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R. Krause[1], A.V. Epimakhov[2], E.V. Kupriyanova[3], I.K. Novikov[4], and E. Stolarczyk[1]

[1]Goethe-Universität,
Campus Westend, Norbert-Wollheim-Platz 1, Frankfurt am Main, 60323, Germany
E-mail: R.Krause@em.uni-frankfurt.de; Stolarczyk@em.uni-frankfurt.de
[2]South Ural Department of the Institute of History and Archaeology, Ural Branch, Russian Academy of Sciences,
South Ural State University,
Pr. Lenina 76, Chelyabinsk, 454080, Russia
E-mail: eav74@rambler.ru
[3]Chelyabinsk State University,
Bratyev Kashyrinykh 129, Chelyabinsk, 454001, Russia
E-mail: dzdan@mail.ru
[4]Kurgan State University,
Sovetskaya 63, bldg. 4, Kurgan, 640020, Russia
E-mail: sherlock2479@yandex.ru

The Petrovka Bronze Age Sites: Issues in Taxonomy and Chronology

This article introduces a series of AMS radiocarbon dates for the Bronze Age Petrovka cemeteries in the Trans-Urals. The results of the AMS ^{14}C-dating of animal and human bones indicate a very high degree of concordance in the 19th and 18th centuries cal BC time range. The previously obtained AMS datings clearly fit into the same chronological interval. Specifically, 17 of 36 analyses of the Petrovka series yielded very similar results. In other cases, where dating was based on wood and charcoal, the results are highly inconsistent, even within the same burial. Before the verification of these results, the short interval based on AMS dates should be preferred. Its comparison with intervals for other cultures of the Trans-Urals demonstrates marked similarity: in fact, complete coincidence of some of them. At the same time, stratigraphic and typological evidence suggests that the Sintashta, Petrovka, and Alakul traditions are stages of a sequence. Additional arguments are features of continuity in the material culture and the practice of using the burial mounds of a previous culture for new graves, without destroying the older ones. In our view, the only explanation is provided by a dynamic scenario of cultural change spanning two centuries, from the migration of the Sintashta people to Southern Urals until the formation of the Alakul culture. The resolution of the radiocarbon method does not suffice to detect such rapid changes. If this explanation is correct, the Petrovka sites should be considered an early stage of the Alakul culture, rather than a separate culture.

Keywords: *Bronze Age, Petrovka sites, AMS radiocarbon dating.*

Introduction

More than 40 years have passed since the Petrovka sites were distinguished as an independent cultural group (Zdanovich, 1973). However, they still remain a subject of discussion as regards a number of key aspects of the Bronze Age archaeology of the Eurasian Steppe related to the Andronovo

cultural and historical community. In this paper, we intend to consider only the data on the absolute chronology on the Trans-Uralian Petrovka group as arguments in favor of selecting one of the alternatives to cultural attribution and taxonomic status. Unfortunately, this cannot be done for the territory of northern and central Kazakhstan. The designation of this group as the Nurtai culture has been proposed for this region (Tkachev A.A., 2002) of Kazakhstan, but there is a lack of radiocarbon dates. In our opinion, disagreements between the authors are caused by the rather small amount of initial archaeological data in general. Although significant steps have been made towards that goal in recent years (Vinogradov, 2003; Drevneye Ustye, 2013; Multidisciplinary Investigations…, 2013; Kupriyanova, Zdanovich, 2015; Vinogradov et al., 2017; and others), not all sites were analyzed and described in the proper way. This assertion also concerns the Kazakhstan data, without which the conclusions will inevitably have a preliminary character.

The controversy among researchers can be reduced to several key aspects. First, some authors consider the Petrovka antiquities as manifestations of an independent archaeological culture, and they even distinguish the stages of development (Zdanovich, 1988: 132–139; Matveev, 1998: 325–329), while others suppose that this cultural type was just the initial stage of the Alakul traditions (Vinogradov, 2011: 143–146; 2017; and others). Second, the issue of relationship to the Sintashta artifacts is decided in different ways: from full (or partial) synchronization to strict continuity along the "Sintashta-Petrovka" line (Kukushkin et al., 2016). Third, the previous issue implies the problem of the genesis of the Petrovka culture (Tkachev V.V., 1998; Grigoriev, 2016; and others). Finally, there is a divergence in the definitions of key cultural features of Petrovka range of sites. Although the parties have not run out of arguments for their own versions yet (for example, working with collections from settlements), the situation is close to a deadlock. New analytical data can give impetus to the discussion and reduce the number of variants. In our opinion, radiocarbon dating can bring certainty to the issue of the absolute chronology of the Petrovka sites, which will be an important step in this direction.

Material and methods

The area of the Petrovka sites is tremendous, but the Trans-Uralian part under consideration (Fig. 1) was obviously of paramount importance in the development and functioning of the Petrovka traditions. For this territory, reliable stratigraphic evidence for determining the "Sintashta"–"Petrovka"–"Alakul" sequence was obtained (the Ustye I and Kamenniy Ambar fortified settlements, the Krivoye Ozero, Stepnoye VII, and Troitsk-7 burial grounds, and the Kulevchi III settlement). However, it should be made clear that the Petrovka sites in the Trans-Urals are noticeably less than the Sintashta and especially the Alakul sites in terms of quantity.

Burial sites in the Tobol River basin located in the southern part of the forest-steppe zone and at the boundary of the steppe zone were selected for analysis. This is the place where over the last decades the largest cemeteries were discovered and studied, four of which are included in our selection (Krivoye Ozero, Ozerny-1, Stepnoye VII, Troitsk-7). Preference was given to this type of sites because it was possible to make distinct cultural attributions of samples as compared to settlements.

In all cases, this implies the kurgan funerary rite. However, at the Stepnoye VII and Troitsk-7 cemeteries, the relief of the terrain proved to

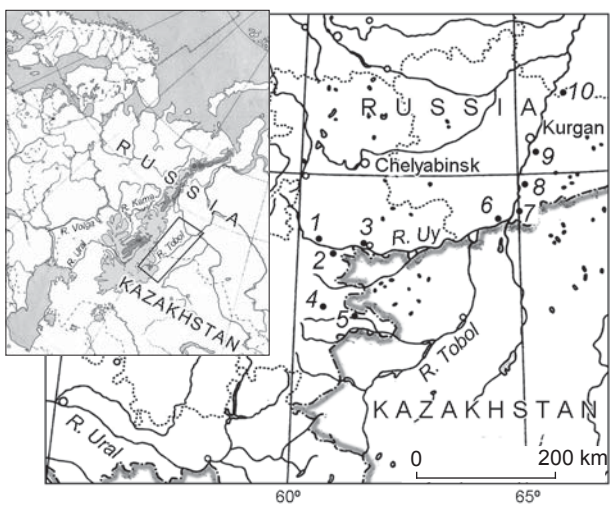

Fig. 1. Locations of the Petrovka sites with radiocarbon dates in the Trans-Urals.
1 – Stepnoye VII; *2* – Krivoye Ozero; *3* – Troitsk-7; *4* – Ustye I; *5* – Kulevchi VI; *6* – Ozerny-1; *7* – Verkhnyaya Alabuga; *8* – Raskatikha; *9* – Tsarev Kurgan; *10* – Chistolebyazhsky.

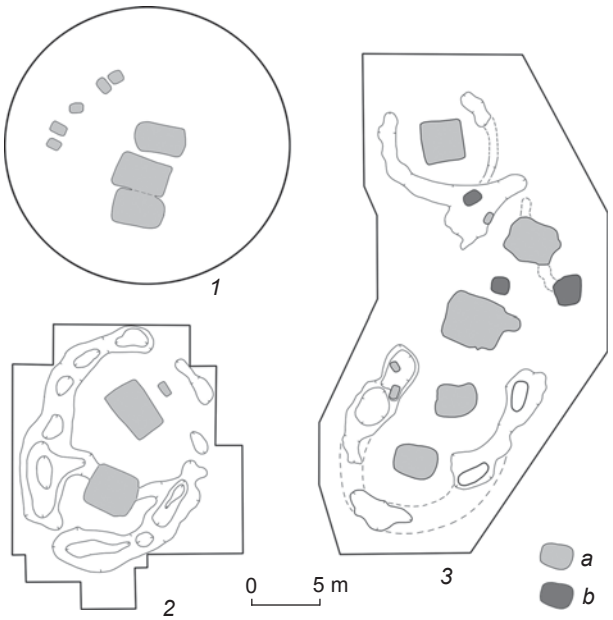

Fig. 2. Variants in the design of the inner space of a kurgan at Petrovka cemeteries.
1 – Krivoye Ozero (kurgan 1); *2* – Stepnoye VII (assemblage 8); *3* – Troitsk-7 (kurgan 7 (southern part) and 8 (northern part)).
a – burial pits; *b* – assemblages of sacrifices.

have been strongly leveled by human-induced impact. As a rule, kurgans within cemeteries include a large number of graves, and in some cases these reliably contain collective burials of people of different ages and sexes. The center is marked by large graves, while children's burials (usually individual) were recorded on the periphery. Differences in the funerary architecture are related only to the presence or absence of small ditches, contouring the kurgan's grounds, and to the number of burials under one mound (Fig. 2). The Stepnoye VII and Troitsk-7 burial grounds, where stratigraphically late Alakul features (burials and sections of ditches) were constructed taking the existing Petrovka ones into account, are particularly similar with respect to the arrangement of the inner space of the kurgan. The practice of offering sacrifices of domestic animals was common. Some sacrificial assemblages are related to burial pits (Fig. 3, *1*); others, on the contrary, constitute independent features in the kurgan's ground.

The cultural attribution of specific burial complexes was determined by the typifying appearance of ceramics (Fig. 4), whose typology was defined by N.B. Vinogradov (2011: 104–107) and S.E. Panteleeva (2017)*. In certain cases, traits of the ceramic assemblages of kurgans in general provided a basis for cultural attribution**.

When selecting samples, preference was given to the bones of domestic animals (11 spec., excluding the Alakul assemblages), since these materials are the least susceptible to distortions[3]*, and humans (3 spec.). In order to improve the reliability of conclusions, a relatively small number of sites (four) and kurgans (nine, excluding Alakul sites) have been dated, and matched samples from the same assemblages were used twice for a cross-check. A total of 12 Petrovka closed assemblages (burial and sacrificial pits) were covered.

Results of dating and discussion

The presented samples were analyzed in compliance with the standard requirements, using acceleration technologies[4]*, along with the determination of the amount of collagen and the nitrogen-to-carbon ratio. An amount of collagen was close to the critical threshold[5]* found in one sample (MAMS-32165), which demonstrates a serious deviation from the main series. Another sample (MAMS-32159) is obviously defective, since it yielded a date of the 17th–18th centuries AD. The only explanation in the last case could be storage-related problems, since the second sample from this assemblage strictly meets expectations, and the obtained result virtually coincides with the others. The same two samples have the lowest $\delta^{13}C$ readings. These data are excluded from further calculations in the general summation of results (see *Table*). Thus, 12 results and the only pair of values obtained from the samples

*Unfortunately, the publication format makes it impossible to present the material in its entirety.

**Such features did not contain alien cultural inclusions: Troitsk-7 (kurgan 7), Ozerny-1 (kurgan 5).

[3]*The species composition is traditional for Petrovka sacrifices and includes cattle, small ruminants, and a horse. Definitions are given by P.A. Kosintsev (Institute of Plant and Animal Ecology, Ural Branch of the Russian Academy of Sciences), D.I. Razhev (Tyumen Scientific Center, Siberian Branch of the Russian Academy of Sciences), L.L. Gayduchenko (Chelyabinsk State University).

[4]*The Klaus-Tschira-Laboratory at Curt-Engelhorn-Centre Archaeometry gGmbH, Mannheim.

[5]*We accepted a value < 1 % as a threshold (Kuzmin, 2017: 181).

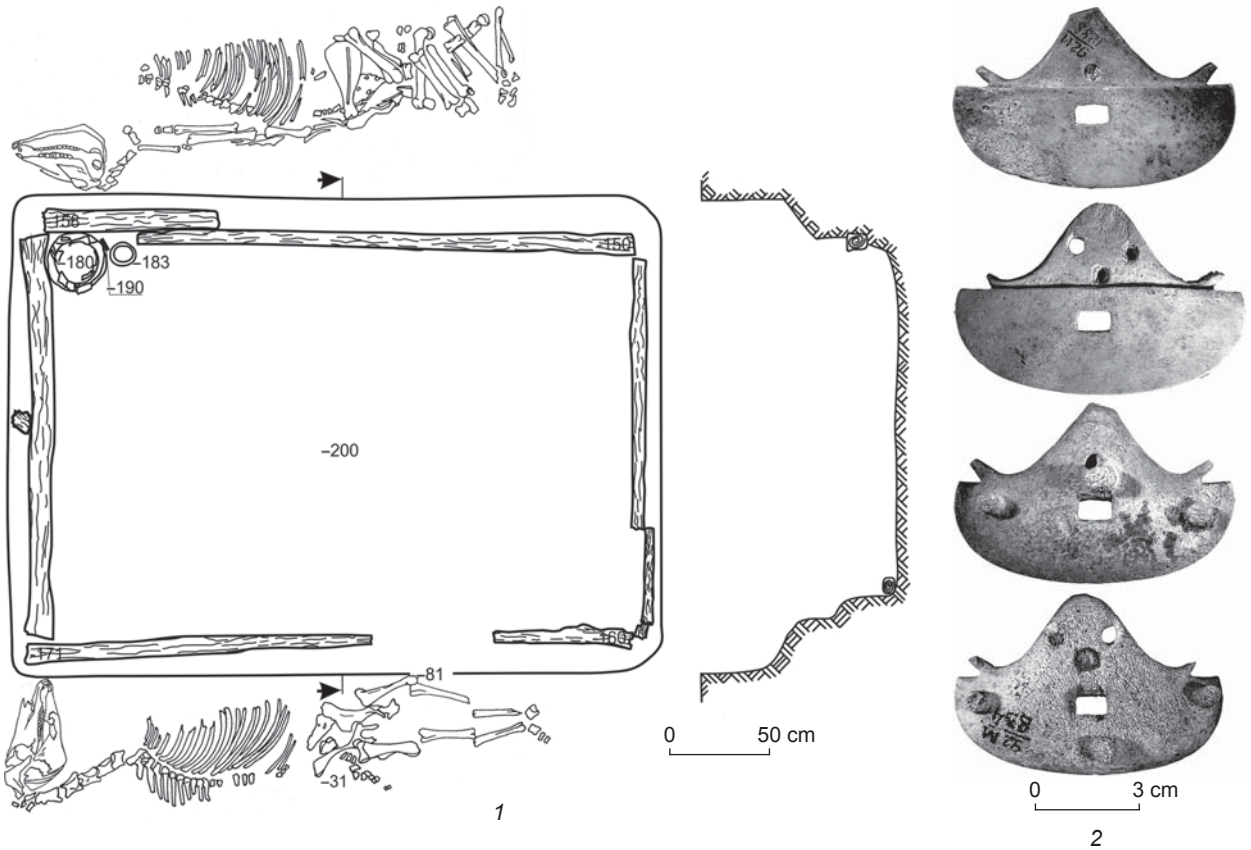

Fig. 3. Petrovka chariot-complex.
1 – layout of grave 1, kurgan 8, the Ozerny-1 cemetery; *2* – cheek-pieces from grave 1, kurgan 1, the Krivoye Ozero cemetery (after (Vinogradov et al., 2017: 25, 29)).

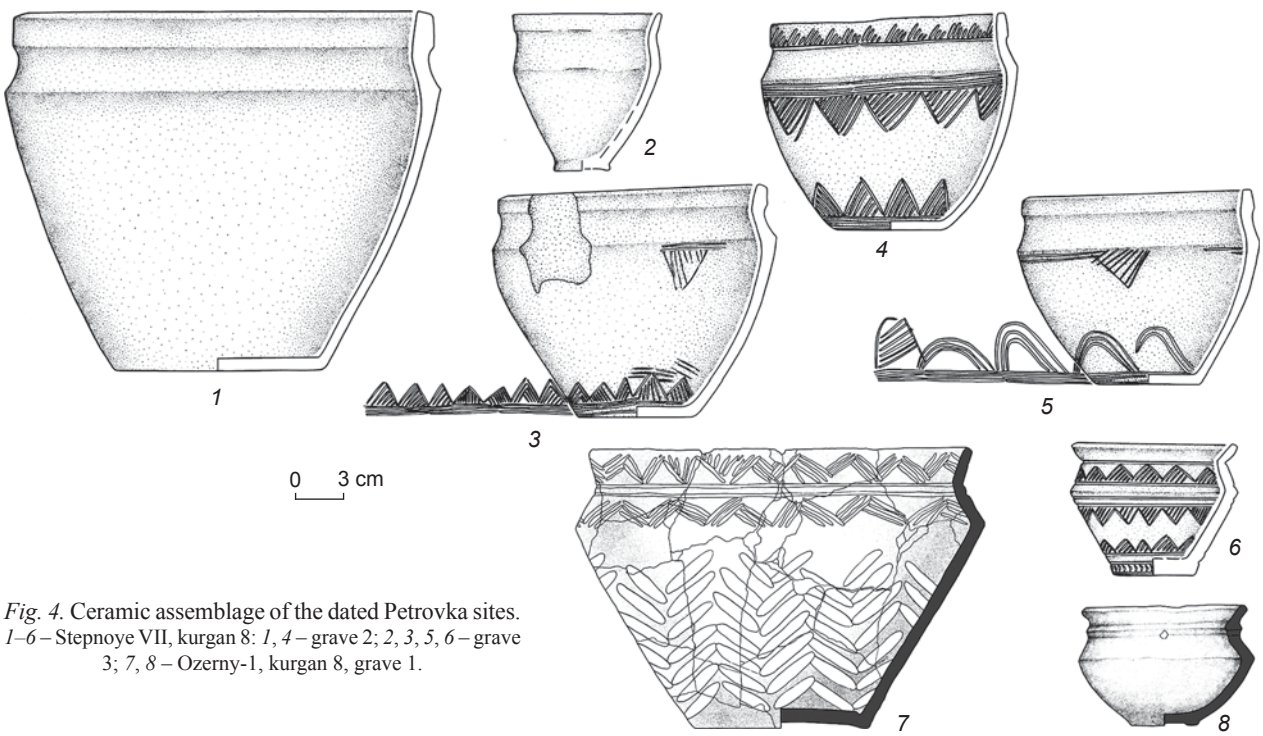

Fig. 4. Ceramic assemblage of the dated Petrovka sites.
1–6 – Stepnoye VII, kurgan 8: *1*, *4* – grave 2; *2*, *3*, *5*, *6* – grave 3; *7*, *8* – Ozerny-1, kurgan 8, grave 1.

The results of ^{14}C dating of the Petrovka and Alakul sites in the Trans-Urals

Site	Complex	Lab code	Material	^{14}C BP	Calibrated values, years BP		$\delta^{13}C$, ‰	C : N	C, (%)	Collagen, %
					1 σ	2 σ				
Petrovka sites										
Stepnoye VII	Kurgan 8, grave 2	MAMS-32154	Human bone	3473 ± 25	1876–1747	1882–1699	–21.5	3.0	38.3	3.1
"	Kurgan 8, grave 2	MAMS-32155	Animal bone	3453 ± 24	1869–1696	1877–1691	–21.3	3.0	37.4	9.1
"	Kurgan 4, grave 17	MAMS-32156	"	3472 ± 24	1875–1747	1881–1699	–21.7	2.9	24.7	2.4
Krivoye Ozero	Kurgan 1, grave 1	MAMS-32158	Human bone	3528 ± 23	1905–1779	1928–1771	–22.9	3.2	39.0	6.0
"	*Kurgan 1, grave 1*	*MAMS-32159*	"	*228 ± 25*	1652–1795 AD	1644–1950 AD	–24	3.2	35.5	3.0
Ozerny-1	Kurgan 5, grave 6	MAMS-32160	Animal bone	3438 ± 24	1768–1692	1875–1666	–21.1	3.2	34.0	7.1
"	Kurgan 5, grave 7	MAMS-32161	"	3492 ± 24	1878–1771	1887–1746	–20.3	2.8	24.9	10.3
"	Kurgan 8, grave1	MAMS-32162	"	3483 ± 25	1876–1755	1885–1702	–20	2.8	25.2	3.6
"	Kurgan 6, grave 1	MAMS-32163	"	3517 ± 24	1890–1776	1916–1760	–23	3.0	31.5	9.5
Troitsk -7	Kurgan 6, grave 1	MAMS-32164	"	3483 ± 24	1876–1755	1884–1703	–21.5	3.0	31.0	1.1
"	*Kurgan 7, grave 4*	*MAMS-32165*	"	*3130 ± 25*	1434–1325	1490–1304	–29.1	3.4	6.7	0.6
"	Kurgan 8, grave 1	MAMS-32166	"	3422 ± 25	1749–1688	1868–1642	–21.8	2.7	20.0	2.2
"	Kurgan 7, grave 5	MAMS-32167	"	3472 ± 26	1876–1746	1882–1698	–18.2	2.8	25.6	3.9
"	Kurgan 7, grave 10	MAMS-32169	"	3447 ± 25	1866–1694	1877–1688	–21.9	2.8	20.4	4.1
Alakul sites										
Stepnoye VII	Kurgan 4, grave 33	MAMS-32157	Animal bone	3402 ± 24	1740–1665	1750–1632	–23.5	3.4	16.8	0.5
Troitsk-7	Kurgan 14, grave 1	MAMS-32168	"	3474 ± 24	1875–1748	1881–1700	–21.9	2.8	20.4	4.1

Note. The italicized results are excluded from the procedure of summation of probabilities.

found in the same assemblage (Stepnoye VII, kurgan 8, sacrificial pit 2) remained at our disposal: animal (horse) and human bones. These values proved to be nearly identical; therefore, we cannot rule out the influence of a reservoir effect in this case. Statistical verification of their consistency was conducted***, which confirmed the high degree of validity of the obtained results.

For assemblage 4 of the Stepnoye VII burial ground, we obtained two dates: 3472 ± 24 BP (MAMS-32156) and 3402 ± 24 BP (MAMS-32157) for Petrovka burial 17 and Alakul pit 33, respectively. Their positions on the chronological scale meets expectations, i.e. the first one proved to be earlier. However, according to the site's researchers, the second feature functioned throughout the duration of the Petrovka and Alakul phases of this complex (Kupriyanova, Zdanovich, 2015: 30).

The summation of probabilities for the sites (Fig. 5) and for the series in general (Fig. 6) has become the format for the generalization of dates. Both yielded very similar results within the 19th–18th centuries BC. In any case, it makes no sense to discuss the position of each site in the classification of Petrovka antiquities. It is impossible to narrow the probability intervals within the specified procedures. All that remains is to correlate our results with those obtained earlier (Hanks, Epimakhov, Renfrew, 2007; Molodin, Epimakhov, Marchenko, 2014), even more so in view of the critical comments expressed with regard to previous conclusions (Grigoriev, 2016). Taking into account the series currently being published, we have 36 dates (almost half of them AMS-dates), with a very wide scatter of values (for the summary report see (Epimakhov, 2016)). The most doubtful are the results from dating the Chistolebyazhsky and Verkhnyaya Alabuga burial grounds, not only owing to serious aging in a number of cases, but also in view of the inconsistency of the data*. It is fair to say that very ancient dates are encountered beyond these cemeteries as well. All results of this kind have been obtained without using acceleration technologies, and with dating based on wood and charcoal. A generalization of these values without critical analysis would only distort our understanding of the actual situation.

The AMS-dates obtained from human and animal bones in the Oxford and Mannheim laboratories are in complete contrast with the above results. Except for the admittedly erroneous dates mentioned, other dates are not only close, but are even identical in some cases. The generated interval actually stays within the 19th–18th centuries BC, which is fully consistent with the earlier assumption about the chronology of Petrovka antiquities, formulated on the basis of a much smaller series*.

To answer the questions raised in the beginning of this paper, we should consider the interval obtained in the system of other dates for Bronze Age sites in the region. Without going into detail, it should be noted that very close values are demonstrated by Sintashta antiquities (Epimakhov, Krause, 2013), as well as by those of the Seima-Turbino culture in the Urals (Chernykh, Korochkova, Orlovskaya, 2017). Does the conclusion about their synchronization follow from this? This is doubtful with regard to Sintashta and Petrovka artifacts, since there is stratigraphic evidence suggesting the priority of the former with respect to Petrovka material (see above). In addition, it is difficult to imagine the simultaneous existence in the same territory of two groups whose cultures differed**. It is a different matter that the two traditions are chronologically very close, which implies a considerable overlap of the intervals.

However, a synchronization with the Seima-Turbino antiquities seems to be more plausible (taking the differences in distribution areas into account). This is additionally confirmed by the presence of typical Seima-Turbino artifacts in Petrovka assemblages, kurgan 8 at Stepnoye VII being one of the recent finds (Kupriyanova, 2017: 34). This conclusion cannot be extended to other

*Calibration and other procedures were made using the OxCal 4.3 program (Bronk Ramsey, 2009) and the IntCal 13 calibration curve (Reimer et al., 2013).

**There are also examples where the standard deviation is 120 or 270 (!) years. It is clear that an interval cannot be meaningfully interpreted after calibration.

*Close results have been obtained for the Petrovka assemblage of Novoilyinovka in the Upper Tobol Region (excavations by E.R. Usmanova), in the neighborhood of Lisakovsk city (Kostanay Region, Republic of Kazakhstan).

**Along with distinctions in the appearance of ceramics, the differences in the funerary rites (Berseneva, 2017) and the typology of the assemblages have been well observed. In our series, the Petrovka traditions are represented, for example, by a chariot complex: the arrangement of a pair of horse-skeletons at the edge of the grave (Ozerny-1), and typical Petrovka cheek-pieces (Krivoye Ozero) (see Fig. 3).

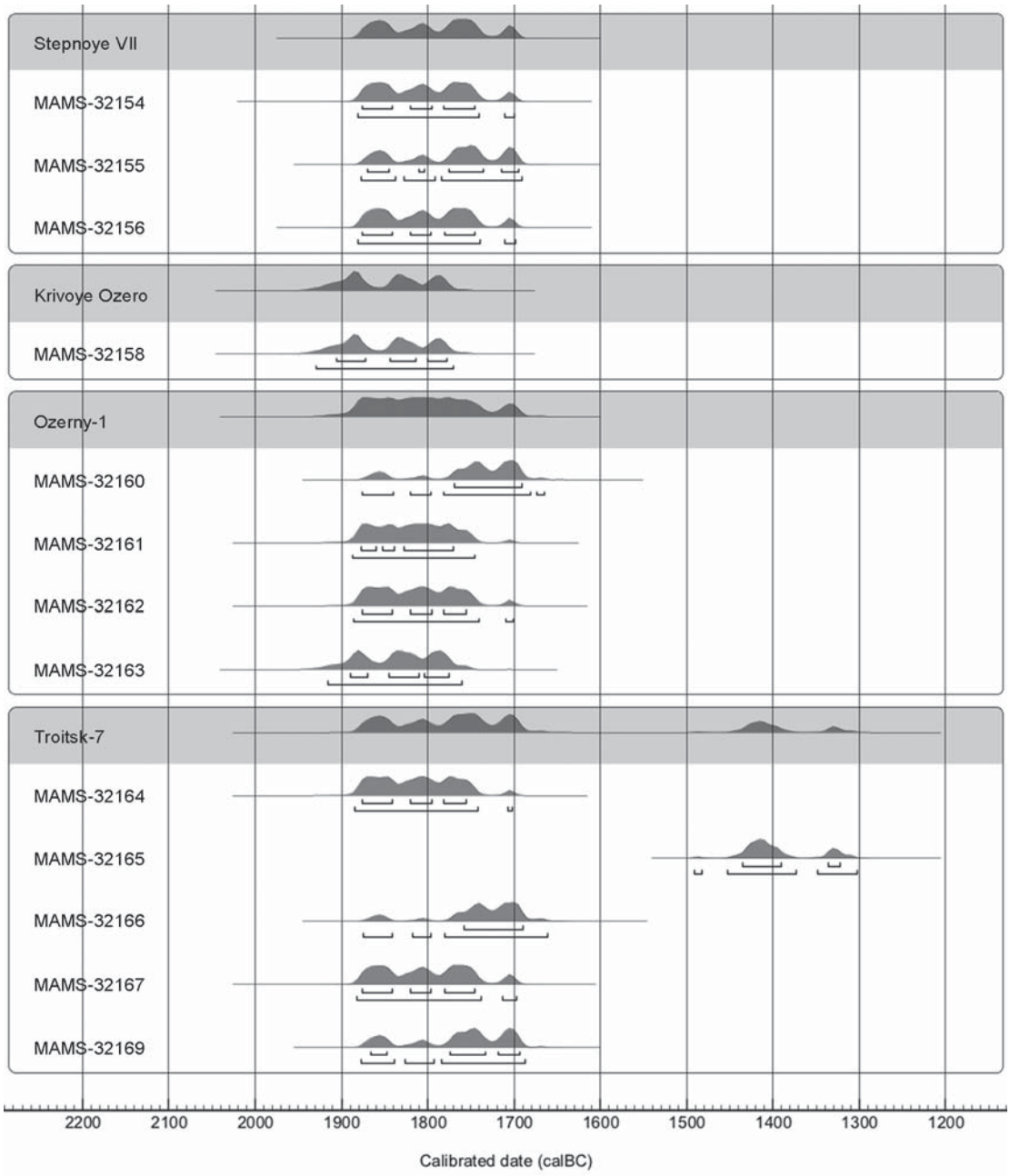

Fig. 5. Radiocarbon chronology of Petrovka cemeteries: results of the summation of probabilities of four sites.

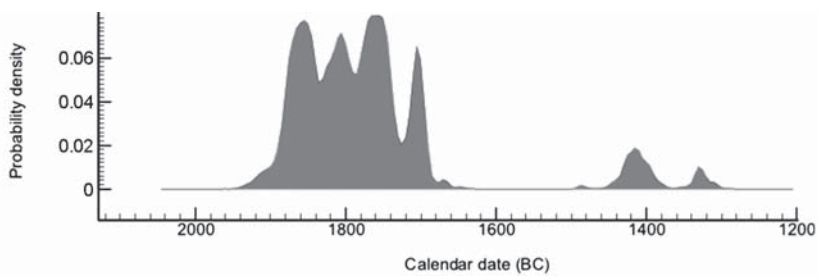

Fig. 6. Radiocarbon chronology of Petrovka sites: results of the summation of probabilities for the published series of dates.

regions where Seima-Turbino bronze artifacts were found, since arguments in favor of an earlier position of the eastern area are gradually increasing (Marchenko et al., 2017).

In an attempt to solve the second debatable issue (regarding the relationship between the Petrovka and Alakul traditions), various authors refer to various kinds of information. On the one side, there is the precedence of Petrovka sites to the "classical" Alakul*. This is based on stratigraphic and typological evidence. On the other side, almost half of the Alakul series of dates consists of very early ones (Epimakhov, 2016), which allows S.A. Grigoriev (2016) to defend the proposal of partial contemporaneity of Sintashta (in steppe) and Alakul (in forest-steppe) artifacts. Also, with regard to evidence, the resemblance of the Alakul ceramics to ceramics from the Middle Bronze Age in the Volga Region is emphasised. It is notable that the available "radiocarbon argument" is weak: about one-third of the Alakul dates are much earlier than the Sintashta dates. They do not even fall within the hypothesis of the very early history of the Alakul community, whose origins are in any case related to Sintashta traditions.

The debate is still far from over, as partially confirmed by our materials. For the Alakul assemblages of the Troitsk-7 and Stepnoye VII cemeteries, we have obtained two dates that are nearly identical to those of the Petrovka series: 3474 ± 24 BP (MAMS-32168) and 3402 ± 24 BP (MAMS-32157). As was pointed out earlier, the Alakul people arranged their burials with regard to already-existing Petrovka funerary structures. The most telling illustrations of this are an extension of an additional ditch section for new graves, and the conduction of sacrifices and burials within the boundaries of Petrovka kurgans. Thus, it is hardly possible to talk about a break with the tradition. On the contrary, here we can see an example of a foreign ritual space being mastered without destruction to preceding structures. Currently, there is reliable information about the "supplementation" of Sintashta funerary complexes with Petrovka features, and the latter in turn with Alakul features, which points to the sequence of these cultures. In fact, researchers agree on the issue of evolution of the Alakul ceramic assemblage towards the "elimination" of Petrovka traits.

It may appear as though the summary of facts presented here is logically inconsistent within a unified scheme. In our view, the solution to this problematic situation is to recognize that there must have been very high-speed and intense cultural and genetic evolutionary processes. The resolution of the radiocarbon chronology does not yet suffice to detect such rapid changes. In other words, the main events in the region under study took place within an interval outlined by a probability interval of the 19th–18th centuries BC, which is not so short (at least two centuries!). This version would stay within the interpretation of Petrovka antiquities as an early phase of the Alakul culture, as defended by N.B. Vinogradov. This is also indirectly confirmed by the mentioned relatively small number of Petrovka sites*.

Conclusions

New data on the chronology of Petrovka sites in the Trans-Urals have considerably increased the validity of previous conclusions about the chronological framework and succession of cultures in the region, but also require critical rethinking and detailing of the scheme of cultural genesis. The array of AMS-dates, which seems to be maximally reliable from our point of view, indicates that the Petrovka sites functioned within the 19th–18th centuries BC. We think the abandonment of these dates—until verification by repeated dating of these complexes is conducted—will be the only reasonable solution with respect to other analyses that demonstrate a great variation in values and inherent contradictions. The designated boundaries are no more than a statistically significant time interval, within which the events of interest took place. They do not record (and cannot record, owing to the method's specifics!) the actual duration of the existence of Petrovka traditions. This fact, along with stratigraphic and typological observations that determine the progression in the "Sintashta"–"Petrovka"–"Alakul" sequence, should be taken into consideration when

*This group is marked by ceramic ware with stepped shoulders, which is abundant at the eponymous site.

*Unfortunately, it is impossible to assess this parameter for the territory of northern and central Kazakhstan due to the absence of current data for this region.

working out a solution. Besides, the Petrovka people often continued to use the grounds (and sometimes the structures) of Sintashta settlements and cemeteries, while the Alakul population utilized Petrovka kurgans by extending their architectural elements and making burials on their peripheries*.

In our view, the only method of the noncontradictory reconciliation of these facts is to recognize such a high rate of cultural evolution that cannot be detected by radiocarbon dating methods. In this case, some early Alakul dates, whose calibrated intervals proved to be similar and even identical to Sintashta and Petrovka ones, are not an error in age determination, but illustrate a real historical situation in which a tradition was formed dynamically. As for the Petrovka antiquities, these represent a rather short initial episode in the long history of the Alakul community.

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