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SPATIAL DISTRIBUTION AND PROBLEMS IN THE INTERPRETATION OF RADIOCARBON DATES OF THE SUNGIR SITE, RUSSIA

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ABSTRACT. The Upper Paleolithic open-air site Sungir is located in the central Russian Plain. The blank production of the lithic industry is characterized by parallel reduction with flakes being the main blank type. The tool assemblage has two components: archaic types (Mousterian-like) on the one hand and Upper Paleolithic types on the other. The available data does not allow for a confident determination of the chronological position of the Sungir site, nor does it enable researchers to distinguish different stages of human occupation. The horizontal distribution of the dated samples demonstrates the almost complete absence of radiocarbon (^{14}C) dates for household features identified at the site (fireplaces, fire and ritual pits, large accumulations of bones, etc.). In addition, the vertical distribution of ^{14}C dates in the rather thick cultural layer points to the exposure of the site to solifluction.

KEYWORDS: Aurignacian, Early Upper Paleolithic, radiocarbon chronology, spatial distribution, Streletskian culture, Sungir site.

INTRODUCTION

The Upper Paleolithic open-air site Sungir is located on the central Russian Plain on the high left bank of the Klyazma River (56°11'N, and 40°30'E; see Figure 1; Bader 1978). Sungir was discovered in 1956. For 24 field seasons (1957–2004) an expedition under the leadership of O.N. Bader, N.O. Bader, and L.A. Mikhajlova explored over 4000 square meters of the site area. Some authors define the cultural layer as “cultural soil,” because remains are to a large extent mixed and can be found through the whole depth of the soil. The thickness of the find-bearing layer is up to 1 m (Bader 1978). The archaeological remains consist of stone and bone objects, faunal remains, fireplaces, firepits, and ritual pits. A complicated burial complex with two graves with four burials (six individuals in all) was also found at the site.

The lithic industry is characterized by parallel reduction. The most numerous blanks are flakes. The tool assemblage has two components. The first one has a rather archaic (Mousterian-like) character and consists of side-scrapers, triangular bifacial points with a concave base, and projectile points. The second part of the tool set is from the Upper Paleolithic and includes end-scrapers (single end-scrapers, circular end-scrapers, oval end-scrapers, etc.), burins (truncation burins, straight burins, etc.), punches and *pièces esquillées*, etc. (Bader 1978; Seleznyov 2004). An analogous industry has been discovered at numerous Streletskian culture sites in the middle of Don River. Due to the presence of triangular bifacial points with concave bases, the Sungir site has been classified as a transitional cultural phase of the Early Upper Paleolithic (Bader 1978; Marom et al. 2012: 6879), a hypothesis that sometimes has been underlined by the emphasis that the industry combines elements of the Aurignacian and the Szeletian (Bader 1978; Grigoriev 1990; White 1993).

The fauna of the Sungir site contains numerous remains of reindeer (*Rangifer tarandus*), mammoth (*Mammuthus primigenius*), horse (*Equus caballus* cf. *Taubachensis* Frend), polar fox (*Alopex lagopus*), wolf (*Canis lupus*), and others (Gromov 1966).

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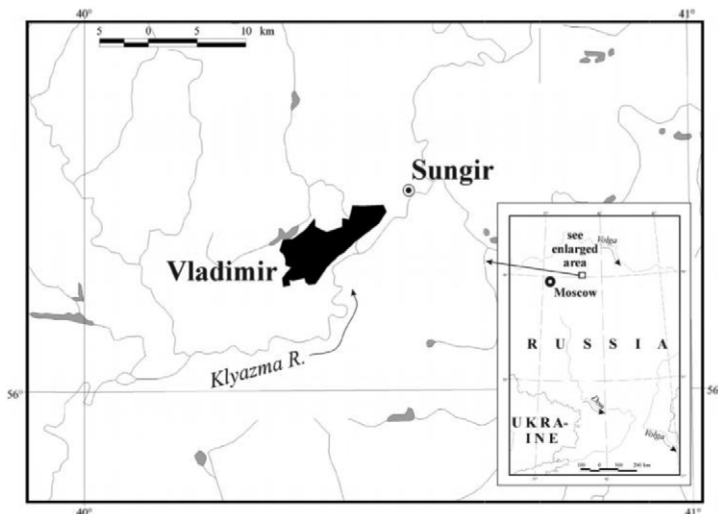


Figure 1 Location of the Sungir site (Kuzmin et al. 2004).

Interpretation of the radiocarbon (^{14}C) dates from Sungir is one of the most debated issues in the discussion of the peculiarities of the site, with consequences for the view of the cultural layer as well as for the establishment of different periods of human occupation there (e.g., Alekseeva and Bader 2000; Dobrovolskaya et al. 2012; Marom et al. 2012; Kuzmin et al. 2014). It has been repeatedly noted that ^{14}C dates on human bones from the famous burials do not correspond well to one other and, at the same time, do not correlate with ^{14}C dates obtained on samples from the cultural layer (e.g. Alekseeva and Bader 2000). There are unresolved questions about the presence of two cultural layers at Sungir as well as the question of the general chronological position of the site. In various publications, Sungir is attributed to the Early or Middle Upper Paleolithic, and some argue that it belongs to the Eastern Gravettian (e.g. Dobrovolskaya et al. 2012; Marom et al. 2012; Soldatova 2017). At the same time, the lithic industry, with its combination of both archaic (Mousterian-like) and Upper Paleolithic tools, as well as the study of the bone, antler, and ivory industry, as conducted by the author of the current article, lead to the conclusion of the possible influence of the Early Aurignacian culture (Bader 1978; Seleznyov 2004; Soldatova 2017).

MATERIAL AND METHODS

The area of Sungir was investigated within the boundaries of three excavation blocks, which have their own grid system. The thickness of the cultural layer varies from 0.5 to 1 m, with a greater thickness noted in the upper parts of the slope (Bader 1998; see Figure 2). In the course studying the statistical data, E.D. Kaverzneva concluded that the “initial” cultural layer was no more than 40 cm thick (Kaverzneva 1985). According to Kaverzneva, the difference between the thickness of the original cultural layer and its current state is associated with the influence of solifluction (Kaverzneva 1985, 2004). On the other hand, in a 1998 publication, the concept of the effect of solifluction on the cultural layer was called into question (Lavrushin and Spiridonova 1998). Instead, Yu.A. Lavrushin and E.A. Spiridonova developed the idea of widespread gravitational processes in the slope area of the Sungir site and concluded that the deformations described before as resulting from solifluction are associated with the lower parts

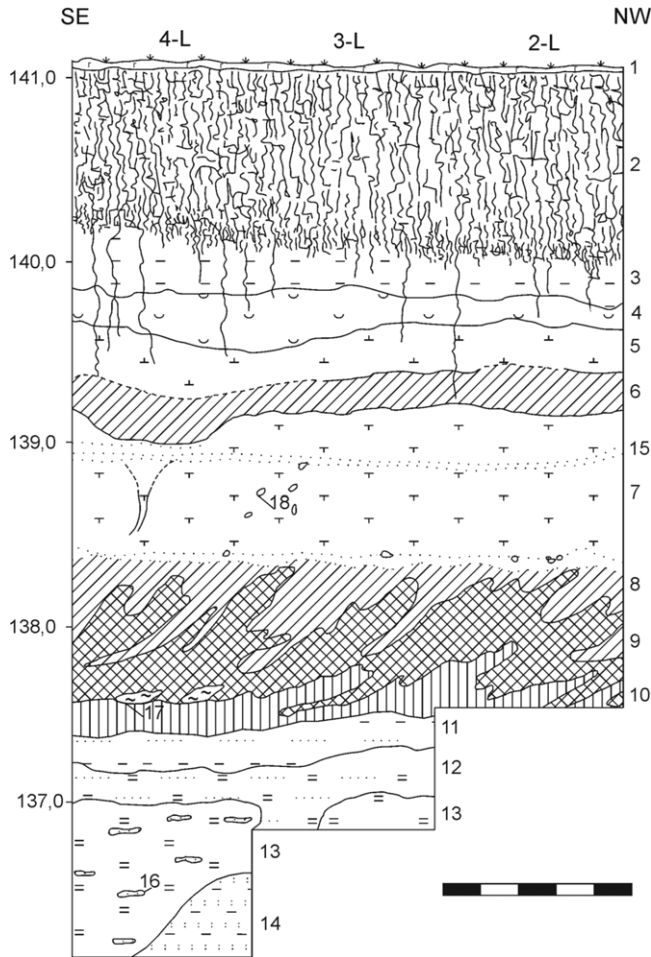


Figure 2 Stratigraphy of the Sungir site (Bader 1998): 1) modern soil; 2) columnar brown loam; 3) bottom of columnar loam denser structure; 4) loam scaly structure with a significant amount of carbonate inclusions; 5) light loam, yellowish; 6) upper buried soil; 7) loam with numerous whitish carbonate and point inclusions of manganese; 8) light-gray humus loam, contains rare cultural remains; 9) dark-gray humus loam contains cultural remains; 10) light loam; 11) clay loam, grayish, with inclusions of manganese; 12) clay loam, bright orange color with a lot of manganese; 13) clay loam, bright, with horizontal stripes, light sand and a lot of manganese; 14) bright red loam; 15) ortsand horizon; 16) carbonate; 17) varved clay; 18) sandy clay.

of landslide blocks, not with solifluction processes (Lavrushin and Spiridonova 1998: 196). It should be noted that the analysis of the original collection of Sungir by T. Soldatova showed that the objects have no signs of rounding or movement, which speaks for the absence of strong solifluction activities in the zone where bone, antler, and ivory artifacts occur (Soldatova 2017).

Other problems derive from the excavation method applied by O.N. Bader (1978), who was not only confronted with a problem that is was impossible to fix—the paleosurface of the find-bearing layer—but at the same had to find a way to cope with the thickness of the

latter. He decided to subdivide the cultural layer during the field research into arbitrary levels. The levels were counted from a zero-line determined by the level of the first occurrence of finds within the layer. The thickness of the arbitrary levels depended on the frequency of cultural remains and averaged between 15 and 20 cm, but sometimes arbitrary levels of 5–10 cm were excavated separately (Bader 1978).

Although O.N. Bader notes that the level of first stratigraphical appearance of material culture and fauna “was on average about 20 cm above the visually definable, well-defined fossil soil horizon” (Bader 1978: 25, 61; translation by the author), the level of the soil itself would have varied throughout the entire excavation area. Thus, it is not possible to establish the exact depth of the finds. Consequently, the stratigraphic analysis is only possible by using the arbitrary levels in which certain items were excavated. In addition, the correlation of arbitrary levels between different excavation blocks is hampered by the fact that they start at different zero-lines, the latter resulting from the depth of the first occurrence of archaeological remains. Furthermore, it is impossible to fully analyze the the spatial distribution. Although the locations of particular finds in a specific area of each square were documented during the excavations, not all plans of each excavation block are available in the field reports of O.N. Bader stored the Archive of the Institute of Archaeology Russian Academy of Sciences.

In excavation block No. I, arbitrary levels were not always distinguished (Bader 1978: 25). Moreover, excavation block No. I was located in an area that was dug up in the course of the development of a brick plant’s quarry “by several longitudinal faces for the entire length of the quarry to a depth of 4 m,” which partially disturbed the cultural layer (Bader 1978: 10; translation by the author). In this regard, the arbitrary levels of this excavation block cannot be correlated with the levels of other excavation blocks. Due to the aforementioned reasons, the material from excavations of block No. I was not used in the original consideration of the stratigraphy of Sungir (Bader 1978; Kaverzneva 1985, 2004).

Notwithstanding the aforementioned shortcomings, O.N. Bader (1978) combined all finds from each excavation block into a single system of arbitrary levels. Due to the large size of the excavated area, it is—for the moment—not possible to solve this problem, and it is questionable if any long-term project would be able to do so. Therefore, the present article uses the (overall problematic) state of the art, which is the three-dimensional fixation of archaeological remains within the excavation cubatur. It follows that conclusions based on the stratigraphical information at hand must be treated with caution, especially when it comes to large-scale interpretations.

¹⁴C dates on animal bones and charcoal were produced from the cultural layer of Sungir (Sulerzhitsky et al. 2000). The direct AMS ¹⁴C dates were published by Pettitt and Bader (2000), followed by Kuzmin et al. (2004), and more recently by Marom et al. (2012) and Dobrovolskaya et al. (2012) (Kuzmin et al. 2014: 451). Thirty-four ¹⁴C dates on the mammal bones—mammoth, horse, and reindeer—were obtained from the Sungir cultural layer. Twenty ¹⁴C dates came from human bones from the Sungir burials, and four ¹⁴C dates stemmed from charcoal sampled from the cultural layer and human burials (one sample each) and the soil (two samples). Samples were dated by several laboratories: the Geological Institute of the Russian Academy of Sciences (lab code GIN), the University of Arizona (lab code AA), the University of Groningen (lab code GrA), the University of Oxford (lab codes OxA, OX), and University of Kiel (lab code KIA).

It is also necessary to note the dearth of the archival data linked to the ^{14}C samples. Of the 60 ^{14}C dates available, 20 were obtained on the samples from the human burials. Thirty-three dates come from the cultural layer and were measured in the laboratory of the Geological Institute of the Russian Academy of Sciences, Moscow. Of these, only 16 ^{14}C dates are clearly linked to a specific excavation unit (square). For four additional ^{14}C dates, it was possible for the author of the present article to identify their origin after consulting the field reports of O.N. Bader. For five ^{14}C dates, which were measured during an experimental phase when the laboratory was established, no information exists except that the samples came from the Sungir site. In the remaining eight cases, the number of the square is not clearly indicated. Recent investigations of the available data in the logbook of the Geological Institute by the current author allowed for the correction of some information given in the publication by L.D. Sulerzhitsky (Aleksieva and Bader 2000), who partly analyzed the location of the samples dated in the laboratory of the Geological Institute of the Russian Academy of Sciences. For example, in two cases, Sulerzhitsky did not publish the excavated square, although it is recorded in the logbook (GIN-9591 and GIN-9027). In the same publication, date GIN-9030 was reported to come from excavation block No. III. However, according to the field reports, this excavation block was not excavated in the area indicated (164-6). In these cases, it is logical to assume that the information from the logbook is more reliable because it is more detailed and precise than the information given in the publication. Vice versa, for dates taken from horse bones, the information published by L.D. Sulerzhitsky seems to be more reliable. In this case, the publication lists seven different squares for the seven horse bones ^{14}C -dated, whereas only one square was noted for all these samples in the logbook. However, since these results may be a weighted average of specimens of different ages, the author does not consider it appropriate to use them in the spatial analysis of the distribution of ^{14}C dates.

Also noteworthy is the discrepancy between the depths of the majority of the samples and one sample with a date of $27,460 \pm 310$ BP (OxA-9039). While the counting of the depths of the arbitrary levels usually began with the appearance of the first finds (Bader 1978), sample OxA-9039 was obtained during the 1995 excavation, also conducted by N.O. Bader but this time using modern excavation methods. Thus, this sample has a three-dimensional control point, whereas the rest of the samples discussed here, as a whole, are referenced by arbitrary levels without exact depth.

Unfortunately, detailed archive data on the remaining seven dates, which were obtained in laboratories other than the one in Moscow, were not available to the author. Thus, the presented spatial analysis is based on the distribution of 22 ^{14}C dates. Information about the relative depth of a particular sample is indicated in 13 cases. In this regard, a number of the following assumptions should be understood to be a hypothesis based on the available archival data.

RESULTS AND DISCUSSION

All the direct ^{14}C values published to date from the Sungir site are summarized in Table 1. The author calibrated the dates of the cultural layer using the IntCal09 data set (Reimer et al. 2009) and CalPal software (Weninger and Jöris 2008).

All in all, ^{14}C values range between ~14,000 and 30,000 BP. There are 40 ^{14}C dates from the cultural layer of the Sungir site run on animal bones, charcoal, and soil, and 20 dates on human bones from the burials.

Table 1 Results of ¹⁴C dating from the Sungir site.

Material	¹⁴ C date (BP)	Lab code	Calendar age, cal BP ¹	Location	Reference
Bone, cultural layer	14,600 ± 600	GIN-14	17,782 ± 657	—	Bader 1978: 64
Soil underlying the cultural layer	16,200 ± 400	GIN-15	19,477 ± 517	—	Bader 1978: 64
C 1, vertebra fragments	19,160 ± 270	AA-36473	22,967 ± 358	—	Sulerzhitsky et al. 2000: 32
Charcoal interlayer	19,780 ± 80	LE-1058	23,663 ± 933	—	Bader 1978: 64
Mammoth, femur	20,360 ± 900	GIN-9585	24,427 ± 1,142	Ex. block I, 154-a	Sulerzhitsky et al. 2000: 30
Soil	20,540 ± 120	GIN-16	24,499 ± 300	—	Bader 1978: 64
C 1, vertebra	21,310+240/–250	GrA-21513	25,475 ± 406	—	Kuzmin et al. 2004: 454
Charcoal from the floor of the burial / charcoal from the hearth / charcoal from the cultural layer	21,800 ± 1000	GIN-326a	26,203 ± 1,284	—	Sulerzhitsky et al. 2000: 32 / Sinitsyn and Praslov 1997: 60 / Bader 1978: 64
Charcoal from the floor of the burial / charcoal from the hearth / charcoal from the cultural layer	22,500 ± 600	GIN-3266	26,970 ± 823	—	Sulerzhitsky et al. 2000: 32 / Sinitsyn and Praslov 1997: 60 / Bader 1978: 64
Mammoth	22,700 ± 600	GIN-10887	27,157 ± 809	—	Sulerzhitsky 2004: 111
C 1, tibia fragments	22,930 ± 200	OxA-9036	27,530 ± 442	—	Sulerzhitsky et al. 2000: 32
Mammoth, radial fragment	23,600 ± 500	GIN-8998	28,510 ± 651	Ex. block I, arb. level 3, 164-m	Sulerzhitsky et al. 2000: 30
C 2, tibia fragments	23,830 ± 220	OxA-9037	28,737 ± 423	—	Sulerzhitsky et al. 2000: 32
C 3, tibia fragments	24,100 ± 240	OxA-9038	28,912 ± 427	—	Sulerzhitsky et al. 2000: 32
C 3, rib	24,170+120/–130	GrA-28182	28,947 ± 392	—	Kuzmin et al. 2004: 454
Deer	24,430 ± 400	Gro-5446 / GrN-5446	29,225 ± 596	—	Bader 1978: 64 / Sinitsyn and Praslov 1997: 60
C 3, right tibia	24,830 ± 110	OxA-15754	29,859 ± 302	—	Marom et al. 2012: 2
C 2, right tibia	25,020 ± 120	OxA-15753	29,989 ± 257	—	Marom et al. 2012: 2
C 3, right tibia	25,430 ± 160	OxA-15751	30,276 ± 318	—	Marom et al. 2012: 2
Charcoal from the cultural layer	25,500 ± 200	Gro-5425 / GrN-5425	30,416 ± 404	—	Bader 1978: 64 / Sinitsyn and Praslov 1997: 60

(Continued)

Table 1 (Continued)

Material	¹⁴ C date (BP)	Lab code	Calendar age, cal BP ¹	Location	Reference
Horse, 7 fragments	25,740 ± 600	GIN-9001	30,654 ± 657	102-103-т; 165, 165, 166, 166, 163-х-ф-у, 163-х-ф-ц / Ex. block II, arb. level 3, 150-д	Sulerzhitsky et al. 2000: 30 / Logs records of analyzes
C 3, humerus	26,000 ± 410	KIA-27007	30,951 ± 440	—	Dobrovolskaya et al. 2012: 100
Mammoth	26,100 ± 1000	GIN-10886	30,793 ± 902	Ex. block II, arb. level 2, 164-уц	Sulerzhitsky 2004: 111
C 2, tibia	26,190 ± 120	GrA-34760	31,076 ± 338	—	Kuzmin et al. 2004: 454
C 3, rib fragments	26,190 ± 640	AA-36476	31,010 ± 556	—	Sulerzhitsky et al. 2000: 32
C 2, left ribs	26,200 ± 640	AA-36475	31,016 ± 555	—	Sulerzhitsky et al. 2000: 32
C 1, vertebra	26,300+220/-230	GrA-21507	31,132 ± 368	—	Kuzmin et al. 2004: 454
Mammoth, femur	26,300 ± 260	GIN-8995	31,128 ± 380	Ex. block III, arb. level 3, 142-a	Sulerzhitsky et al. 2000: 30
Horse, 5 fragments	26,300 ± 300	GIN-9034	31,125 ± 392	Ex. block III, 166-ж; 151-з; 158-к; 158; 138-л / Ex. block III, arb. level 3, 158-к	Sulerzhitsky et al. 2000: 30 / Logs records of analyzes
Mammoth, femur	26,600 ± 300	GIN-9030	31,302 ± 398	Ex. block I, arb. level 1, 164-б	Sulerzhitsky et al. 2000: 30
Deer, vertebra	26,900 ± 260	GIN-9035	31,647 ± 234	Ex. block III, 147-м	Sulerzhitsky et al. 2000: 30
Mammoth, tubular bone	27,000 ± 320	GIN-9591	31,713 ± 256	Ex. block I, 152-б	Sulerzhitsky et al. 2000: 30
C 1, femur	27,050 ± 210	KIA-27006	31,790 ± 164	—	Dobrovolskaya et al. 2012: 100
Mammoth, ulna	27,200 ± 400	GIN-9027	31,906 ± 310	Ex. block I, 157-с	Sulerzhitsky et al. 2000: 30
Mammoth, femur	27,200 ± 500	GIN-9586	31,901 ± 435	Ex. block III, arb. level 3, 157-с	Sulerzhitsky et al. 2000: 30
Mammoth	27,200 ± 700	GIN-10885	31,862 ± 696	Ex. block II, 169-с	Sulerzhitsky 2004: 111

Table 1 (Continued)

Material	¹⁴ C date (BP)	Lab code	Calendar age, cal BP ¹	Location	Reference
C 2, right ribs	27,210 ± 710	AA-36474	31,874 ± 705	—	Sulerzhitsky et al. 2000: 32
Deer, vertebra	27,260 ± 500	GIN-9036	31,982 ± 432	Ex. block II, line B-ж	Sulerzhitsky et al. 2000: 30
Horse, 6 fragments	27,400 ± 400	GIN-9033	32,134 ± 532	Ex. block II, 132-п; 159-160-с-т; 147-п / Ex. block I, 127-а; 147-с-т	Sulerzhitsky et al. 2000: 30 / Logs records of analyzes
Mammoth, tubular bone	27,460 ± 310	OxA-9039	32,123 ± 292	Ex. block III, arb. level 4, depth 137,3 cm, 162-с	Sulerzhitsky et al. 2000: 30
Mammoth, femur	27,630 ± 280	GIN-9031	32,251 ± 316	Ex. block III, arb. level 2, 118-г	Sulerzhitsky et al. 2000: 30
Mammoth, humerus	27,700 ± 500	GIN-5880	32,369 ± 453	—	Sinitsyn and Praslov 1997: 60
Mammoth	27,700 ± 600	GIN-10888	32,393 ± 524	Ex. block I, 152-б	Sulerzhitsky 2004: 111
Mammoth, vertebra	27,800 ± 600	GIN-9588	32,469 ± 531	Ex. block I, 109-В	Sulerzhitsky et al. 2000: 30
Mammoth, femur	28,000 ± 250	GIN-8997	32,498 ± 335	Ex. block I, 151-п	Sulerzhitsky et al. 2000: 30
Mammoth, femur	28,000 ± 300	GIN-9029	32,510 ± 360	Ex. block I, arb. level 2, 159-а	Sulerzhitsky et al. 2000: 30
Mammoth, humerus	28,120 ± 170	GIN-8999	32,568 ± 309	Ex. block III, depth 33-62 cm, 150-д	Sulerzhitsky et al. 2000: 30
Mammoth, femur	28,130 ± 370	GIN-8996	32,625 ± 414	Ex. block I, 132-133-п	Sulerzhitsky et al. 2000: 30
Mammoth	28,200 ± 800	GIN-10883	32,824 ± 728	—	Sulerzhitsky 2004: 111
Mammoth, femur	28,350 ± 200	GIN-9032	32,752 ± 348	Ex. block I, arb. level 1, 170-пс	Sulerzhitsky et al. 2000: 30
Mammoth	28,600 ± 600	GIN-10884	33,072 ± 645	Ex. block III, arb. level 1, 132-г	Sulerzhitsky 2004: 111

(Continued)

Table 1 (Continued)

Material	¹⁴ C date (BP)	Lab code	Calendar age, cal BP ¹	Location	Reference
Mammoth	28,700 ± 1000	GIN-10889	33,133 ± 845	Ex. block II, arb. level 3, 161-н	Sulerzhitsky 2004: 111
Mammoth, ulna	28,800 ± 240	GIN-9028	33,384 ± 388	Ex. block II, arb. level 2, 144-п	Sulerzhitsky et al. 2000: 30
C 1	28,890 ± 430	OxA-X-2464-12	33,326 ± 518	—	Nalawade-Chavan et al. 2013: 4
Mammoth	29,450 ± 180	OxA-15755	33,819 ± 308	—	Marom et al. 2012: 2
Mammoth	29,640 ± 180	OxA-15752	33,973 ± 271	—	Marom et al. 2012: 2
C 4	29,820 ± 280	OxA-X-2462-52	34,082 ± 282	—	Nalawade-Chavan et al. 2013: 4
C 3, right tibia	30,000 ± 550	OxX-2395-7	34,166 ± 488	—	Marom et al. 2012: 2
Mammoth	30,100 ± 400	OxX-2395-8	34,300 ± 311	—	Marom et al. 2012: 2
C 2, right tibia	30,100 ± 550	OxX-2395-6	34,294 ± 493	—	Marom et al. 2012: 2

¹Calibrated using the IntCal09 data set (Reimer et al. 2009) and CalPal software (Weninger and Jöris 2008); -2σ , with all possible intervals rounded to the next 10 yr and combined.

It must be mentioned that the youngest ^{14}C values up to 20,000 BP were obtained in the laboratory of the Geological Institute of the USSR Academy of Sciences when the ^{14}C dating method was in an early stage of development. This has also been clearly stated by O.N. Bader (1978), who interpreted these dates as too young.

^{14}C samples of tibiae found in the human burials S 1, S 2, and S 3 were measured at the University of Oxford and range from $22,930 \pm 200$ BP (OxA-9036) to $24,100 \pm 240$ BP (OxA-9038). These dates contradict ^{14}C dates obtained by the ^{14}C laboratory of the University of Arizona on rib fragments from the same burials, which fall into a range from $19,160 \pm 270$ BP (AA-36473) to $26,200 \pm 640$ BP (AA-36475; Alekseeva and Bader 2000). These ^{14}C dates have no correlation with each other; at the same time ^{14}C dates $22,930 \pm 200$ BP (OxA-9036) and $19,160 \pm 270$ BP (AA-36473) contradict most of the cultural layer dates (Alekseeva and Bader 2000). It was noted by Kuzmin et al. (2004, 2014) that there was a substantial discrepancy in the results and that a reanalysis was needed. AMS ^{14}C measurements of the S 1 individual on a sample from the femur and of the S 3 individual's on a humerus were conducted in the Leibniz Laboratory at the Christian-Albrecht-University of Kiel, Germany. The dates are $27,050 \pm 210$ BP (KIA-27006) and $26,000 \pm 410$ BP (KIA-27007), respectively (Dobrovolskaya et al. 2012).

Because results obtained for the human burials by the Oxford, Arizona, and Kiel labs were “highly inconsistent, both between the laboratories and between the different individuals dated,” there was an attempt to carry out the analysis using the AMS hydroxyproline dating method (Marom et al. 2012: 6879). The results obtained from samples from the double burial (S 2, S 3) and a mammoth bone found in the cultural layer were published in 2012: $30,100 \pm 550$ BP (S 2, OxX-2395-6), $30,000 \pm 550$ BP (S 3, OxX-2395-7), and $30,100 \pm 400$ BP (mammoth bone, OxX-2395-8), respectively (Marom et al. 2012). The AMS dates are in good agreement to each other, and according to the authors of the study, reflect the actual age of the investigated burials (Marom et al. 2012). In 2013, additional AMS hydroxyproline dates for the burials S 1 and S 4, measured in the Oxford laboratory, were published: $28,890 \pm 430$ BP (OxA-X-2464-12) and $29,820 \pm 280$ BP (OxA-X-2462-52), respectively (Nalawade-Chavan et al. 2013). Although Nalawade-Chavan et al. (2013) emphasize that the specimens have traces of impurity resulting from museum conservation, they still conclude that the results, if compared to the results published in 2012, are reliable (Nalawade-Chavan et al. 2013: 5).

Therefore, the rather reliable AMS hydroxyproline dates for S 1, S 2, S 3, S 4 and of the mammoth bone indicate that the samples' ages are approximately between 28,000 and 30,000 BP (or 31,000 and 34,000 cal BP).

There are three ^{14}C values from horse bones: $25,740 \pm 600$ BP (GIN-9001), $26,300 \pm 300$ BP (GIN-9034), and $27,400 \pm 400$ BP (GIN-9033). It is not clear how far the single specimens of bulk samples were measured here, so the results may be a weighted average of specimens of different ages (Alekseeva and Bader 2000: 30). Moreover, the sample for the date of $25,740 \pm 600$ BP (GIN-9001) was taken from a mixed layer and is not connected with archaeological complexes (Alekseeva and Bader 2000: 34).

In contrast to the new dates on human bones, but comparable to the horse remains dates, the 27 ^{14}C dates on mammoth bones, which range from 20,360 to 30,100 BP, also raise questions with regard to their reliability. It is known that prehistoric hunter-gatherers used bone as fuel to run fireplaces and raw material for tool production as well as the construction of dwellings,

obtaining them not only from hunting but also from gathering fossil bones (e.g. Kuzmin et al. 2001). Therefore, the dates on mammoth bones found at Sungir may indicate the death of the animal, but do not necessarily correlate with the age of human activities at the site (e.g., Sulerzhitskiy 2004).

There are three ^{14}C values run on reindeer bone, which date to $24,430 \pm 400$ BP (GrN-5446), $26,900 \pm 260$ BP (GIN-9035), and $27,260 \pm 500$ BP (GIN-9036). They appear to be directly connected with human activities and therefore more accurate than the other dates on animal bones, as most of the faunal remains at Sungir come from reindeer (Gromov 1966; Alexeeva 1998). V.I. Gromov underlines that “The debris [of reindeer; comment by the author] contains skull fragments and all bones of the postcranial skeleton.” He also states that “Many bones have traces of manmade splitting for brain extraction” (Gromov 1966: 78; translation by the author). In addition, reindeer antler was used extensively for tool production. In sum, 28 items or 16% of all hard organic raw material tools found in the cultural layer were made of antler (Soldatova 2014). Therefore, in the author’s opinion, ^{14}C ages of the reindeer bones are fairly reliable. The calendar age range for those bones falls between $\sim 29,000$ and $31,000$ cal BP.

Four ^{14}C dates were obtained from charcoal samples: $19,780 \pm 80$ BP (LE-1058), $21,800 \pm 1000$ BP (GIN-326a), $22,500 \pm 600$ BP (GIN-326b), and $25,500 \pm 200$ BP (GrN-5425). The first, $19,780 \pm 80$ BP, was measured in a laboratory at the Leningrad department of the Institute of Archaeology of the USSR Academy of Sciences, and, in O.N. Bader’s opinion, did not prove to be accurate (Bader 1978: 65). The charcoal material for the other two results is equally unclear because the exact provenience is uncertain. Due to the information available, the samples were either taken from the cultural layer, a hearth, or the floor of the burial (Bader 1978: 64; Sinitsyn and Praslov 1997: 60; Sulerzhitskiy et al. 2000: 32). With regard to dates on charcoal, it appears that only the date of $25,500 \pm 200$ BP (GrN-5425) ^{14}C is reliable.

In the course of the current study, the author analyzed the spatial distribution of ^{14}C -dated samples from animal bones. The spatial distribution of the dated samples is shown in Figure 3. All in all, spatial information was available for 22 samples: 21 samples on mammoth bones and one sample on a deer bone. Apart from the fact that the presence of mammoth remains at the site might go back to the gathering of fossil bones, one can say that the results so far for ^{14}C dating at Sungir essentially do not correlate with evident structures, e.g. fireplaces, fire and ritual pits, large accumulations of bones, etc.

Excavation block No. I is the best dated. In sum, 11 ^{14}C dates were obtained from samples from the cultural layer. At the same time, this area is relatively poor in finds (Bader 1978; Soldatova 2012). The main array of dates covers the period from $26,600 \pm 300$ to $28,350 \pm 200$ BP. Two dates show a younger age of $20,360 \pm 900$ and $23,600 \pm 500$ BP. In contrast to excavation block No. I, excavation block No. II has only four ^{14}C dates (without considering the results of dating burials), which fall in a range between $25,740 \pm 600$ and $28,800 \pm 240$ BP. Finally, excavation block No. III has seven ^{14}C dates, which cover a period from $26,300 \pm 260$ to $28,600 \pm 600$ BP.

As far as the vertical distribution of the ^{14}C -dated samples is concerned, the available data suggests that most of the samples came from arbitrary levels 1 to 3, which correspond to a depth of about 20 to 60 cm “from the beginning of the finds” (Bader 1978). It should be noted that arbitrary levels below this level were also rich in archaeological finds (Bader 1978; Soldatova 2012). Therefore, it must be assumed that the results of the ^{14}C dating in

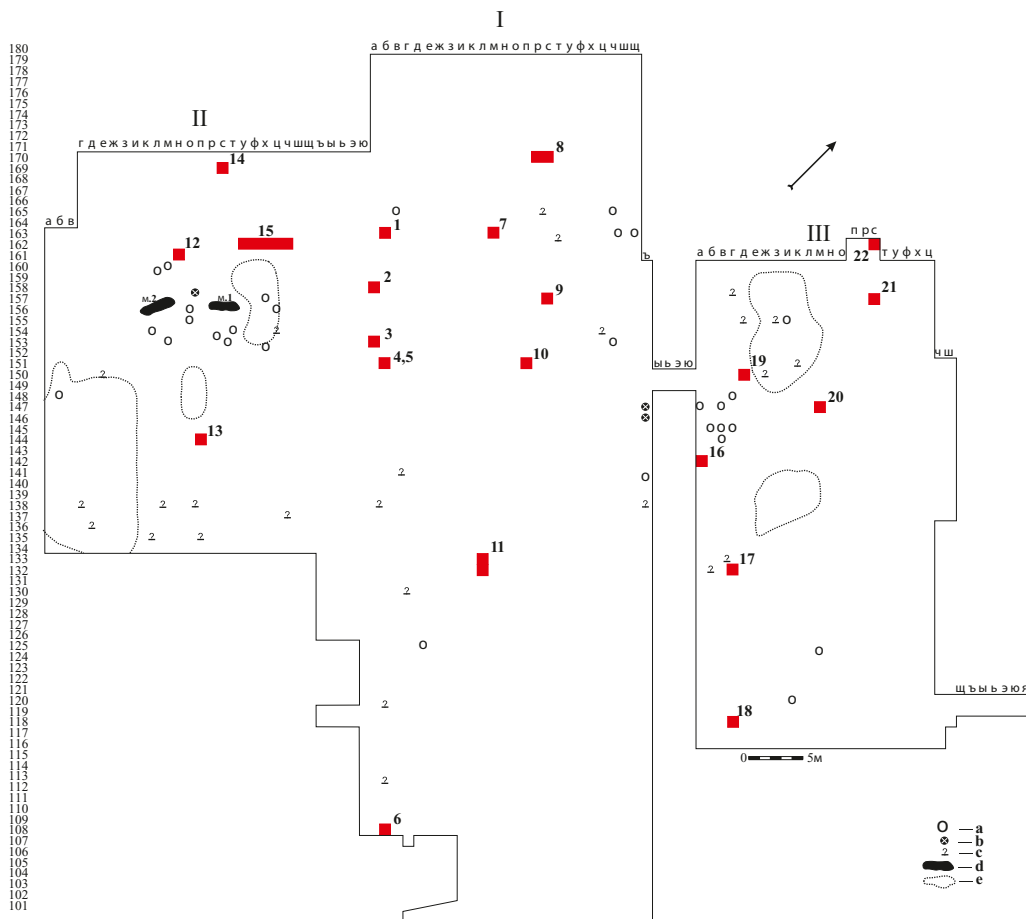


Figure 3 Spatial distribution of the samples of ¹⁴C dating. a) firepit; b) ritual pit; c) fireplaces; d) grave; e) large accumulations of bones. Excavation block No. I: 1) 26,600 ± 300 BP (GIN-9030); 2) 28,000 ± 300 BP (GIN-9029); 3) 20,360 ± 900 BP (GIN-9585); 4) 27,000 ± 320 BP (GIN-9591); 5) 27,700 ± 600 BP (GIN-10888); 6) 27,800 ± 600 BP (GIN-9588); 7) 23,600 ± 500 BP (GIN-8998); 8) 28,350 ± 200 BP (GIN-9032); 9) 27,200 ± 400 BP (GIN-9027); 10) 28,000 ± 250 BP (GIN-8997); 11) 28,130 ± 370 BP (GIN-8996); excavation block No. II: 12) 28,700 ± 1,000 BP (GIN-10889); 13) 28,800 ± 240 BP (GIN-9028); 14) 27,200 ± 700 BP (GIN-10885); 15) 26,100 ± 1,000 BP (GIN-10886); excavation block No. III: 16) 26,300 ± 260 BP (GIN-8995); 17) 28,600 ± 600 BP (GIN-10884); 18) 27,630 ± 280 BP (GIN-9031); 19) 28,120 ± 170 BP (GIN-8999); 20) 26,900 ± 260 BP (GIN-9035); 21) 27,200 ± 500 BP (GIN-9586); 22) 27,460 ± 310 BP (OxA-9039).

general only poorly correlate with the frequencies of archaeological finds in the artificial arbitrary levels of the cultural layer.

In addition, there are cases in which the dates are in contradiction with the stratigraphical sequence. For example, for excavation block No. I, three dates yield information about their stratigraphical context: one sample from arbitrary level 1 is dated to 26,600 ± 300 BP, another sample from arbitrary level 2 below dates to 28,000 ± 300 BP, and a third sample from the lowermost arbitrary level 3 with a date of 23,600 ± 500 BP is the youngest. Excavation block No. III shows a similar picture (Figure 4). The dates from excavation block No. II seem to be in stratigraphical order: arbitrary level 2 dates to 26,100 ± 1000 BP

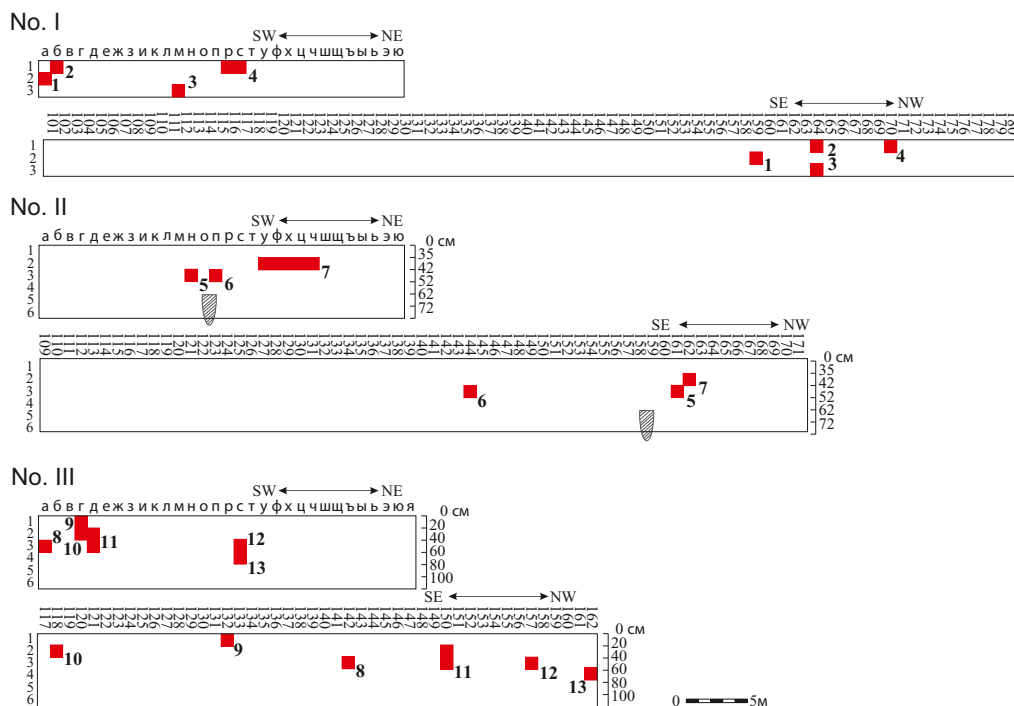


Figure 4 Stratigraphic distribution of the samples of ¹⁴C dating. Excavation block No. I: 1) 28,000 ± 300 BP (GIN-9029); 2) 26,600 ± 300 BP (GIN-9030); 3) 23,600 ± 500 BP (GIN-8998); 4) 28,350 ± 200 BP (GIN-9032); excavation block No. II: 5) 28,700 ± 1,000 BP (GIN-10889); 6) 28,800 ± 240 BP (GIN-9028); 7) 26,100 ± 1,000 BP (GIN-10886); excavation block No. III: 8) 26,300 ± 260 BP (GIN-8995); 9) 28,600 ± 600 BP (GIN-10884); 10) 27,630 ± 280 BP (GIN-9031); 11) 28,120 ± 170 BP (GIN-8999); 12) 27,200 ± 500 BP (GIN-9586); 13) 27,460 ± 310 BP (OxA-9039).

and arbitrary level 3 delivered ¹⁴C ages of 28,700 ± 1000 and 28,800 ± 240 BP. Whereas the low number of samples calls for caution, the inverse order in excavation block No. I indicates the activity of solifluction and/or slope processes, which lead to a mixing of the cultural layer.

Once again, I would like to point out the insufficiency of archival materials and the presumptive nature of the statements made above.

CONCLUSIONS

Consequently, despite the significant number of 60 ¹⁴C dates, there are still many open questions concerning the age of the Sungir site.

The available ¹⁴C dates do not allow for an exact determination of the period of existence of the Sungir site, nor do they enable us to clearly distinguish different occupations. On the other hand, it must be emphasized that a comprehensive analysis of the archaeological items made from hard, organic raw materials, including a technical-typological and spatial analysis of bone, antler, and ivory objects, did not give any argument for the existence of different cultural layers and/or a long chronology of site use. The presented spatial and stratigraphic data is certainly incomplete due to the lack of archive data. However, the results presented here still allow one to draw some general conclusions: (1) the stratigraphic analysis of the

distribution of dates argues for a mixed character of the cultural layer of the Sungir, and (2) the results of the horizontal distribution of the dates showed the absence of dates associated with the evident features (fire places, pits, etc.) of the cultural layer.

To solve the problems described above, it is necessary to conduct new ^{14}C datings from the cultural layer of Sungir. In the recent past, the most attention was paid to dating samples from the burials, which are connected both with their world value and the contradictory results of older datings. However, for a better understanding of the cultural layer of the site, a series of ^{14}C dates should be obtained directly from the cultural layer. From the author's point of view, samples from all arbitrary levels of a selected representative yet undisturbed area of Sungir should be used. In addition, it would be important to collect more detailed information about the excavations in which burials were discovered in order to better correlate the burials with the cultural layer.

In general, material for new ^{14}C dates would be available: faunal remains are stored in the Vernadsky State Geological Museum, at the Paleontological Institute of the Russian Academy of Sciences (collection from 1986) and in the Vladimir-Suzdal Museum-Reserve (excavations from the 2000s). In addition, reference samples are hosted in the Geological Institute of the Russian Academy of Sciences in Moscow and in the Zoological Institute of the Russian Academy of Sciences in St. Petersburg. Finally, there is a collection of bone, antler, and ivory products from Sungir at the Vladimir-Suzdal Museum-Reserve. Among these are items with a clear reference to arbitrary levels and square meters of the excavations that would allow for sampling stratigraphical sequences in areas with evident features and high frequencies of finds. Perhaps, in light of a new series of dates, it will be possible to distinguish the presence of several cultural layers, the impact of solifluction processes, and the chronological position of the Sungir site.

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