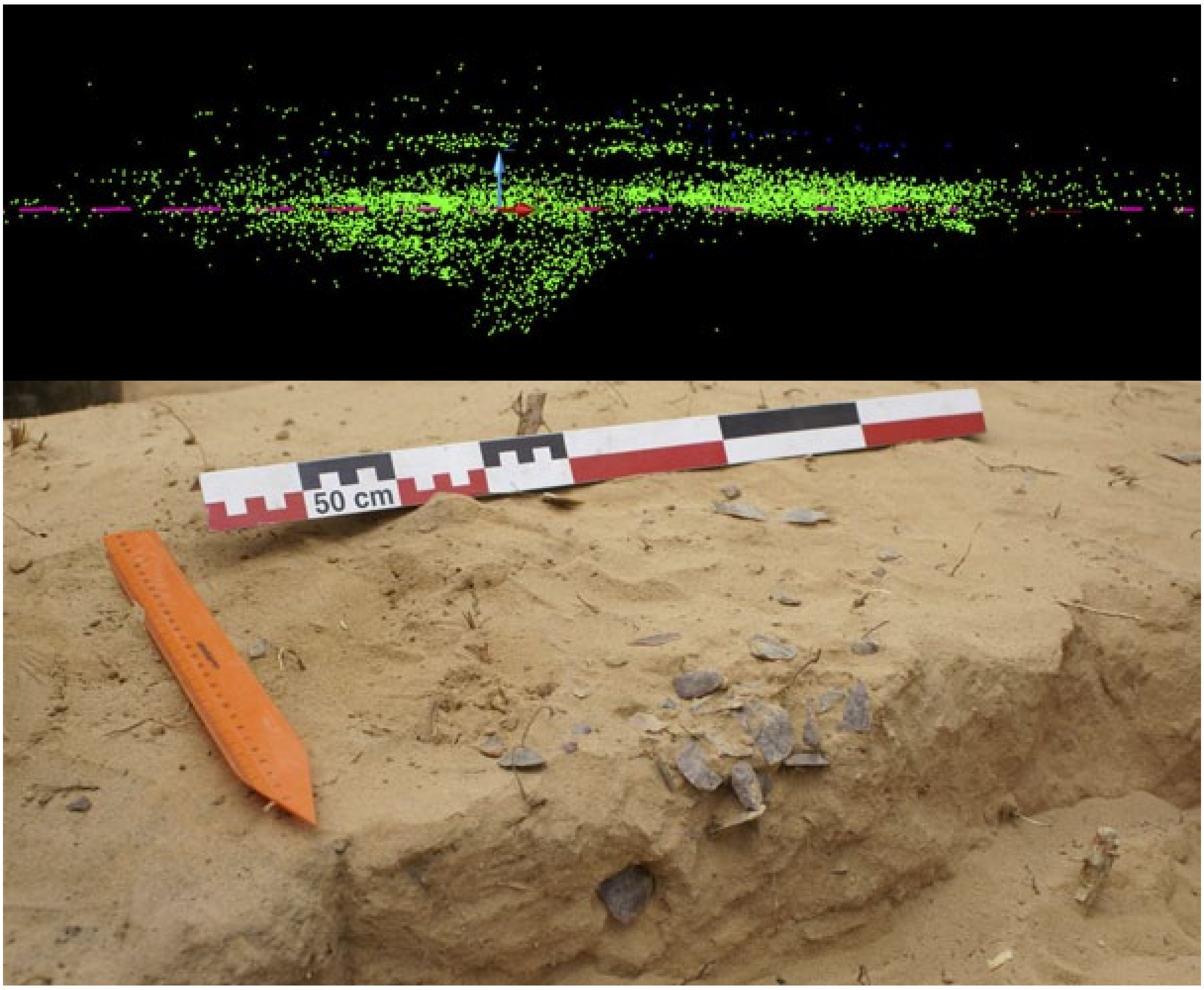

Fig. 3. 3d reconstruction of flint debris distribution (each flint artefacts is marked by a green dot) and view on the site.

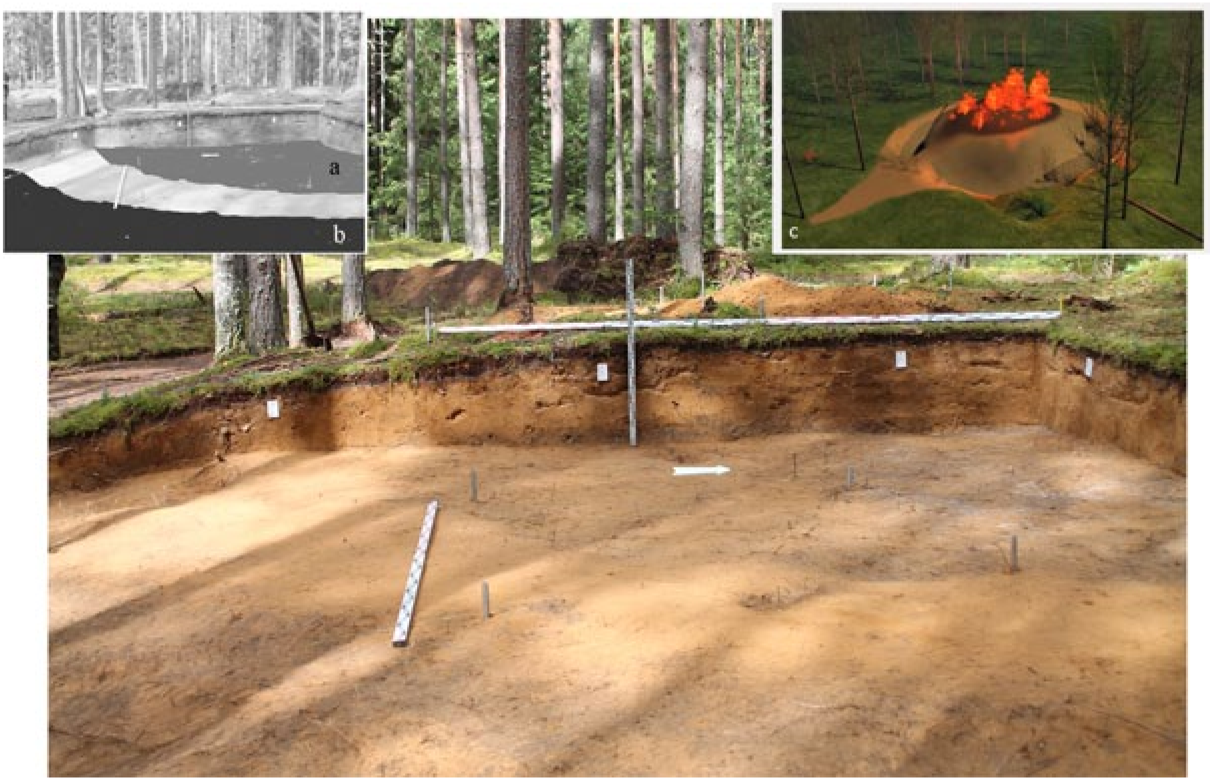

Fig. 4. Platform covered by ash in the central part of the kurgan (first stage of the mound creation – *a*); slopes of the kurgan with traces of fire (stage four – *b*)) and reconstruction of the first stage (*c*).

Fig. 5. Base layer of the kurgan near Serteya village.

Fig. 6. View on the site Serteya II and underwater excavations.

 ISSN 2519-4542

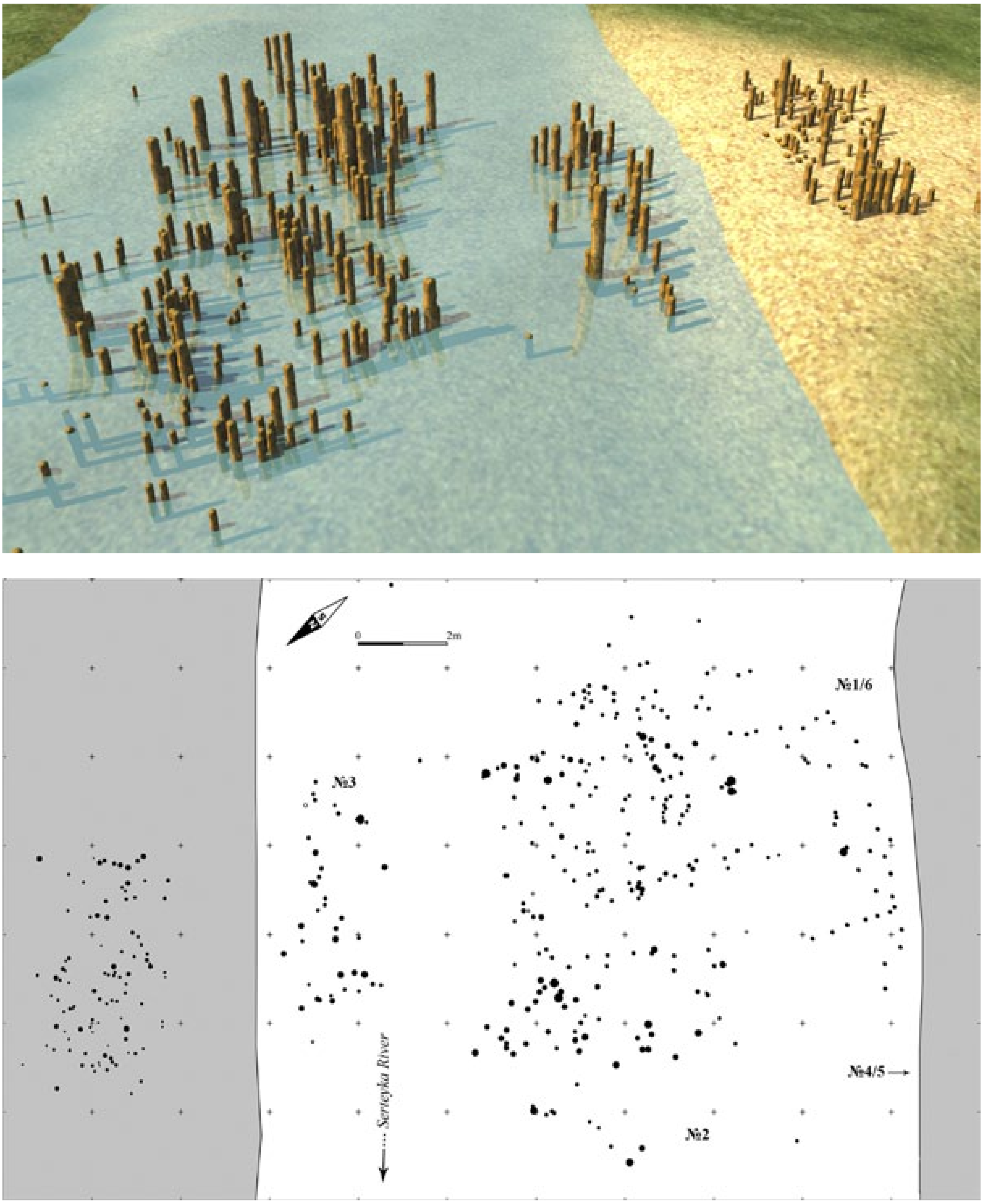

Fig. 7. Plan of constructions and 3d reconstruction of piles distribution.

Fig. 8. Photo of human bones found on the site Serteya II.

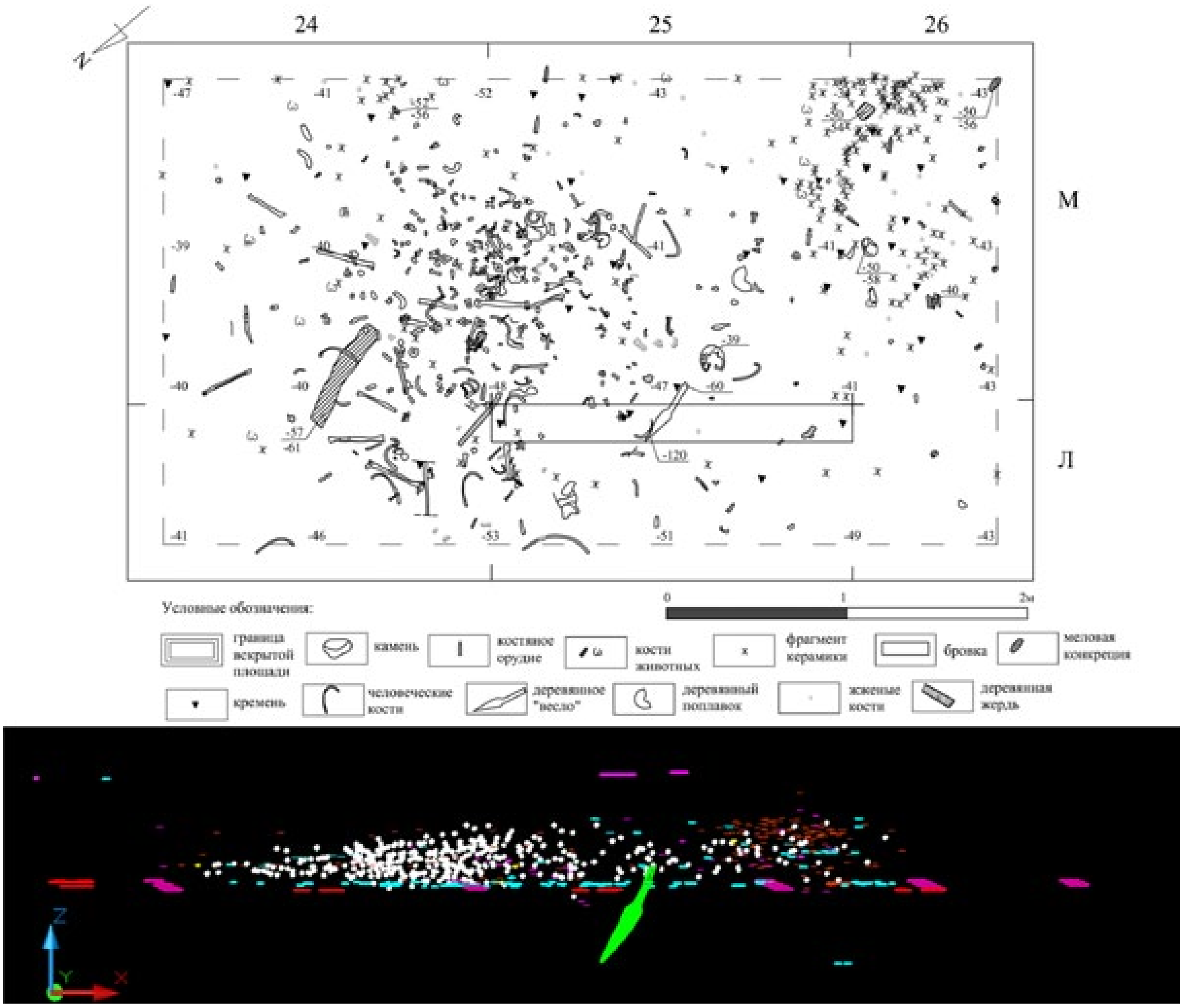

Fig. 9. 3d reconstruction (each human bone is marked by white dot, brown lines – pottery, likes of other colours – flint and bone finds) and plan of human bones and other finds distribution on the site.