

CHRONOLOGY AND PERIODIZATION OF THE PIT-GRAVE CULTURE IN THE REGION BETWEEN THE VOLGA AND URAL RIVERS BASED ON RADIOCARBON DATING AND PALEOPEDOLOGICAL RESEARCH

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ABSTRACT. We studied the chronology and periodization of the Pit-Grave (Yamnaya) culture at the Volga and Ural interfluvium. Establishing the chronology of the Pit-Grave culture by archaeological methods is difficult due to the lack of artifacts in the burials. Therefore, we excavated 3 kurgan groups in the Orenburg region of Russia during the last decade. Eighteen kurgans of the Pit-Grave culture were studied using archaeological and paleopedological methods and radiocarbon dating. The funeral complexes studied were divided into 3 stages. A variety of carbon-containing materials from the same complexes were dated by different laboratories to increase the accuracy of the obtained dates. In addition, from the excavations of the last years some monuments of the Repino stage, the earliest period of the Pit-Grave culture, were dated using ceramics. Together with archaeological and paleopedological data, ^{14}C dating helped to clarify and, in general, to confirm the 3-stage periodization of the Pit-Grave culture in the Volga-Ural interfluvium: the early (Repino) stage, 4000–3300 BC; the advanced (classical) stage, 3300–2600 BC, which is divided into substages A and B at 3300–2900 and 2900–2600 BC, respectively; and the late (Poltavinsky) stage, 2600–2300 BC.

INTRODUCTION

During the Bronze Age in Eurasia, the Pit-Grave (Yamnaya) culture, which occupied the steppe area from the Danube River in the west to the southern Urals in the east, has played a major role (Merpert 1974; Gimbutas 1980). The most stable Pit-Grave culture developed in the Volga-Ural interfluvium, which presently consists of Volgograd, Saratov, Samara, Orenburg, and the western Kazakhstan regions (Figure 1).

On this vast territory, a community developed that used monotonous funeral rites characterized by earthen mounds (kurgans) overlying deep and large burial pits. Characteristic is a crouched posture of the dead, bent on the right side and sprinkled with ochre (Figure 2). The population practiced nomadic pastoralism, introduced wheeled vehicles, and used copper tools. Production of metal from the local Kargaly copper deposit was also developed in the southern Urals at that time.

Because of the transition from the Eneolithic (Copper Age) to the Bronze Age and the obvious connection of many technological developments with the Pit-Grave culture, it is especially important to establish the chronological limits of the cultural existence and the stages of its development. According to archaeological data, 3 cultural stages are traditionally recognized. However, dating of the Pit-Grave burials by archaeological methods is hampered by a lack of inventory in most burials. Radiocarbon dates for the culture were not available for this region until the mid-1990s. Today, more than 80 ^{14}C dates for the monuments of the Pit-Grave culture in the Volga-Ural interfluvium are known (Morgunova and Khokhlova 2006; Morgunova 2007; Kuznetsov 2007).

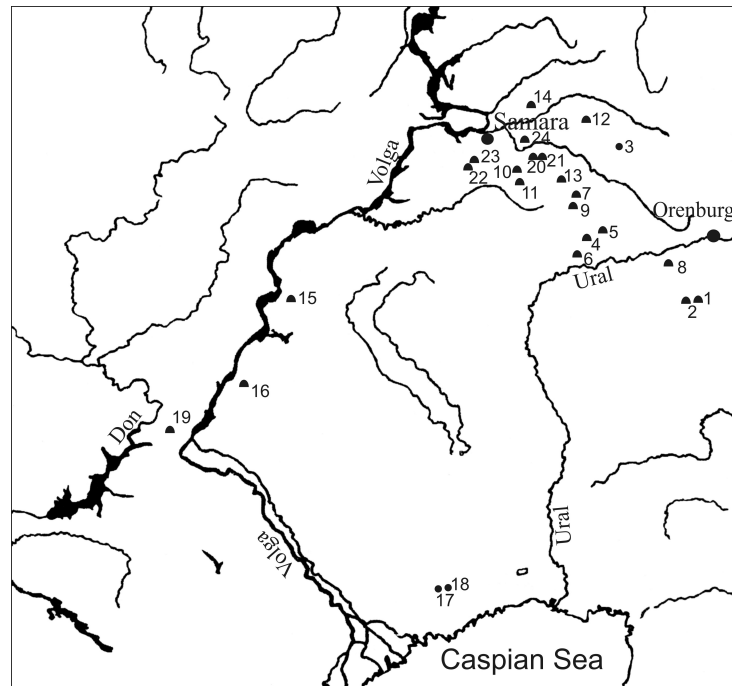


Figure 1 Location of the Pit-Grave culture monuments in the Volga and Ural interfluvium: 1) Tamar-Utkul VII, VIII kurgan cemetery (KC); 2) Izobilnoye I KC; 3) Turgan-ikskoe settlement; 4) Shumaev I, II KCs, isolated kurgan N2; 5) Mustaevo V KC; 6) Boldyrevo I KC; 7) Skvortsovka KC; 8) Nizhaya Pavlovka V KC; 9) Petrovka KC; 10) Lopatino I KC; 11) Orlovka I KC; 12) Poludni II KC; 13) Gvardeytsy II KC; 14) Grachevka II KC; 15) Shumeika KC; 16) Skatovka KC; 17) Kyzyl-Khak I settlement; 18) Kyzyl-Khak II settlement; 19) Repin Khutor settlement; 20) Nur I KC; 21) Uvarovka II KC; 22) Podlesnoe I KC; 23) Zhuravlikha I KC; 24) Kalinovka I KC.

METHODS

During the last decade, under the leadership of the first author, the kurgan cemeteries in Orenburg region were studied using scientific methods including paleopedology and ^{14}C dating. The kurgans of the Pit-Grave culture in a complex of cemeteries Shumaev I and II, Mustaevo V, and Skvortsovka and the isolated large kurgan N2 near the Shumaev village were investigated. In 5 burials, ceramics, metal, and bone pins were found that enabled us to assign these burials to the 2nd (advanced) and 3rd (late) stages of the culture. Other burials did not contain inventory and attributing them to any stage by the archaeological approach was not possible.

Paleosols buried under the kurgans were studied by the second author in order to investigate the chronology of the cemeteries. Using the similarity of morphological and analytical properties of buried paleosols, the kurgans were divided into groups, allowing the determination of the relative chronological order of the construction of the kurgans. The obtained results were confirmed by ^{14}C dating. In a few cases, kurgan mounds were constructed on scalped buried paleosol, the top soil layers of which were used for the construction of the adjacent kurgan mound. Thus, it was possible to correct a date made for humus apparently taken not from the upper horizons but from the older layers of a buried paleosol, as well as to obtain additional data to check the chronology of kurgan construction in a cemetery, in order to archaeologically interpret the ^{14}C dates obtained from burials of

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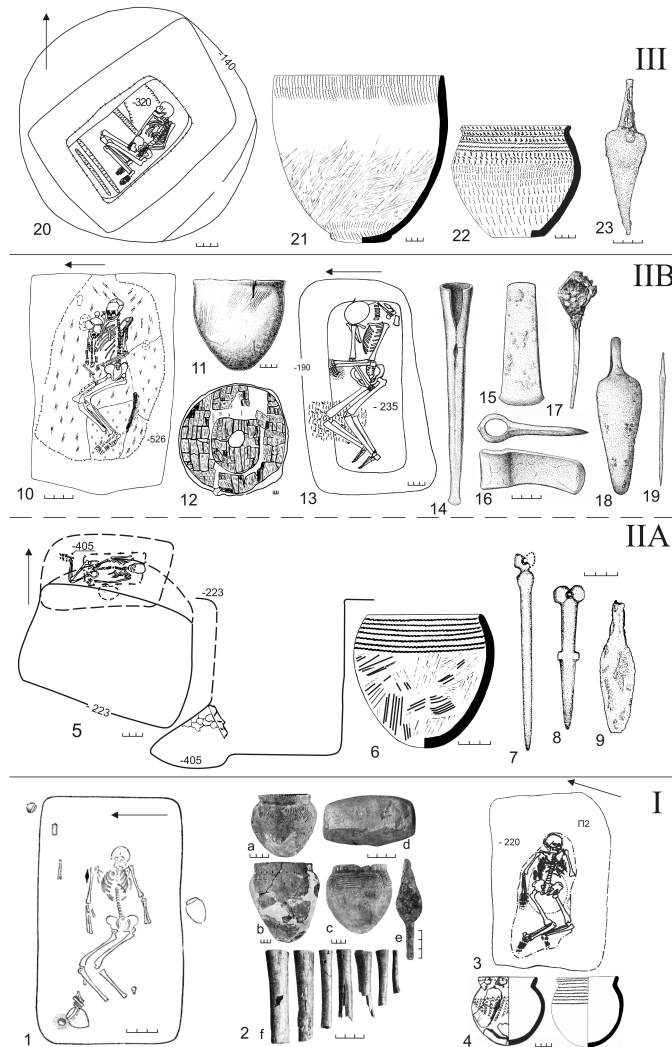


Figure 2 Periodization of the Pit-Grave culture monuments in the Volga and Ural interfluvium: **I. Early (Repino) stage:** 1–2: Skatovka KC, 5/3 burial; 3–4: Petrovka KC, 1/1 burial. **II A. Advanced (classical) stage:** 5: Shumaevo I KC, 3/6 burial; 6: Mustaevo V KC, 8/2 burial; 7–9: Mustaevo V KC, 9/2 burial. **II B. Advanced (classical) stage:** 10, 12: Shumaevo isolated kurgan N2, 2 burial; 11: Tamar-Utkul VIII KC, 8/1 burial, 13–19: Tamar-Utkul VII KC, 8/4 burial. **III. Late (Poltavkinsky) stage:** 20–23: Skvortsova KC, 6/1, 3, 4 burials.

each mound. In 3 kurgan cemeteries, 19 burials in 18 kurgans of the Pit-Grave culture were studied and 62 published ^{14}C dates were analyzed (Morgunova 2006, 2007; Morgunova et al. 2003, 2005, 2010a,b). New ^{14}C dates have been recently obtained at the Groningen AMS facility in the Netherlands (van der Plicht et al. 2000) and are included herein.

^{14}C dates were obtained for each burial, including those not containing material inventory. For ^{14}C dating, various sample materials were taken: human bones, wood, parts of wheeled carts, humus of buried paleosols, and ceramics. For some burials, 2–4 dates were obtained. This allowed us not only to specify the age of a burial but also to reject those dates that do not correspond to the actual date

of a burial. However, this way was not always possible due to the absence of a variety of carbon-containing materials in most of the studied burials.

In addition to the ^{14}C dates obtained for 3 kurgan cemeteries mentioned above, some burials of the Pit-Grave culture were dated from excavations in the 1980s and 1990s in the Orenburg region close to the Volga River. These data represent all stages of Pit-Grave culture development, including the early (Repino) stage (Petrovka, Skatovka, Shumeyka, Repin Khutor, Kyzyl-Khak I and II, Gerasimovka II kurgan cemeteries). For the monuments of earlier excavations, it was possible to conduct ^{14}C dating of ceramics only. For example, it so happened that monuments of the Repino stage could be dated by ceramics only. In the last decades, no burials from this time were opened in the region studied, with the exception of the Orlovka I 2/2 burial. Here, a ^{14}C date of human bone was obtained, which corresponded with the average value of the results on ^{14}C dates obtained by ceramics for the stage. Unfortunately, paleopedological research on the Repino stage kurgans was not conducted.

Approximately 20 dates for ceramic materials are available. Not all researchers believe the results of ^{14}C dating of ceramics, and indeed dates from ceramics should be treated with caution. According to the technical analysis of ceramics dated by us, the pottery was made of mud or clay loam. Clay is added to the admixture of crushed and burned shells (Salugina 2005:90–1). For analysis of the pottery, the impurities possibly affecting the ^{14}C age of the sample were removed using hydrofluoric acid (Kovalyuh and Skripkin 2007; Zaitseva et al. 2009). The reliability of this procedure has been demonstrated for ^{14}C dating of pottery of the Neolithic and Eneolithic Ages in the Volga region (Vybornov et al. 2008). However, this does not guarantee a correct date. Sometimes ^{14}C dates both by ceramics and other materials appear out of range. The ^{14}C dates of human bones may be subject to reservoir effects. This can be checked by dating other materials, when available. We believe that a reservoir correction for the Pit-Grave culture of the Volga-Ural interfluvium is not so strictly necessary. The population at that time consisted of nomadic pastoralists with a mobile lifestyle that was therefore unlikely to consume fish. The majority of the ^{14}C dates by human bones coincide with those of the same complex, obtained from other materials (Table 2, 12–20; Table 3, 2–4, 6–8).

Only in 4 cases were ^{14}C dates corrected for isotopic fractionation (Table 2, lines 3, 5, 12, 16, the corrected dates are marked with a gray shaded background). This correction is small and does not have a significant influence on the dates obtained for the Pit-Grave culture. Quite a few ^{14}C dates representative for the Pit-Grave culture of the region were taken from the literature. The corresponding references are given in the table footnotes.

RESULTS AND DISCUSSION

Early (Repino) Stage

In this stage, some signs of the steppe Eneolithic remain, but Pit-Grave culture features begin to appear, such as kurgans with skeletons buried in a crouched position on their backs with bent legs and in eastern orientation, and the ochre application. There are changes in the technology and design of pottery; locally produced copper goods made their first appearance (Figure 2, I). The monuments of this period are represented by burials under kurgan mounds and short-term settlements.

For ^{14}C dating, fragments of pottery were collected from sites in the northern Caspian region (Kyzyl-Khak I and II) and in the southern Cis-Urals (Turganikskoe and Repin Khutor settlements) (Table 1, lines 1–10). The chronology for all these sites is similar. The dates range between 5230 ± 90 and 4540 ± 80 BP, corresponding to 4200–3100 cal BC. However, considering that some of the dates could be slightly too old because of the presence of impurities of old organic carbon in the clay

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of the ceramic products, the lower boundary of the chronological period could be 3900–4000 BC. The end of the Repino stage can thus be estimated to 3400–3500 BC, which is confirmed by ¹⁴C dates for the beginning of the next advanced stage of this culture.

Table 1 ¹⁴C dates of the monuments of the early (Repino) stage within the Pit-Grave culture in the Volga and Ural interfluvium. All ages (BP and BC) 1σ uncertainty.^a

	Monument	Lab nr ^b	Sample	¹⁴ C age (BP)	Calibrated range (1σ)
1	Kyzyl-Khak II settlement	Ki 15092	cr	4550 ± 70	3370–3100
2	Kyzyl-Khak II settlement	Ki 15075	cr	4730 ± 70	3540–3490
3	Kyzyl-Khak I settlement	Ki 14542	cr	4510 ± 80	3350–3100
4	Kyzyl-Khak I settlement	Ki 14543	cr	4540 ± 80	3300–3100
5	Kyzyl-Khak II settlement	GIN ??	h	5050 ± 45	3900–3700
6	Turganikskoe settlement	Ki 15597	cr	4710 ± 80	3630–3370
7	Turganikskoe settlement	Ki 15598	cr	5230 ± 90	4230–3960
8	Turganikskoe settlement	Ki 15599	cr	5150 ± 90	4050–3790
9	Repin Khutor settlement	Ki 16486	cr	4830 ± 80	3710–3520
10	Repin Khutor settlement	Ki 16272	cr	5060 ± 80	3960–3770
11	KC Lopatino I 31\1	AA 47804	mb	4432 ± 66	3300–3100
12	KC Lopatino I 31\1	Ki 7764	mb	4560 ± 80	3300–3100
13	KC Lopatino I 31\1	Ki 14544	cr	4750 ± 70	3700–3300
14	KC Lopatino I 31\1	Ki 14545	cr	4800 ± 80	3700–3300
15	KC Petrovka 1/1	Ki 14521	cr	4730 ± 90	3640–3490
16	KC Orlovka I 2/2	LE 7896	mb	4790 ± 150	3700–3400
17	KC Skvortsovka 5/2	Ki 16268	cr	5140 ± 70	4000–3800
18	KC Skatovka 5/3, vessel 2	Ki 16487	cr	4890 ± 70	3770–3630
19	KC Skatovka 5/3, vessel 3	Ki 16488	cr	5080 ± 80	3970–3790
20	KC Shumeyka, complex A	Ki 16276	cr	5290 ± 100	4230–3980
21	KC Shumeyka, complex B	Ki 16277	cr	5420 ± 100	4360–4050
22	KC Gerasimovka II 4/2	GrA 54389	cr	4480 ± 35	3390–3095

^aAbbreviations (the same for Tables 1–3): mb – human bone; cr – ceramics; h – humus of buried paleosol; w – wood; pd – plant decay; IK – isolated kurgan; KC – kurgan cemetery; 31/1 – the numerator is the number of kurgan, the denominator is the number of burial.

^bLaboratory indexes: Ki – Kiev Radiocarbon Laboratory of NAS, Ukraine; LE – Institute of History of Material Culture Sciences, Saint Petersburg, Russia; IGAN – Institute of Geography, Moscow, Russia; Poz – Poznań radiocarbon laboratory in Poland; GrA – Groningen, the Netherlands. Dates in lines 1–4, 6–8 were published in Morgunova et al. 2010a,b; line 5: Barykin 1992; lines 9, 10, 15, 17–21: Morgunova et al. 2011; lines 11–14: Kuznetsov 2007; line 16: Ovchinnikova and Fadeev 2007; line 22: this study, with permission from J van der Plicht.

Burials under kurgans in the Skatovka, Petrovka, Orlovka I, Skvortsovka, Lopatino I, Shumeyka, and Gerasimovka II cemeteries were initially assigned to the Repino stage due to the presence of typical ceramics and metal products. Dates were obtained for the ceramics and occasionally for human bones. Their values are similar to the ¹⁴C dates obtained in the settlements (Table 1, lines 11–22). One part of the dates seem to be somewhat older (lines 17, 20–21), others somewhat younger (lines 11, 12). It is probably more correct to accept the dates on ceramics from the burial KC Lopatino I 31/1 because its ceramic material is similar to that from the Repin Khutor settlement.

Thus, on the basis of ¹⁴C dating, the chronological limits of the early (Repino) stage of the Pit-Grave culture in the Volga-Ural region are approximately between 4000 and 3300 cal BC. This is ~500 yr older than previously thought (Chernykh and Orlovskaya 2004). At this stage, the Pit-Grave culture developed synchronously with the early stage of the Maikop culture in the northern Caucasus, according to the archaeological evidence and the calibrated ¹⁴C dates obtained for the early stage of the Maikop culture (Korenevsky 2004).

Advanced (Classical) Stage of the Pit-Grave Culture

Based on paleopedology and ^{14}C dating, the advanced (classical) stage can be divided into 2 chronological ranges, named A and B. It was the study of paleosols from the advanced stage of the culture that initially served as a basis for distinguishing different groups of kurgans within this stage. By paleopedological analysis, the Shumaev I 3/6, Mustaevo V 8/2, 9/2, and Skvortsovka 9/1 burials were assigned to the advanced stage A (Figure 2, II A). Paleosols buried under kurgans of this group are characterized by low stocks of humus, more carbonate and gypsum, and the presence of exchangeable sodium in the soil-absorbing complex (Khokhlova 2010).

The majority of ^{14}C dates for the burials of this group (Table 2, lines 1–11) range from 4480 ± 100 to 4290 ± 80 BP, corresponding to 3400–2600 cal BC. This is a large range. But to clarify the upper limit of this range we can use the ^{14}C dates for the burials in the Nizhnjaya Orlyanka I 4/2, 1/5 as well as Kutuluk I 4/1 with a copper sword-scepter (Table 2, lines 7–10). All 4 dates are calibrated into a narrower time interval, 3350–2920 cal BC. Therefore the best time interval of existence of the advanced stage A is in the range from 3300 to 2900 cal BC (Morgunova 2007:211–4). This would mean that 2 ^{14}C dates, lines 2 and 4 in Table 2, must be rejuvenated.

The isolated kurgan Shumaev 2, Shumaev II 6/6 and Mustaevo V 1/1, Skvortsovka 7/1, 8/1 kurgans and burials were assigned to the advanced stage B based on paleopedological data and ^{14}C dates. Paleosols buried under kurgans of this group are considerably different from those buried under kurgans of stage A, are characterized by large amounts of humus, but less carbonate and gypsum and by absence of exchangeable sodium in the soil absorbing complex (Khokhlova and Khokhlov 2011).

Archaeologically, the kurgans of stage B are not different from the preceding ones of stage A, considering the funeral traditions, technology and morphology of the clay vessels (Figure 2, II B). However, in the group of dated monuments that we assign to stage B there are kurgans of different size and complexity of funeral ritual design, burials with human sacrifices and numerous metal and other objects indicating an increase of social differentiation of the Pit-Grave culture during this period.

^{14}C dates for this time interval show that there are the burials with pieces of wheeled carts near Shumaev village and the elite burial 1/1 in a large kurgan (60 m in diameter, 6 m in height) with numerous objects made of copper and meteoric iron from the Boldyrev I kurgan cemetery. For the Boldyrev I kurgan, 2 ^{14}C dates for the same material (decayed plants) are obtained. One of them is obviously too old (Table 2, line 22), the other (Table 2, line 21) corresponds to prehistoric classification and is in agreement with the rest of the dates for this chronological horizon.

^{14}C dates (Table 2, lines 12–46) show that the chronological limits for the advanced stage B range from 3000–2900 to 2600–2500 cal BC. These limits are confirmed by single dates for other monuments of the Pit-Grave culture in the Volga and Ural regions and correlate with identical findings of objects in different kurgan cemeteries. For instance, for the burial 1/4 of the Pershin kurgan cemetery with a casting-form for making axes the ^{14}C date is 4200 ± 60 BP. Two ^{14}C dates for the burials with axes cast in similar form (Figure 2, 16) in the Tamar Utkul VIII kurgan cemetery are 4145 ± 35 and 4165 ± 35 BP (Table 2, lines 42 and 44, respectively). Their values are very close to the date of the Pershin burial. Other dates of the Tamar Utkul kurgans are in the same range, except for N43 which is far too young; it does not correspond to the chronology of the Early Bronze Age. Perhaps this is caused by a lack of sufficient material submitted for dating.

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Table 2 ¹⁴C dates for monuments of the advanced (classical) stage of the Pit-Grave culture in the Volga and Ural interfluvium.^a

Monument	Lab nr	Sample	¹⁴ C age (BP)	Age cal BC (1σ)	Artifacts
Advanced stage, step A					
1 KC Mustaev V 8/2	IGAN 3016	h	4480 ± 100	3475–3174	Round-bottomed vessel
2 KC Mustaev V 8/2	Poz-47868	cr	4245 ± 35	2908–2871	Round-bottomed vessel
3 KC Mustaev V 9/2	LE 7021	mb	4330 ± 100 4459 ± 104	3100–2700	Copper knife, bone pin
4 KC Mustaev V 9/2	IGAN 3017	h	4290 ± 80	3200–3060	Copper knife, bone pin
5 KC Shumaev I 3/6	LE 6091	mb	4300 ± 150 4422 ± 152	3300–2600	No inventory
6 KC Skvortsovka 9/1	LE 8579	mb	4440 ± 140	3340–2920	No inventory
7 KC Nizhnjaya Orlyanka I 4/2	AA 12573	mb	4520 ± 75	3350–3100	No inventory
8 KC Nizhnjaya Orlyanka I 1/5	OxA 4254	mb	4520 ± 75	3350–3100	No inventory
9 KC Kutuluk I 4/1	OxA 4306	mb	4400 ± 70	3110–2920	Copper sword
10 KC Kutuluk I 4/1	AA 12570	mb	4370 ± 75	3100–2910	Copper sword
11 KC Poludni II 2/7	IGAN 3233	mb	4542 ± 75	3350–3100	“Mask” made of clay
Advanced stage, step B					
12 IK Shumaev 2/2	LE 6088	w	4100 ± 40	2810–2590	Wooden wheels
13 IK Shumaev 2/2	LE 6090	mb	4060 ± 120 4183 ± 123	2870–2490	Wooden wheels
14 IK Shumaev 2/2	IGAN 2448	w	3980 ± 50	2563–2457	Wooden wheel
15 IK Shumaev 2/2	IGAN 2391	h	4030 ± 120	2966–2695	Wooden wheel
16 KC Shumaev II 6/6	LE 6087	w	4070 ± 45	2860–2500	Wooden wheel
17 KC Shumaev II 6/6	LE 6089	mb	4080 ± 100 4193 ± 104	2870–2500	Wooden wheel
18 KC Mustaev V 1/1	LE 6732	w	4140 ± 25	2870–2620	Copper pickaxe
19 KC Mustaev V 1/1	IGAN 2780	w	4070 ± 30	2615–2503	Copper pickaxe
20 KC Mustaev V 1/1	IGAN 2869	h	4180 ± 70	3100–2900	Copper pickaxe
21 KC Boldyrevo I 1/1	Ki 14518	pd	4080 ± 70	2700–2550	Copper spear, knife, awl, iron things
22 KC Boldyrevo I 1/1	Ki 14519	pd	4340 ± 80	3100–2880	Copper spear, knife, awl, iron things
23 KC Skvortsovka 7/1	LE 8580	mb	4230 ± 150	3020–2600	Stone pestle, copper awl
24 KC Skvortsovka 8/1	LE 8578	mb	4180 ± 140	2920–2500	No inventory
25 KC Krasnosamarskoje IV 1/3	AA 37031	mb	4241 ± 70	2920–2680	No inventory
26 KC Nizhnjaya Orlyanka I 1/4	OxA 4255	mb	4230 ± 80	2930–2620	Copper knife
27 KC Kurmanaevka III 3/1	AA 47805	mb	4234 ± 60	2911–2690	Bone pin
28 KC Pershin 1/4	BM 3157	mb	4200 ± 60	2910–2660	Casting-form for ax
29 KC Tamar-Utkul VIII 8 1	Poz-47845	cr	4260 ± 90	3013–2851	Copper ax, round-bottomed vessel
30 KC Nizhnjaya Pavlovka V 2/3	Ki 7766	mb	4010 ± 90	2835–2350	No inventory
31 KC Poludni II 3/1	LE 7509	mb	4270 ± 80	3020–2700	No inventory
32 KC Grachevka I 1/2	GIN-11452	mb	4250 ± 40	3000–2800	Flat-bottomed vessel
33 KC Uvarobka II 2/2	LE 6550	w	4195 ± 20	2900–2700	Silver pendant, copper adze, flint arrowheads
34 KC Nur I 1/5	AA 47810	mb	4127 ± 59	3000–2600	Flat-bottomed vessels
35 KC Grachevka II 5/1	AA 53804	mb	4179 ± 55	2800–2600	Bones of sheep
36 KC Grachevka II 5/1	IGAN 2876	mb	4050 ± 70	2700–2500	Bones of sheep
37 KC Podlesnoje I 3/3	GIN 13208	w	4290 ± 50	2920–2880	No inventory
38 KC Podlesnoje I 3/3	GIN 13206	w	4260 ± 50	2920–2700	No inventory
39 KC Krasnosamarskoje IV 1/1	AA 37033	mb	4284 ± 79	3020–2700	No inventory
40 KC Tamar-Utkul VII 1/1	GrA 54386	mb	4105 ± 35	2848–2600	Copper knife, bone pin
41 KC Tamar-Utkul VII 4/9	GrA 54383	mb	4145 ± 35	2864–2635	Copper knife and awl
42 KC Tamar-Utkul VII 8/4	GrA 54390	mb	4145 ± 35	2864–2635	Copper ax, knife, awl, chisel cutter

Table 2 ¹⁴C dates for monuments of the advanced (classical) stage of the Pit-Grave culture in the Volga and Ural interfluve.^a (Continued)

Monument	Lab nr	Sample	¹⁴ C age (BP)	Age cal BC (1σ)	Artifacts
43 KC Tamar-Utkul VIII 5/1	GrA 54381	mb	3600 ± 35	2014–2013	Vessel made of clay
44 KC Tamar-Utkul VIII 4/1	GrA 54382	mb	4165 ± 35	2873–2677	Copper ax, vessel made of clay
45 KC Pjatiletka V 5/2	GrA 54392	mb	4140 ± 35	2862–2632	Copper chisel, human sacrifice
46 KC Nizhnjaya Pavlovka V 1/2	GrA 54391	mb	4175 ± 35	2876–2695	Copper pickaxe

^aDates in lines 1–5, 11–19 previously published by Morgunova 2006; lines 20–23, 26, 28: Morgunova et al. 2011; lines 7–10, 24–25, 29, 31, 35, 36: Kuznetsov 1996, 2007; lines 30, 32–34, 37–39: Turetsky 2007; line 27: Chernykh et al. 2000; lines 40–46: this study, with permission from J van der Plicht.

The time interval 3000–2600 cal BC corresponds to the classical phase of the Pit-Grave culture in other steppe areas of eastern Europe (Telegin 1977; Nikolova 1999; Ivanov 2006; Shishlina 2007). The upper limit of the period supports the ¹⁴C dates for the early Catacomb burials and the start of the gradual decline of the Pit-Grave culture. Thus, ¹⁴C dating allows not only the determination of the chronological limits of the advanced stage of the Pit-Grave culture in the Volga and Ural interfluve, but also the identification of 2 consecutive steps in its development. This stage can be considered as the golden age of the culture, the time of its unity and the greatest activity on all steppe areas of eastern Europe.

The ¹⁴C dates corrected for isotope fractionation (Table 2, lines 3, 5, 13, 17, dates with gray background) are 113–129 ¹⁴C yr older than the uncorrected ones. Taking this into account, the number of ancient dates for the advanced stage of the Pit-Grave culture increases. At that, the corrected dates do not change the chrono-intervals of the phases A and B of the advanced stage of the Pit-Grave culture obtained using the uncorrected dates.

Late (Poltavkinsky) Stage

During this period, in the region between the Don and the Dnieper rivers, the Catacomb culture assimilated with the Pit-Grave one. However, in the Volga-Ural interfluve the Pit-Grave culture was preserved, but was affected by the Catacomb population as shown by the distribution of flat-bottomed pottery forms (Figure 2, III).

From the paleopedological and archaeological data, the kurgan cemeteries and burials Shumaev II 7/1, Skvortsovka 5/1, 5/3, 5/4, 6/1, 6/3, and 7/1 were attributed to this stage. They were created in climatic conditions characterized by initial signs of increasing aridity. Compared with the previous Pit-Grave paleosols, soils buried under the kurgans of this stage show the largest humus amounts and the lower contents of carbonates, the clearest signs of biological activity (holes of burrowers) and the absolute absence of easily soluble salts and exchangeable sodium in the soil-absorbing complex (Khokhlova 2012).

¹⁴C dates were obtained for all kurgans but three ¹⁴C dates for 2 burials made for Skvortsovka 5/1 and 5/4 are the most significant. They were measured for different materials (ceramics, human bone, and wood) and have similar dates: 3940 ± 70, 3810 ± 25, and 3810 ± 40 BP (Table 3, lines 2–4), with 2 dates practically coinciding. The date from burial N3 of the same kurgan is also close to these dates (Table 3, line 5), as are the dates for the Skvortsovka 6/1, 6/3 burials (Table 3, lines 6–8). The assignment of this group of burials to the Pit-Grave/Catacomb time is confirmed by the presence of flat-bottomed vessels and a copper knife with a curved end (Skvortsovka 5/4). Similar ¹⁴C dates

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were obtained in the kurgan cemetery Izobilnoye I 1/1 on the wooden wheels and for a number of burials marked by flat-bottomed vessels from other kurgan cemeteries (Table 3, lines 9–13). The late stage of the Pit-Grave culture in the Volga and Ural interfluvial dates from 2600 to 2200 BC. This corresponds to dates from the early stage of the Catacomb culture monuments in Kalmykia, on the Lower Don (Shishlina 2007) and in the Dnieper (Nikolova 1999).

Table 3 ^{14}C dates for monuments of the late (Poltavkinsky) stage of the Pit-Grave culture in the Volga and Ural interfluvial.^a

	Monument	Lab nr	Sample	^{14}C age (BP)	Calibrated range BC (1σ)
1	KC Shumaevo II 7/3	IGAN 2476	h	3610 ± 190	1631–2036
2	KC Skvortsovka 5/4	Ki 16489	cr	3940 ± 70	2500–2300
3	KC Skvortsovka 5/4	LE 7685	w	3810 ± 25	2290–2200
4	KC Skvortsovka 5/1	LE 8415	mb	3810 ± 40	2560–2130
5	KC Skvortsovka 5/3 (lower skeleton)	LE 7685	mb	4080 ± 60	2860–2500
6	KC Skvortsovka 6/1	LE 8583	mb	4100 ± 110	2870–2500
7	KC Skvortsovka 6/1	Ki 16260	cr	4090 ± 90	2870–2550
8	KC Skvortsovka 6/3	LE 8582	mb	3950 ± 400	3100–1800
9	KC Izobilnoje I 1/1	Ki 14522	w	3920 ± 90	2500–2280
10	KC Kalinovka I 1/3	GIN 11289	mb	4050 ± 40	2700–2500
11	KC Gvardeytsy II 1/2	GIN 10611	mb	3960 ± 40	2580–2300
12	KC Gvardeytsy II 1/6	GIN 10613	mb	3960 ± 40	2570–2350
13	KC Zhuravlikha I 1/16	GIN 10614	mb	3990 ± 40	2500–2300

^aLines 1: date published in Morgunova 2006; lines 2–9: Morgunova et al. 2011; lines 10–13: Turetsky 2007.

CONCLUSION

In its long existence, the Pit-Grave culture was characterized by conservatism in their burial practices and rituals. This creates difficulties to establish its archaeological periodization. ^{14}C dating solves this problem partly. The study of archaeological sites using paleopedological methods and ^{14}C dating helped to determine the chronological limits of the culture and its stages in the interfluvial between the Volga and Ural rivers.

In the region studied, the Pit-Grave culture underwent a long development, with 3 stages distinguished: early (Repino), 4000–3300 BC; advanced (classical), 3300–2600 BC with 2 phases, A and B at 3300–2900 and 2900–2600 BC, respectively; and late (Poltavkinsky), 2600–2300 BC. However, chronological questions still remain. First of all, we note a significant increase of the Pit-Grave culture age compared with traditional ideas, in particular using calibrated ^{14}C dates. With this approach the culture becomes not only more ancient, but the duration of its functioning prolongs to 2000 yr from 4000 to 2300 BC. Traditionally, all obtained ^{14}C dates were limited within the 3rd millennium BC only. The traditional range of the Pit-Grave culture seems more correct, as history knows only few cultures ranging longer than a millennium. This is especially true for nomadic cultures, including the Pit-Grave culture.

In addition, paleopedological investigation of a number of the Pit-Grave culture monuments in the Cis-Ural steppe shows that the time ranges of buried paleosols for particular groups of kurgans are somewhat smaller than those based on ^{14}C dating. Such conclusions were repeatedly made in our previous work on paleosols of the Pit-Grave culture in the region (Khokhlova 2006, 2012; Khokhlova et al. 2006, 2011). ^{14}C dating should be more widely used in studies of archaeological

sites of the Pit-Grave culture, and if possible, used together with an archaeological approach and other possible analyses of complementary scientific methods.

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