

RADIOCARBON DATING OF POTTERY FROM BRONZE AGE SITES IN EASTERN EUROPEAN STEPPES (RUSSIA)

P Kuznetsov • O Mochalov*

Samara State Social and Pedagogical University, Samara, ul. M. Gorkogo 65/67, 443099, Russia.

ABSTRACT. In recent decades, the radiocarbon method has frequently been used for dating organic admixtures in pottery. This method is useful for dating the Late Stone Age cultures in eastern Europe due to the poor availability of other organic materials. On the contrary, Bronze Age sites offer a great variety of organic sources, including remains of wooden structures, charcoal, and human and animal bones. This paper analyzes the ^{14}C dates obtained on bones and pottery from six Bronze Age sites in order to determine the feasibility of ^{14}C pottery dating for this particular period. Bronze Age pottery is made of silty clay containing organic matter, which can comprise older material. Therefore, ^{14}C dates obtained on bones, wood, or charcoal are more representative. This paper analyzes the ^{14}C dates obtained on bones and pottery from six Bronze Age sites. Based on this limited study, the authors conclude that dating of pottery from the Bronze Age is controversial and can result in much older dates. We argue this method is acceptable only if no other organic materials are available.

KEY WORDS: Bronze Age, eastern Europe, chronology.

INTRODUCTION

In recent decades, radiocarbon dating was frequently used for dating organic admixtures in pottery (e.g. Hedges et al. 1992; Skripkin and Kovalyukh 1998; O'Malley et al. 1999; Kuzmin 2012). It is extensively applied to dating the late Stone Age cultures in eastern Europe because the availability of other organic materials is limited (Zaitseva et al. 2009; Vasilieva 2011; Vybornov et al. 2012).

Although the Bronze Age sites in east European steppes provide a variety of other carbon-containing sources, pottery dating lately became widespread for age determination of Bronze Age cultures (Chernykh and Orlovskaya 2011; Kuznetsov 2013). However, in this case the ages determined were often significantly older compared to earlier results (Morgunova and Khokhlova 2013; Morgunova 2014). For example, the age of the Yamnaya culture based on ^{14}C dating of pottery was determined to be more than 500 yr older compared to previous ^{14}C dates obtained on other materials (Morgunova and Khokhlova 2013). The chronology of the Early Yamnaya period was based on 18 pottery ^{14}C dates, three values run on human bones, and a single date on soil humus (Morgunova and Khokhlova 2013: Table 1). In determining the age of the classic Yamnaya period, 30 ^{14}C dates on human bones, 8 values on wood, 4 dates on soil humus, and 2 values on pottery were used (Morgunova and Khokhlova 2013: 1293, Table 2). Thus, the age of the Early Yamnaya period was determined with 81.1% of dates run on pottery, while for the Middle Yamnaya period the majority of dates (68.1%) were obtained on human bones, and ^{14}C pottery dates made up only 4.5% of the total. It is therefore important not to rely on dates run on pottery but also consider other organic sources from the same cultural complexes. The Bronze Age sites of the east European steppe provide a good opportunity for this.

The Bronze Age is a significant historical period, which began in the mid-4th millennium BCE and ended at the transition from the 2nd to 1st millennia BCE. The eastern part of this vast area is bounded by the Ural Mountains. The largest rivers in east European steppe include the Volga, the Ural, the Don, and their many tributaries. Grasslands made this region suitable for cattle breeding. Populations of cattle-herders were dominant on this territory, and they left numerous burial mounds and habitation sites with cultural layers rich in archaeological remains.

*Corresponding author. Email: oleg-mochalov00@rambler.ru.

Table 1 ^{14}C dating results of pottery and animal bones found together in Repin Khutor (Kuznetsov 2013).

Site	Sample	Lab nr	^{14}C age BP	cal BC (95.4%)
Repin Khutor	Pottery 1	Ki-16540	4510 \pm 70 BP	3500–2900
Repin Khutor	Pottery 2	Ki-16541	4630 \pm 80 BP	3650–3100
Repin Khutor	Pottery 3	Ki-16542	4640 \pm 70 BP	3650–3100
Repin Khutor	Pottery 4	Ki-16543	4560 \pm 80 BP	3550–3000
Repin Khutor	Pottery 5	Ki-16272	5060 \pm 80 BP	3990–3660
Repin Khutor	Pottery 6	Ki-16486	4830 \pm 80 BP	3780–3370
Repin Khutor	Horse 1	Ki-15663	4180 \pm 70 BP	2910–2570
Repin Khutor	Horse 2	Ki-15664	4070 \pm 60 BP	2870–2470
Repin Khutor	Horse 3	Ki-15665	4150 \pm 70 BP	2900–2490
Repin Khutor	Cow	Ki-15666	4380 \pm 90 BP	3350–2870

Table 2 Paired dates from the same complexes on pottery, bones, and teeth*.

Site	Sample	Lab nr	^{14}C age BP	cal BC (95.4%)
Lopatino I, 31/1	Human bone	AA-47804	4432 \pm 66	3340–2910
Lopatino I, 31/1	Pottery 1	Ki-14544	4800 \pm 80	3720–3370
Lopatino I, 31/1	Pottery 2	Ki-14544	4750 \pm 70	3650–3360
Tamar-Utkul VIII, 4/1	Human bone	GrA-54382	4165 \pm 35	2890–2620
Tamar-Utkul VIII, 4/1	Pottery	Poz-47845	4200 \pm 90	3050–2450
Skvortsovka 1/1	Human bone	Le-8583	4100 \pm 110	2950–2300
Skvortsovka 1/1	Pottery	Ki-16260	4090 \pm 90	2950–2300
Usmanovo III	Pottery	Beta-352489	4040 \pm 30	2630–2470
Kazburunovo I 5/1	Teeth 1	Beta-347343	3490 \pm 30	1900–1730
Kazburunovo I 5/1	Teeth 2	Beta-347344	3520 \pm 30	1930–1750
Kizil-Khak II	Pottery, sp.1	Ki-15075	4730 \pm 70	3640–3360
Kizil-Khak II	Pottery, sp.2	Ki-15092	4550 \pm 70	3390–3020
Lebyazhinka IV	Pottery, sp.1	Ki-15076	4020 \pm 70	2900–2300
Lebyazhinka IV	Pottery, sp.2	Ki-15093	4330 \pm 80	3350–2650

*The comparison of date pairs shows that all pottery ^{14}C values are considerably older than bone and teeth ones, with the exception of the one coinciding pair from Skvortsovka mound 1 grave 1.

This paper therefore aims to determine whether ^{14}C dates run on pottery can provide credible age information, are reliable to build a Bronze Age cultural chronology, and puts forward evidence showing that pottery analysis results in older dates.

METHODS

There is a large data set of Neolithic ^{14}C dates mostly obtained on pottery from different regions in eastern Europe (Zaitseva et al. 2009; Vybornov et al. 2012). Bronze Age pottery was also actively dated, often by applying the technology developed by Skripkin and Kovalyukh (Skripkin and Kovalyukh 1998). This method allows analyzing all the organic admixtures in pottery. The carbon contained in pottery is converted into the lithium carbide with further synthesis of benzene (Skripkin and Kovalyukh 1998). Currently, there are many ^{14}C dates run on human and animal bones from the Bronze Age sites in eastern Europe (see Anthony 2007: 314–6). However, the pottery dates differ from the ^{14}C dates obtained on other materials.

We sampled several Bronze Age sites that had ¹⁴C dates both on pottery and other carbon-containing materials. In addition, we dated three pots from three different sites (Lopatino kurgan 31 grave 1, Kizil-Khak II settlement, and Lebyazinka IV settlement), and had the opportunity to compare the dates obtained on two separate potsherds taken from each pot. Finally, we received and analyzed 24 ¹⁴C dates from eight Bronze Age sites in east European steppes. Most of these dates are already published (see Anthony 2007: 266, 274–5; Kuznetsov 2013: 18–20; Morgunova 2014: 194).

MATERIALS

We analyzed the ¹⁴C dates from the sites undoubtedly corresponding to three main periods of the Bronze Age in the east European steppe (Figure 1). These archaeological cultures are clearly associated with certain periods, and their age determination is confirmed by the series of ¹⁴C dates.

The sites of the Yamnaya and Repin cultures belong to the Early Bronze Age (Anthony 2007). We analyzed the materials from the Repin Khutor settlement, Lopatino I burial ground, and Lebyazhinka VI and Kyzyl-Khak settlements. The Repin Khutor site on the Don River (49°11'29.13"N, 43°48'05.25"E) is a settlement with one cultural layer. We received four ¹⁴C dates on animal bones and six ¹⁴C values on pottery from this site. Mound 31 of Lopatino I burial ground on the Sok River (left tributary of the Volga River; 53°38'31.89"N, 50°39'15.04"E) belongs to the Yamnaya culture. We dated two potsherds of one pot and one human bone. Lebyazhinka VI settlement (53°41'27.60"N, 50°40'57.47"E) and Kyzyl-Khak settlement

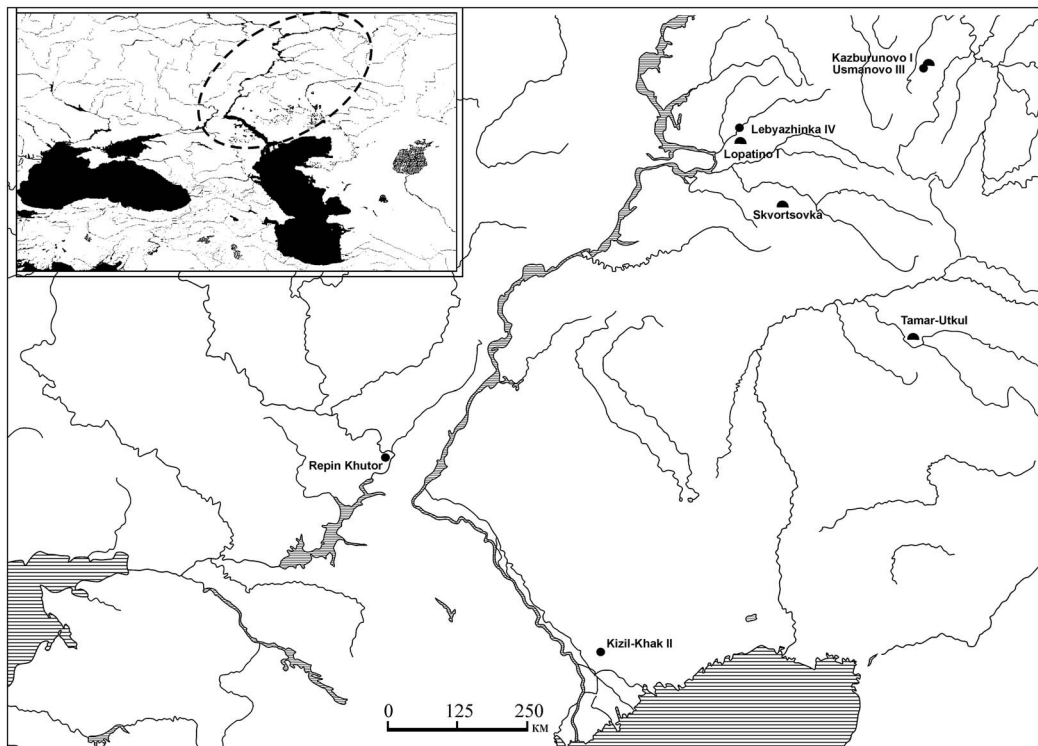


Figure 1 Map of the Bronze Age sites used in the paper

(46°56'01"N, 48°20'13"E) are sites with several cultural layers. We obtained four ¹⁴C dates on the Yamnaya–Repin pottery, two from each site.

The Late Yamnaya and the early Poltavka sites are related to the Middle Bronze Age (Anthony 2007: 328–36). Mound 6 of Skvortsovka burial ground on the Samara River (52°34'52.46"N, 52°08'10.91"E) and mound 4 of Tamar–Utkul VIII burial ground on the Ural River (50°53'03.93"N, 54°24'57.15"E) correspond to this very period. Two samples from each mound were dated: one pottery date and one ¹⁴C date on human bone from each site.

The Usmanovo III settlement (54°03'32.06"N, 55°31'48.29"E) is related to the Late Bronze Age generally dated to 1800–1600 BCE (Anthony 2007: 408–11). Some 500 m northeast from the settlement, the Usmanovo inhabitants created mounds over their relatives' graves at the burial ground Kazburunovo I on the Urshak River (54°03'44.08"N, 55°32'08.1"E) (Shcherbakov et al. 2013). These two sites were abandoned by the Srubnaya people. There are two ¹⁴C dates on human teeth from two graves in the mound and one ¹⁴C date on pottery from the settlement.

Our study is based on materials from eight Bronze Age sites providing 15 direct pottery dates and 9 ¹⁴C values on human and animal bones. Four ¹⁴C dates on bones were generated by the accelerator mass spectrometric (AMS) ¹⁴C method.

RESULTS

In order to determine the feasibility of direct ¹⁴C dates on pottery for archaeology of eastern Europe, we compared the dates obtained on pottery with the dates from other materials excavated at the same sites. An analysis was conducted on six fragments of pottery, three horse bones, and one cow bone (Table 1). Dates were calibrated with OxCal v 4 software (Bronk Ramsey and Lee 2013) and the IntCal13 calibration data (Reimer et al. 2013).

Figure 2 summarizes the sum of date probabilities. The pottery gave much earlier ¹⁴C dates of 4000–3000 BCE (95.4% confidence), and this is significantly different from values on the animal bones dating back to 3350–2450 BCE.

Figure 3 (numbers 1–5) and Table 2 present the analysis of human bones and pottery from three Yamnaya sites (Lopatino I mound 31 grave 1, Tamar–Utkul VIII mound 4 grave 1, and Skvortsovka mound 1 grave 6). There are ¹⁴C dates obtained on pottery from the Usmanovo III site, and on human teeth from the Kazburunovo I burial ground (Shcherbakov et al. 2013). Overall, we obtained 20 ¹⁴C dates on both pottery and bones from six Bronze Age sites (Table 2), including 11 values on pottery and 9 dates on bones and teeth.

DISCUSSION

Our results show that pottery tends to give older dates in over 90% of cases in comparison with other materials excavated at Bronze Age sites in the east European steppes. Furthermore, the age of some potsherds was determined to be 500 yr older than the dates obtained on bones (Morgunova and Khokhlova 2013: 1290). Moreover, separate potsherds taken from the same pot gave different ¹⁴C dates.

To a certain degree, this is caused by admixtures in pottery containing crushed shells (Anthony 2007; Vasilyeva 2011: 74). However, we consider the origin of the raw materials used for pottery-making to be the basic reason for older age determination. The majority of the dated Bronze Age pots were made of silty clay (Salugina 2011: 87, 92). Silty clay is formed by sedimentary deposits at the bottom of a river. This material is characterized by a high concentration

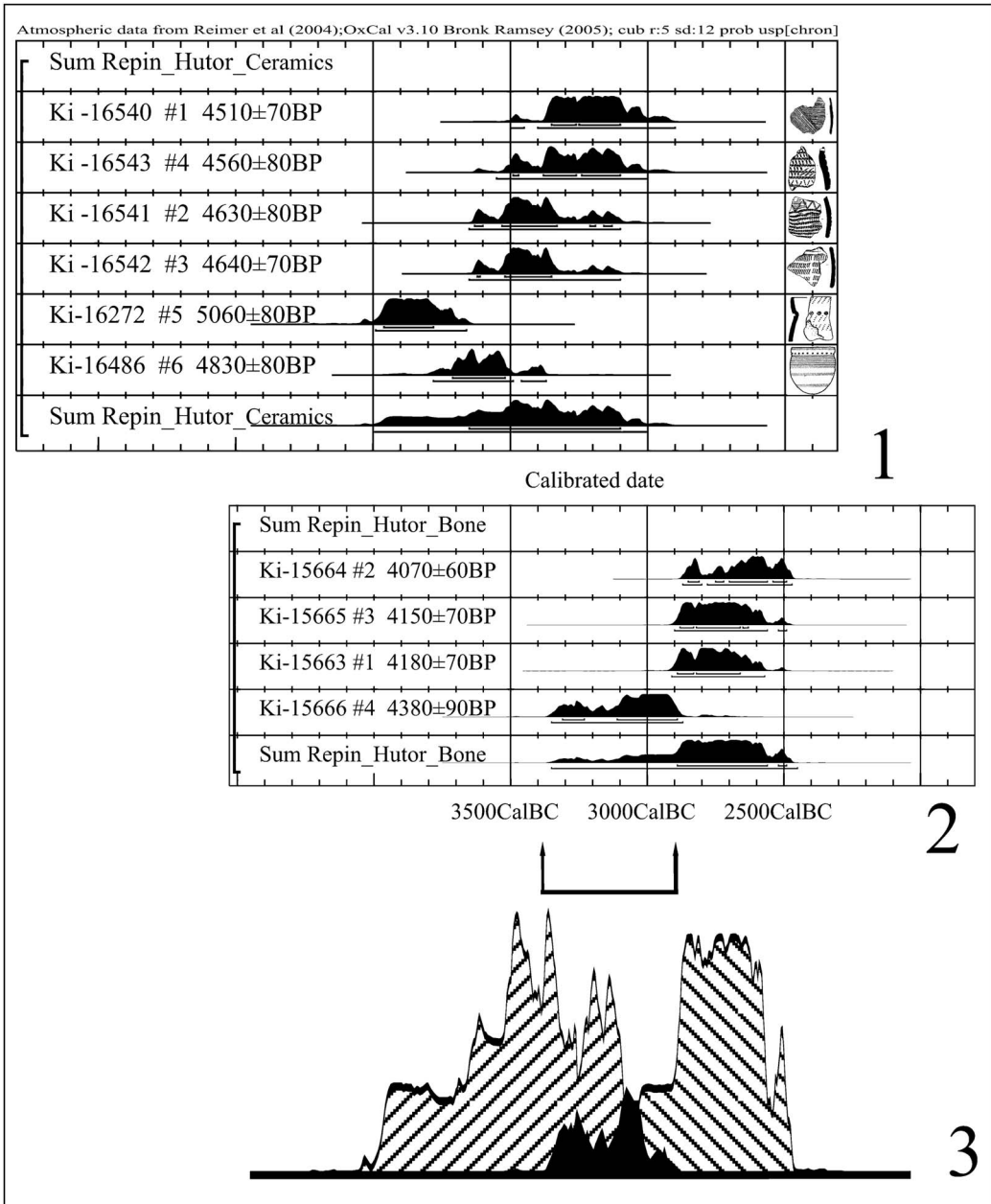


Figure 2 Radiocarbon dates for Repin Khutor: (1) sum of 6 dates on pottery; (2) sum of 4 dates on bones; (3) both groups of dates combined. The black field means the area of overlay of the calibrated dates, obtained on pottery and bones. Dates calibrated with OxCal v 4 software (Bronk Ramsey and Lee 2013) and the IntCal13 calibration data (Reimer et al. 2013).

of organic matter, which can have a substantial age. Hence, the pottery dates are often on older carbon not associated with the archaeological period. Due to the unsystematic sedimentation of organic remains in silt, it is unlikely to find a general correction value that can be applied to all pottery ¹⁴C dates.

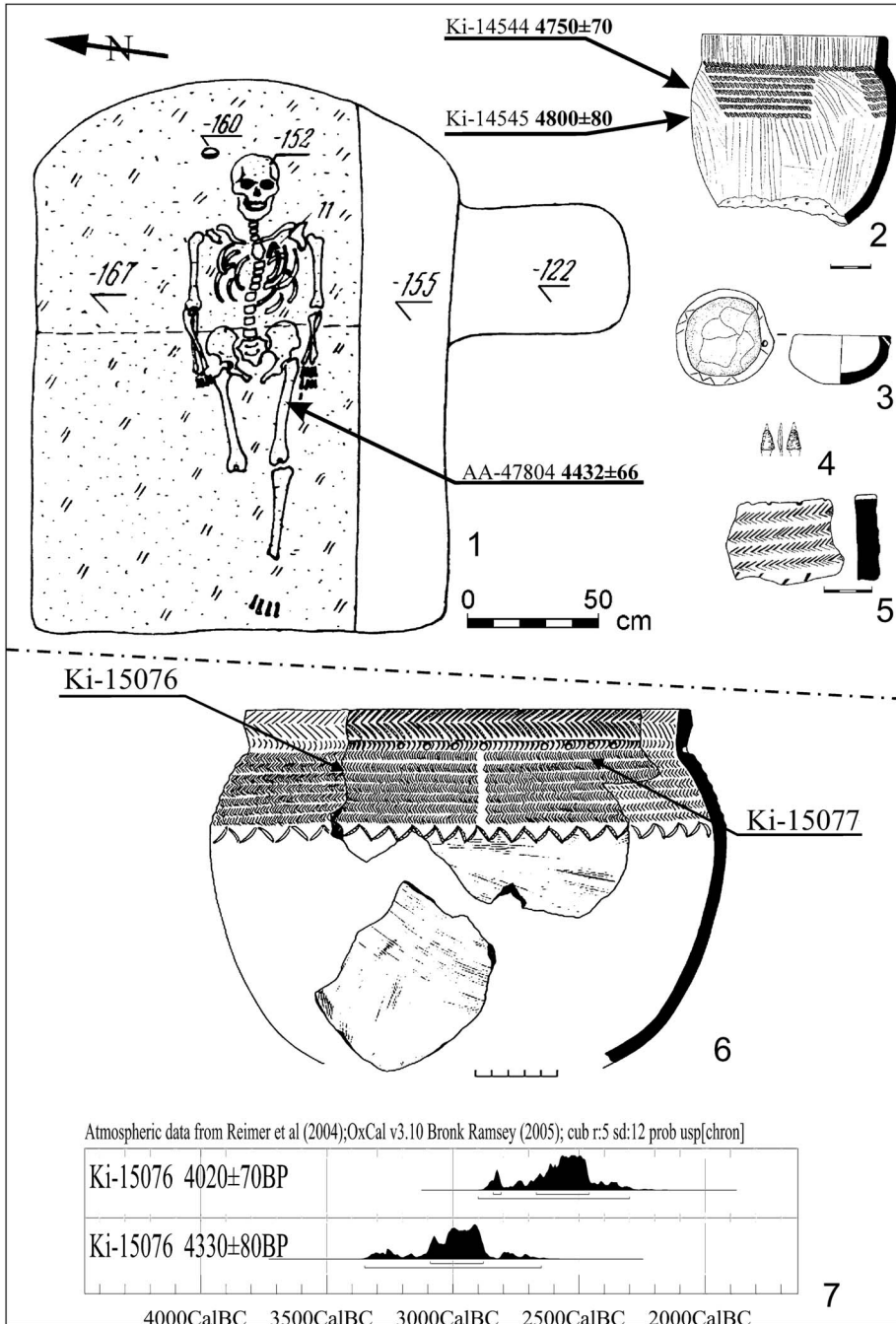


Figure 3 Dates for bones and pottery of Yamnaya sites (Early Bronze Age): (1) Lopatino I mound 31 grave 1; (2) dated pot from the ritual pit; (3) ochre-colored bowl beside the skull in the buried body; (5) potsherd; (6) pot from Lebyazhinka IV; (7) calibrated dates on the Lebyazhinka IV pot.

The dates obtained on Neolithic pottery excavated at east European sites form a similar picture. For example, Vybornov et al. (2012: 797) obtained 11 ¹⁴C dates for the Neolithic site of Kairshak III, including 7 values on pottery, 3 on bones, and 1 on charcoal. All pottery ¹⁴C dates turned out to be older than the ones on bones and charcoal. Kuzmin (2012: 124) previously addressed this effect. The Early Neolithic pottery from the Elshanka cultural complex does not have any organic temper (Vasilieva 2011), and pottery ¹⁴C dates will be a priori older compared to the actual age of this culture.

CONCLUSION

We have determined that Bronze Age pottery consistently gives older dates compared to the values obtained on bone and wood. The Bronze Age in eastern Europe is represented by various archaeological sites rich in other organic materials alongside with pottery. The use of wood, charcoal, and animal and human bones in age determination gives dates that appear to be more closely associated with the archaeological age. Thus, we consider direct ¹⁴C dating on pottery only appropriate for those archaeological periods that do not contain any other organic materials. In contrast, where the organic material was clearly deliberately added by potters just before firing the pot, this can be expected to give good results.

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