Radiocarbon (2024), **66**, pp. 532–551
doi:10.1017/RDC.2024.72

CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Combined AMS ^{14}C and archaeological dating of the Rouran period cemetery of Choburak-I (Northern Altai)

N N Seregin[1], S V Svyatko[2], G Barrett[2], S S Matrenin[1] and P J Reimer[2]

[1]Altai State University, Barnaul, Russia and [2]Queen's University Belfast, Belfast, Northern Ireland
Corresponding author: S.V. Svyatko; Email s.svyatko@qub.ac.uk

Received: 11 December 2023; **Revised:** 03 April 2024; **Accepted:** 06 April 2024; **First published online:** 18 September 2024

Keywords: Altai; Bulan-Koby Culture; Choburak-I; material culture; Rouran Khaganate

Abstract

This paper presents a detailed chronological study of the previously undisturbed burial ground of Choburak-I of the Bulan-Koby Culture in the Northern Altai using a program of comprehensive dating, including AMS ^{14}C dating of human and animal remains (26 ^{14}C dates from 12 kurgans in total), and archaeological dating of the associated artifacts. This completely excavated cemetery contained numerous grave goods and various organic remains (anthropological and archaeozoological) critical for understanding the social and chronological dynamics of this culture during the Rouran period in Altai (second half of the 4th–first half of the 6th century CE). The results of archaeological dating, supported by the largest set of AMS ^{14}C dates for the Bulan-Koby Culture, and further aided by Bayesian analysis, demonstrate the likely continuous existence of the necropolis within the period of 310–400 cal CE, which broadly corresponds to the beginning of the Rouran period in the history of Altai, with a maximum duration of 66 years. The presented results make it possible to consider the necropolis of Choburak-I as a chronologically defining monument of the Rouran period of Northern Altai and permit a new level of relative and absolute chronological reconstructions for archaeological sites of this region and adjacent territories at the turn of late antiquity and the early Middle Ages.

Introduction

The period of the second half of the 4th–first half of the 6th century CE, when, according to Chinese dynastic chronicles, the Rouran Khaganate existed on the territory of modern Mongolia, and spread its influence to many nomadic tribes across the vast areas, is still one of the "blank spots" in the history of Central Asia (Barfield 2009, 199–204; Drobyshev 2019, 133–142; Golden 1992, 76–79; Handsuren 1993, 66–106; Kradin 2000, 80–94; Kychanov 2010, 91–95; Sinor 1969, 97–100; Vorobyov 1994, 297–303; etc.). This time, which can be referred to as Rouran or pre-Turkic, is of fundamental importance for understanding the complex ethno-cultural and socio-political phenomena of the Great Migration Period (GMP), as well as for the reconstruction of the processes of formation of the early medieval nomadic communities. Archaeological sites that could be securely associated with the Rourans (as well as with other cultures) are virtually absent in the territory of modern Mongolia during this period (Kradin 2007, 147; Savinov 1984, 22). Only in recent decades have isolated burials been investigated that date from the second half of the 4th - first half of the 6th century CE in different parts of Mongolia (see review in Seregin and Matrenin, 2020). These burials have quite likely been left by representatives of the Rouran ethno-political association.

To date, the most representative corpus of well-attributed archaeological sources on the Rouran period originates from the territory of Altai and demonstrates the existence in the region in the second half of the 4th-5th century CE of the polyethnic Bulan-Koby Culture (a culture that spans the 2nd century BCE–5th century CE; Mamadakov 1990; Soenov 1997; Matrenin 2005; Tishkin 2007; Seregin

and Matrenin 2016). Based on the available published and archival information, the studied complex of sites of this period consists of more than 130 burials (sites of Berel, Verkh-Elanda-II, Verkh-Uymon, Dyalyan, Katanda-I, Kok-Pash, Stepushka, Chendek, Ust-Biyke-III, Yaloman-II; Gavrilova 1965; Soenov and Ebel 1992; Bobrov et al. 2003; Tishkin and Gorbunov 2005; Seregin and Matrenin 2016; Tishkin et al. 2018), rock paintings (Gorbunov 2003, 118), Kosh-Agach iron-melting furnaces (Bogdanov et al. 2018; Murakami et al. 2019; Vodyasov and Zaitseva, 2020, 2021) and other site types (Kubarev 2010). Research into these sites shows that dating remains a serious problem in their interpretation, which at the moment is based mainly on the typological analysis of objects, as well as radiocarbon (^{14}C) dating of some individual complexes (Verkh-Uymon, Stepushka, Yaloman-II; Tishkin and Gorbunov 2005, 160–161; Tishkin 2007, 175–179). Despite this, the accumulated data from available and unpublished new sources provides opportunities for detailing the time of appearance of specific sites. In particular, a systematic and detailed chronological study on the materials of the undisturbed burial ground of the Bulan-Koby Culture of Choburak-I in the Northern Altai, which has been completely excavated and contained numerous goods and various organic remains (anthropological and archaeozoological) is critical to understanding the social and chronological dynamics of this culture during the Rouran period (e.g. Seregin et al. 2022). The conclusions from such research would be fundamentally important for detailed chronological interpretation of the monuments of the Rouran period, both in Altai and other regions of Central Asia.

A similar analytical approach has recently been applied to another Altai site of the Bulan-Koby Culture—Karban-1 (Seregin et al. 2023), where compatibility between the newly obtained ^{14}C dates and chronological indicators based on the analysis of artifactual complexes was presented and used to help clarify the chronology of monuments for this period in Altai.

Choburak-I site

The funeral and memorial complex of Choburak-I is located in the Chemalsky District of the Altai Republic, south of the village of Elanda, on the right bank of the Katun River (Figure 1). A distinctive feature of this site is the presence of structures and objects of various chronological periods—from the Eneolithic (Afanasyevo Culture) to the early medieval period (Turk culture). In the northern part of this large complex, a necropolis of the Bulan-Koby Culture was identified, subsequently completely excavated by the Chemal archaeological expedition of Altai State University led by N.N. Seregin. This necropolis consisted of 12 burial mounds (kurgans), tightly arranged in a small area (Figure 2.1). These kurgans contained undisturbed burials, organised according to the ritual practice of what has been referred to as the Dyalyan tradition of the Bulan-Koby culture (a sub-group within the polyethnic Bulan-Koby Culture). These burials typically include a small stone mound with an oval crepidoma, shallow and narrow pit, positioning of the deceased stretched out on their back with their head to the western sector of the horizon with inclination to the north, and the accompanying burial of a horse at the deceased's legs (Figure 2.2; Matrenin 2005, 96–97; Seregin and Matrenin 2016, 161–162). Numerous accompanying items were found with the deceased (some of them are shown in Figure 2.3-11), among which various categories of weapons have been identified, as well as human equipment, horse ammunition, tools, household items and jewelry. Anthropological analysis identified seven men, three women, one teenager and a child among the deceased, which was also confirmed by the "typical" composition of the associated grave goods found with the individuals (Seregin and Matrenin 2020, 35–67). The analysed necropolis reflects the existence of a small, but at the same time very uniform, community and probably contains the burials of close relatives (ongoing DNA and anthropological analyses, Svetlana Tur, pers. comm.).

The materials obtained from Choburak-1 turned out to be informative for the implementation of chronological, ethno-cultural and social reconstructions. In particular, traumatic injuries without traces of healing documented on three male skeletons are indicative of armed violence inflicted mainly with a sword (decapitation, cutting off the hand, cut-chopped wounds on the bones), which suggest the

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

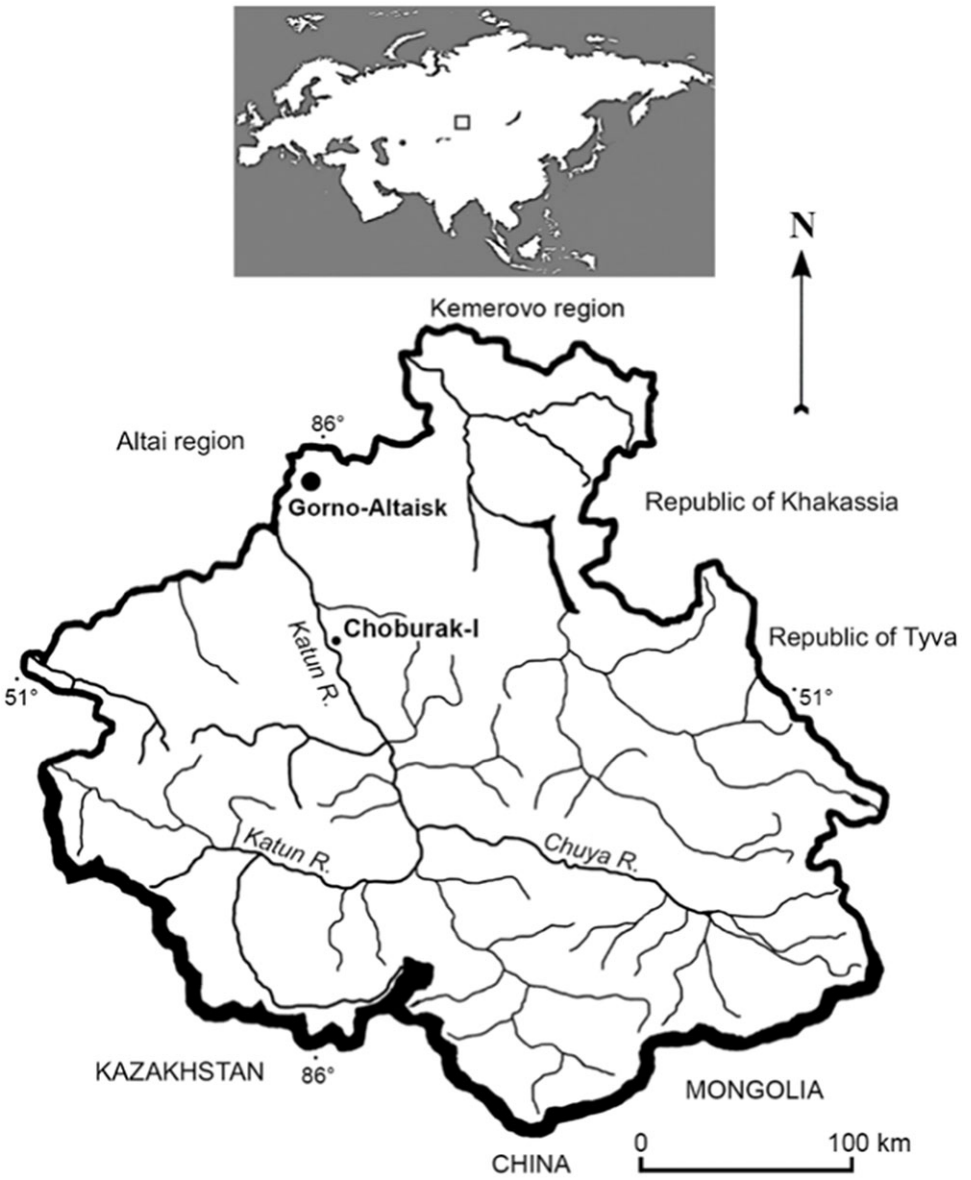

Figure 1. *Location map of the Choburak-I archaeological site in the Altai region of Southern Siberia. The map is based on Shchukina (2005).*

involvement of these men in armed conflicts, reflecting the high level of social tension in Altai in the second quarter of the 1st mil. CE, including possible clashes with culturally/ethnically foreign populations (Tur et al. 2018).

From the available archaeological materials, the historical fate of the local population of the Bulan-Koby Culture, who buried their deceased at the Choburak-I burial ground, was closely connected with the Rouran Khaganate. In the second half of the 4th–beginning of the 5th century CE, being one of the groups bearing the so-called Dyalyan tradition of ritual practices, they became the local elite of the nomadic society of the Northern Altai (Seregin and Matrenin 2020). After the decline of the Rourans and the formation of the First Turkic Khaganate in the middle of the 6th century CE, the Dyalyan population was involved in the migration flow to the west; a manifestation of this can be observed in the

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

appearance in the Eastern European steppes, during the second half of the 6th–7th century CE, of graves with a horse and individual parts of its carcass, laid in long pits with western and northwestern orientation and placed at the legs of the deceased at different levels (Mit'ko 2018, 38; 2019, 58). Another group of representatives of the Dyalyan tradition resettled in the northern foothills of Altai. This eventually led to the formation of one of the ethnic components, which later took part in the genesis of the Srostkinskaya Culture (second half of the 8th–12th century CE) in the Altai forest-steppe (Seregin et al. in press).

The presence of a variety of material culture, anthropological and archaeozoological remains discovered during the excavations of Choburak-I makes it possible to implement a program of comprehensive dating, including archaeological dating and AMS ^{14}C dating; the results of this program are presented and discussed below. This methodological approach has been previously employed in the analysis of the Karban-1 monument of the Bulan-Koby Culture, also located on the territory of the Altai (Seregin et al. 2023).

Methods and materials

Archaeological dating

For the chronological interpretation of the grave goods from Choburak, we carried out typological analysis, comparing different categories of artifacts with relevant reference analogies from the Early Iron Age and Medieval sites of Central and East Asia (including the cemeteries of the Bulan-Koby Culture). This permitted identification of objects with an established initial period of existence elsewhere in Altai. After that, grading of dated types of objects was carried out, taking into account the previously accepted duration of their use in the region. The more detailed analysis of the objects is presented in Seregin and Matrenin (in press). Chronological indicators are considered to be objects dated sufficiently accurately during the cross-correlation of most abundant materials (Bazhan and Gay 1992, 123).

AMS ^{14}C dating and stable isotope analysis

AMS radiocarbon analysis was applied to all twelve excavated burial mounds of the Choburak-I complex. The detailed description of the burials is presented in Appendix 1. Sampling was carried out based on the degree of preservation of anthropological and paleozoological remains in particular burials. As a result, a series of 26 osteological specimens was selected, including 13 humans, 11 horses, and 2 ovicaprids (Table 1). Four samples were taken from burial mound 32 (two from the human and two from the horse) and 34a (two from the human, one from the horse, and one from the sheep), two (human and horse bones) from mounds 30, 31, 31a, 32a, 33, 34, and 38, one (human) from mounds 29 and 29a, and one horse and one ovicaprid from mound 30a. To date, this is a unique series for sites of the late stage of the Bulan-Koby Culture of Northern Altai, and also the most comprehensively radiocarbon dated site for the Rouran period.

Radiocarbon dating was carried out in the ^{14}CHRONO Centre for Climate, the Environment and Chronology of the Queen's University Belfast (Northern Ireland). Bone collagen extraction was carried out following the ultrafiltration method (Brown et al. 1988; Bronk Ramsey et al. 2004) which included: a) bone demineralization in 2% HCl, followed by MilliQ® ultrapure water wash; b) 0.1M NaOH treatment for 15-30 mins, followed by MilliQ® ultrapure water wash; c) further treatment in 2% HCl for 15-30 mins, MilliQ® ultrapure water wash; d) gelatinization in pH=2 HCl at 58°C for 16 hours; e) filtration, using ceramic filter holders, glass filter flasks and 1.2 µm glass microfiber filters; f) ultrafiltration using Vivaspin® 15S ultrafilters with MWCO 30 kDa; 3000-3500 rpm for 30 min; and g) freeze-drying. The dried collagen was stored in a desiccator. Samples UBA-37792-40779 were combusted at 850°C in closed tubes with an excess of CuO. The CO_2 was converted to graphite on an iron catalyst using a zinc reduction method (Slota et al. 1987). The pressed graphite target was then

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

Table 1. *AMS ^{14}C dates, calibrated age ranges and stable C and N isotope values of human and animal bone samples from the Bulan-Koby Culture burials of the Choburak-I necropolis. Sex and age determinations for humans were provided by S. Tur*

Lab ID	Provenance	Sample	AMS ^{14}C, BP	Cal date (2σ)	$\delta^{13}C$, ‰	$\delta^{15}N$, ‰	$C:N_{at}$
UBA-37792	Kurgan 29	Human (9–11 y.o.)	1774 ± 29	218–362 CE	–17.9	9.9	3.17
UBA-37793	Kurgan 29a	Human (♂?, 13–15 y.o.?)	1598 ± 34	414–550 CE	–18.8	10.1	3.16
UBA-37794	Kurgan 32	Human (♂, 25–30 y.o.)	1791 ± 45	130–380 CE	–18.5	10.3	3.16
UBA-37795	Kurgan 32	horse	1650 ± 26	263–535 CE	–20.7	3.3	3.17
UBA-37796	Kurgan 33	Human (♀, 20–25 y.o.)	1739 ± 44	238–411 CE	–19.0	10.1	3.16
UBA-37797	Kurgan 33	horse	1559 ± 50	416–600 CE	–20.7	3.8	3.17
UBA-40778	Kurgan 34a	Human (♂, 30–35 y.o.)	1681 ± 23	261–419 CE	–17.5	9.8	3.06
UBA-40779	Kurgan 34a	horse	1734 ± 25	249–403 CE	–20.8	3.7	3.06
UBA-45460	Kurgan 30	horse	1704 ± 28	254–416 CE	–21.2	4.0	3.16
UBA-45461	Kurgan 30	Human (♂, 30–35 y.o.)	1760 ± 26	237–376 CE	–18.6	10.3	3.19
UBA-45462	Kurgan 30a	horse	1690 ± 21	261–416 CE	–21.4	3.6	3.19
UBA-45463	Kurgan 30a	Animal (ovicaprid?)	1728 ± 22	251–405 CE	–19.3	3.0	3.19
UBA-45464	Kurgan 31	horse	1713 ± 22	255–410 CE	–21.0	4.3	3.19
UBA-45465	Kurgan 31	Human (♂, 40 y.o.)	1738 ± 22	247–402 CE	–18.2	10.2	3.18
UBA-45466	Kurgan 31a	horse	1701 ± 22	258–413 CE	–21.2	4.2	3.17
UBA-45467	Kurgan 31a	Human (♂, >55 y.o.)	1727 ± 21	251–405 CE	–18.5	10.4	3.19
UBA-45468	Kurgan 32	horse	1682 ± 22	261–418 CE	–20.8	3.5	3.19
UBA-45469	Kurgan 32	Human (♂, 25–30 y.o.)	1731 ± 21	250–404 CE	–18.3	10.3	3.16
UBA-45470	Kurgan 32a	horse	1711 ± 22	256–410 CE	–21.0	3.8	3.16
UBA-45471	Kurgan 32a	Human (♀, 40–50 y.o.)	1741 ± 23	245–402 CE	–17.3	10.3	3.16
UBA-45472	Kurgan 34	horse	1751 ± 22	242–376 CE	–21.1	3.7	3.17
UBA-45473	Kurgan 34	Human (♀, 30–35 y.o.)	1735 ± 24	249–403 CE	–18.9	10.2	3.15
UBA-45474	Kurgan 34a	sheep	1703 ± 21	258–412 CE	–19.9	5.3	3.23
UBA-45507	Kurgan 34a	Human (♂, 30–35 y.o.)	1730 ± 21	250–404 CE	–18.2	10.4	3.19
UBA-45511	Kurgan 38	horse	1682 ± 24	260–420 CE	–21.2	4.3	3.18
UBA-45610	Kurgan 38	Human (♂, 25–30 y.o.)	1741 ± 30	244–402 CE	–18.5	10.3	3.17

measured by 0.5 MeV National Electrostatics Compact AMS. The other samples were weighed into pre-cleaned tin capsules and combusted in oxygen with a helium carrier gas in an Elemental Analyser (Elementar Vario Isotope), and then transferred to the AGE3 automated graphite system where they were reduced to graphite using the hydrogen reduction method (Wacker et al. 2010). Graphite was pressed into vacuum cleaned aluminum holders (targets) using an automated hydraulic press, transferred to the magazine, and loaded into the MICADAS AMS together with suitable background (blank) samples (Hollis mammoth bone collagen).

The $^{14}C/^{12}C$ and $^{13}C/^{12}C$ ratios were measured with the MICADAS. The sample $^{14}C/^{12}C$ ratio was background corrected and normalised to the HOXII standard (SRM 4990C; National Institute of Standards and Technology). The $^{14}C/^{12}C$ ratio was corrected for isotope fractionation using the AMS measured $^{13}C/^{12}C$ ratio which accounts for both natural and machine fractionation. The dates were calibrated using Calib8.2 program (http://calib.org/calib/) and IntCal20 calibration curve (Reimer et al. 2020).

For carbon and nitrogen stable isotope measurements (including $\delta^{13}C$, $\delta^{15}N$, and $C:N_{atomic}$ ratios), a Thermo Delta V Isotope Ratio Mass Spectrometer was used. Collagen samples were measured in duplicate with a drift correction standard of certified isotopic composition bracketing every 10–12 samples. Reference materials with known isotopic compositions were also measured to create a two-point regression line, which is used to calibrate the sample data to the VPDB (carbon) and AIR (nitrogen) scales (detailed description of the analytical process is presented in Reimer et al. 2015).

Bayesian modeling

Bayesian analysis and modeling were carried out using OxCal 4.4 (Bronk Ramsey 2009a, the functions *Phase, Sequence, First, Last* were used) with the IntCal20 dataset (Reimer et al. 2020). Outlier analysis was performed using both χ^2-tests (Ward and Wilson 1978) and the *Outlier_Model* function in OxCal 4.4 (Bronk-Ramsey 2009b). For dates from the same samples that are in statistical agreement, weighted averages were carried out using the *R_Combine* function. A uniform phase model (distribution) is used as the underlying prior for sequences and phases (Bronk Ramsey 2009a). It is important to emphasize that the most suitable underlying prior for the site is unknown and other distributions may be more appropriate. However, for this relatively short-lived site (based on calibrated dates alone), the use of a uniform phase model is considered acceptable as an interpretative/explorative tool. Additional archaeologically informed priors were as follows (see Figure 2 for points 2–4 below based on archaeological interpretation of kurgan stratigraphy):

1. From typology of the burial artifacts the site would not be expected to pre-date the mid-4th c. CE. For modeling purposes a less rigid constraint of 325 ± 10 CE was used in the main model to provide a boundary after which activity commenced at the site. In the subsequent text this is referred to as an "artifactual boundary."
2. Kurgan 33 precedes kurgan 29 and kurgan 29a.
3. Kurgan 30 precedes kurgan 30a and kurgan 38.
4. Kurgan 30a and kurgan 38 were stratigraphically contemporary.

Due to concerns over the sensitivity of the model to the 1st prior above, as well as the validity of the prior itself (i.e. using dates based on typological method from elsewhere to constrain similar artifact ages at Choburak-I) the robustness of the modeled results was examined for a range of artifactual boundary ages (from 260–340 CE), discussed below.

Results

Archaeological analysis

Based on the methodology described in Seregin et al. 2023, several groups of chronological indicators have been identified within the accompanying grave goods, which have varying importance for

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

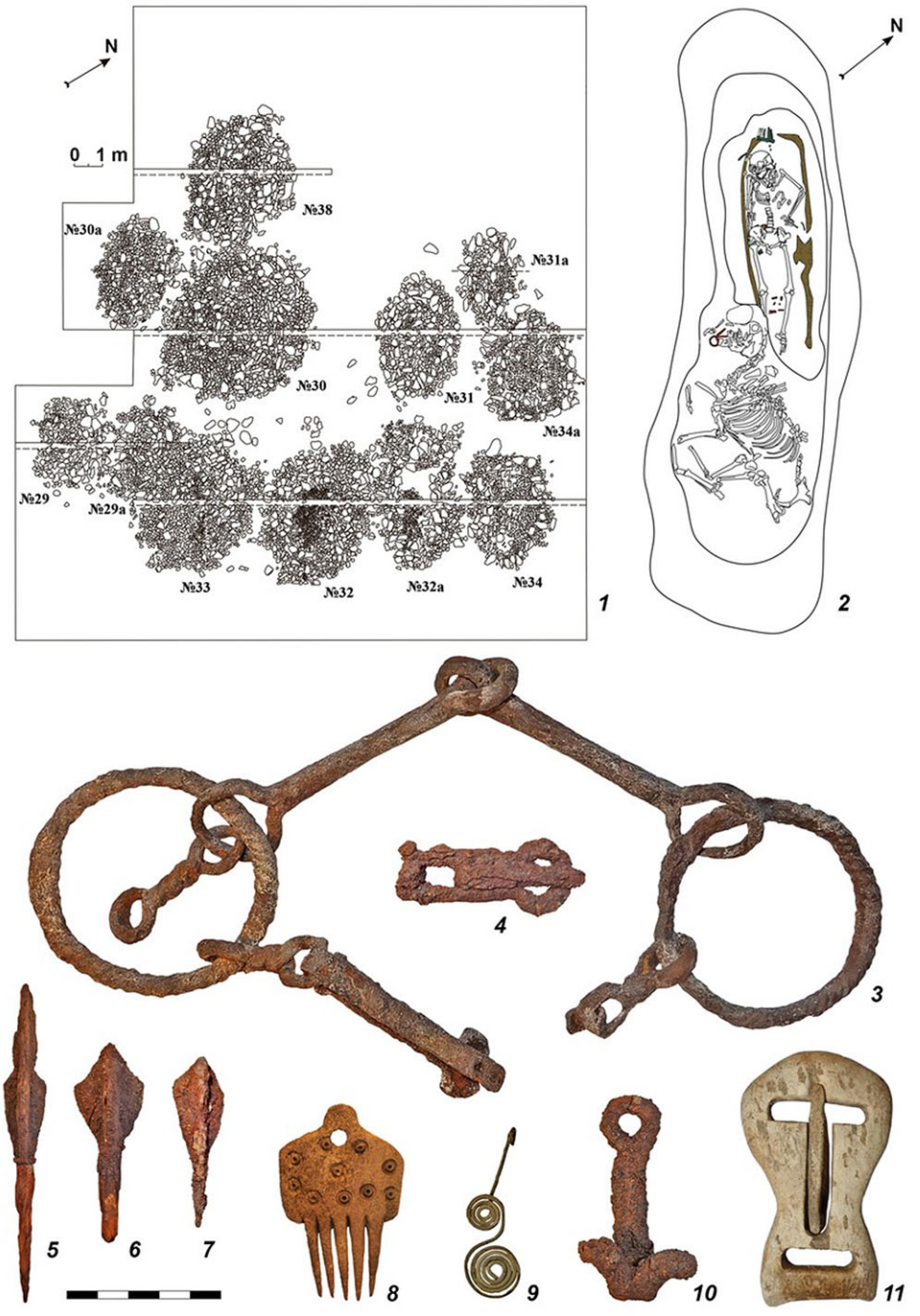

Figure 2. *Choburak-I necropolis: general plan of the mounds (1), funeral rite (2), selected finds (3) – iron bridle bits and psalia, (4) – iron clasp, (5–7) – iron arrowheads, (8) – bone comb, (9) – bronze earring, (10) – iron quiver hook, (11) – bone clasp).*

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

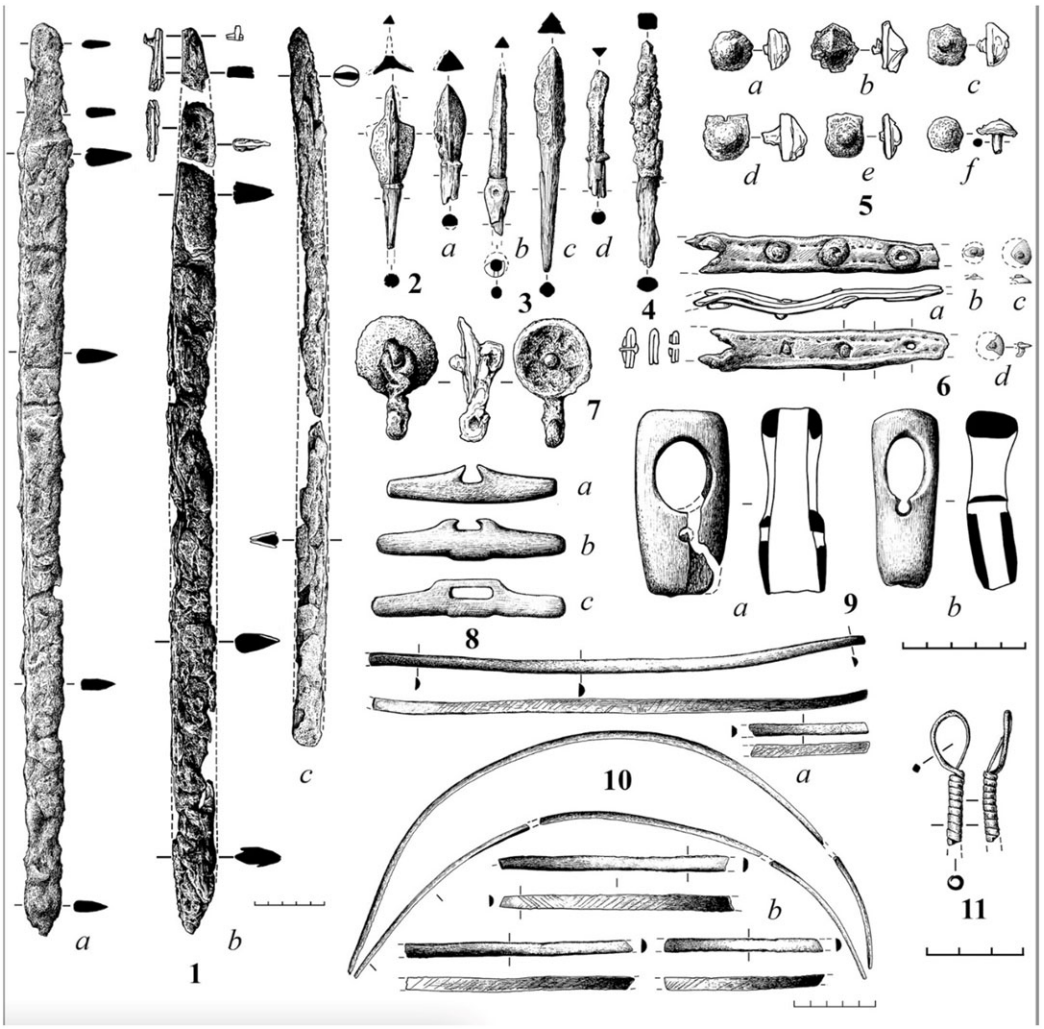

Figure 3. *Chronologically indicative artifacts from the burials of the Choburak-I necropolis. 1 – iron swords; 2-4 – iron arrowheads; 5 – iron bridle buttons; 6 – leather headpiece strap with metal plates; 7 – iron bridle plate with pendant; 8 – bone horse hobble clasps; 9 – bone parts of the lash grip; 10 – bone edges of saddle bows; 11 – bronze earring See Table 2 for the individual burials containing the artifacts.*

determining the time of use of the necropolis. Importantly, within the analyzed materials for Choburak-I there were no "classical" chronological markers with clearly established historical dates for the beginning of their manufacture (these usually include coins, Chinese mirrors, silk fabrics, lacquered items, "personalised" objects), which record the *"terminus post quem"* of closed archaeological complexes.

When determining the archaeological age of Choburak-I, we focused on the placement of funerary objects within the time interval, "... when all the components of the complex coexisted, i.e. between the beginning of the existence of the latest items and the end of the existence of the earliest" (Shchukin 1978, 29–30). All analysed items presented in the paper (Figures 2 and 3) belong to the same chronological interval.

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

The most indicative group of chronological indicators has been represented by the youngest (i.e. latest) among the Bulan-Koby burials of Choburak-I artifacts, marking the lower chronological boundary of the Bulan-Koby burials at the necropolis as not earlier than the middle of the 4th century CE (Figure 3).

Among weaponry, these include iron single-bladed swords, iron armour-piercing three-bladed arrowheads with leaf-shaped and keeled body (Figure 3.1), as well as combat tetrahedral leaf-shaped arrowheads (Figure 3.3, 4), often equipped with an annular stopper and tiered trihedral three-bladed arrowheads with an annular stopper (Figure 3.2) (Gorbunov 2006, 39, 40, 59, 90, 111). Elements of horse harness are iron plaques, fixed with a false pin with a conical or hemispherical cap mounted into the body of a rounded quadrangular in cross-section plate (Figure 3.5); bronze bridle buttons with a hemispherical body of a rounded shape (Figure 3.6); iron plates with a hemispherical body of a rounded shape and a pendant in the form of a twisted eight-shaped loop (Figure 3.7; Belikova and Pletneva 1983, Figure 2.9 and 18.4; Egorov 1993, Figure 1.8; Yu Junyu 1997, Figure 3.6; Soenov 2000, Figure 10.1-5; Matrenin and Tishkin 2016, 1.A1, B, B1, 3A-B; Matrenin 2018, Figure 1.43-51; Yu Junyu 1997, Figure 3.6).

Furthermore, within the horse-riding equipment, bone (antler) horse harness fasteners with an open and solid notch (Figure 3.8) are informative, related to typical objects of the late (Verkh-Uimon) stage of the Bulan-Koby Culture (second half of the 4th–first half of the 5th century CE; Matrenin 2018, Figure 1.43-51). As a late chronological marker, bone (antler) edgings of unpreserved wooden saddle bows can also be considered (Figure 3.10; Seregin et al. 2021, 27–28; Tishkin and Mylnikov 2016, Figure 69.3-5). Among the ornaments, metal earrings with a lobe in the form of a closed ring and a detailed base in the form of a cylindrical spiral are of particular importance for dating (Figure 3.11; Gryaznov 1956, tab. XLV.−11, 25–27; Arslanova 1975, tab. II.−11; Soenov 2000, Figure 7.9; Teterin 2005, Figure 2.29; Trifanova and Soenov 2019, 57). The series of products of the second half of the 4th–first half of the 5th century CE includes bone (horn) parts of lashes or riding crops in the form of massive tubes found in Choburak-I (Figure 3.-9; Teterin 2016, 91, Figure 2.1; Soenov 2017, 122, Figure 9.1; Tishkin et al. 2018, tab. 39.3, 4). From our analysis of the indicated finds from different structures of the Choburak-I site (Table 2), we emphasize that the structures date to the period not earlier than the middle–second half of the 4th century CE, as confirmed by the discovery of similar items in other closed complexes of the Bulan-Koby Culture of Altai (Verkh-Uymon, Stepushka, Yaloman-II), the chronology of which was supported by ^{14}C dating (Konstantinov et al. 2018, tab. 1; Tishkin 2017, 55–56; Tishkin et al. 2018, 149–154).

In summary, the considered chronological indicators suggest the lower boundary (the start date) of the Choburak-I necropolis not earlier than middle of the 4th century CE. The upper boundary cannot be clearly determined based on material culture complex, as there are no solid grounds for documenting the duration of use of the specific groups of items (chronoindicators). From approximately the middle or second half of the 5th century a new—early Turk—population, formed on the basis of the local Bulan-Koby, and also a newly arrived populations appeared in Altai, replacing the Bulan-Koby Culture. Certain groups of the Bulan-Koby artifacts were still in use among the early Turk population (Seregin 2020, 124).

^{14}C dating and stable isotope results

The calibrated radiocarbon results (Table 1) have good overlap with the expected dating of the site based on material culture, and they show a continuous use of the site, with the earliest date belonging to 130–380 cal CE (UBA-37794, kurgan 32) and the latest to 410–600 cal CE (UBA-37797, kurgan 33).

Bayesian analysis

A schematic of the relationship between dates used in the Bayesian modeling is presented in Figure 4. On the basis of outlier analysis samples UBA-37797 and UBA-37793 were removed from subsequent

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

Table 2. *Kurgans of the Bulan-Koby Culture of the Choburak-I necropolis, presence of chronological indicators, and calibrated age ranges for the dated samples. Numbers indicate types of chronologically indicative artifacts (see Figure 3)*

	Presence of chronologically indicative artifacts											
Location	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	Calibrated ^{14}C intervals (2σ)
Kurgan 29												207–339 CE (human)
Kurgan 29a												395–542 CE (human)
Kurgan 30												214–380 CE (human)
												253–401 CE (horse)
Kurgan 30a												251–381 CE (ovicaprid)
												260–407 CE (horse)
Kurgan 31												242–380 CE (human)
												254–392 CE (horse)
Kurgan 31a												252–382 CE (human)
												257–399 CE (horse)
Kurgan 32												125–353 CE (human)
												249–381 CE (human)
												334–430 CE (horse)
												263–413 CE (horse)
Kurgan 32a												240–380 CE (human)
												255–393 CE (horse)
Kurgan 33												210–402 CE (human)
												400–600 CE (horse)
Kurgan 34												244–381 CE (human)
												234–377 CE (horse)
Kurgan 34a												328–415 CE (human)
												250–381 CE (human)
												244–381 CE (horse)
												257–397 CE (ovicaprid)
Kurgan 38												236–384 CE (human)
												261–416 CE (horse)

modeling. This does not exclude the possibility that those dates are valid only that those dates are not consistent with the model and priors employed here.

The Bayesian model results are presented in Figure 5, below. This is with the constraint (*C_Date 'Artifactual Boundary'*) that activity is no earlier than 325 ± 10 years. The agreement indexes for the model are $A_{model} = 63.6\%$ and $A_{overall} = 61.8\%$, both above the recommended 60% (Bronk Ramsey 2009a).

The modeled *Start* and *End* of activity as well as the duration of activity (*Span*) at the site are presented in Figure 6. This model provides an interpretation of the site commencing in 318–359 cal CE (95.4%) and concluding in 343–402 cal CE (95.4%) with a maximum duration of 66 years (95.4%).

A key consideration of modeling activity at Choburak-I is the validity and impact of the artifactual constraint on the modeled results. Typological analysis suggests earliest activity at the site of mid-4th century date, however this could be overly restrictive and exclude the possibility of some artifact types appearing earlier at Choburak-I than elsewhere. The effects this constraint has on the modeled *Start, End* and *Span* (Duration) of the site as well as the model agreement index, A_{model}, are presented in Figure 7.

This sensitivity testing demonstrates that the model fails ($A_{model} < 60\%$) if the site is constrained to occur after 330 CE. For earlier constraints, the Agreement Index is relatively stable. For best

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

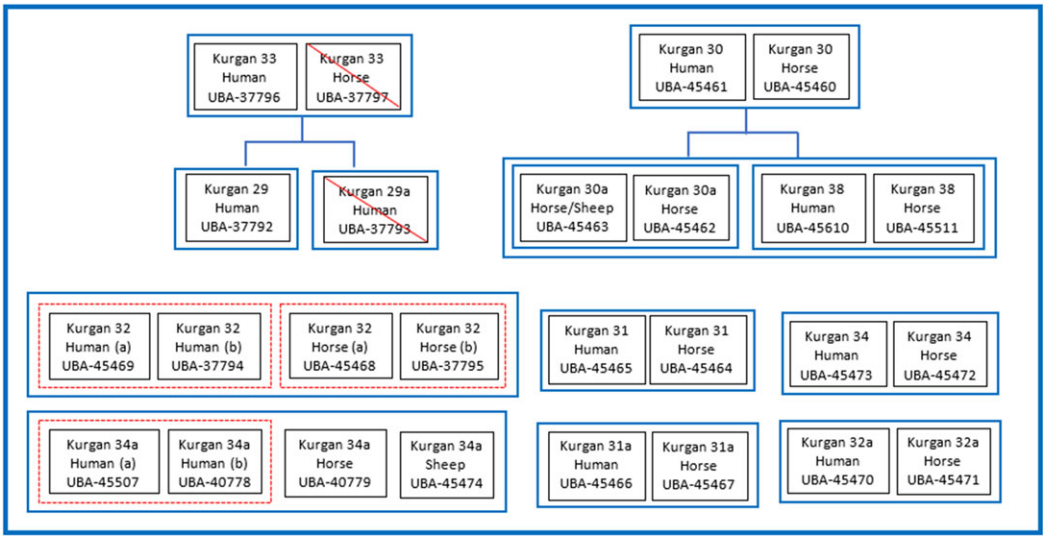

Figure 4. *Schematic of Bayesian modeling for human and animal bone samples from the Bulan-Koby Culture burials of the Choburak-I. Solid blue line—bounds dates of same phase/subphase. Dashed red line—bounds dates that are combined (weighted average). Solid vertical lines—chronological ordering from top (earlier) to bottom (later). Boxes not connected to one another have no certain stratigraphical relationship to one another. Boxes with red line through them were identified as outliers for this particular model.*

compatibility between the quality of the model and dating based on typological method (suggesting mid-4th c.) the constraint of 325 ± 10 CE was used in the main model presented above (the uncertainty on this constraint was selected to allow some additional flexibility on the model while remaining within the order of a generation).

The sensitivity testing also shows that while a shift of 80 years in the artifactual constraint results in a reduction in the modeled duration of the site from approximately 85 years to 55 years, the effect on the modeled start and end of the site (at least considering the single dominant mode in the probability distributions) is more modest. In particular, constraining the site to any period after 280–340 CE results in changes in the modeled start and end boundaries of the order of only 5–20 years typically. As such, the main modeled results above are considered relatively robust for providing generational scale interpretations of the start, end and duration of the site.

Discussion

Chronological indicators represented by the youngest/latest grave good items (Figure 3) provide the basis for the earliest date of the formation of the Bulan-Koby necropolis of Choburak-I as mid-second half of the 4th century CE, which corresponds to the beginning of the Rouran period in the history of the Altai.

Calibrated AMS ^{14}C dates for ten graves of Choburak-I span the second half of the 3rd–beginning of the 5th century CE. However, with Bayesian modeling the chronology of the site can be further refined to suggest a continuous but relatively short-lived period from approximately 318–359 cal CE (95.4%) to 343–402 cal CE (95.4%) with a maximum duration of 66 years (95.4%). Sensitivity tests of the model also support the site being in use before 350 cal CE as well as demonstrating that the modeled start and end of the site is relatively robust with respect to earlier constraints based on typology method on when the site was first used. These ranges broadly agree with the typological analysis albeit allowing for a

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

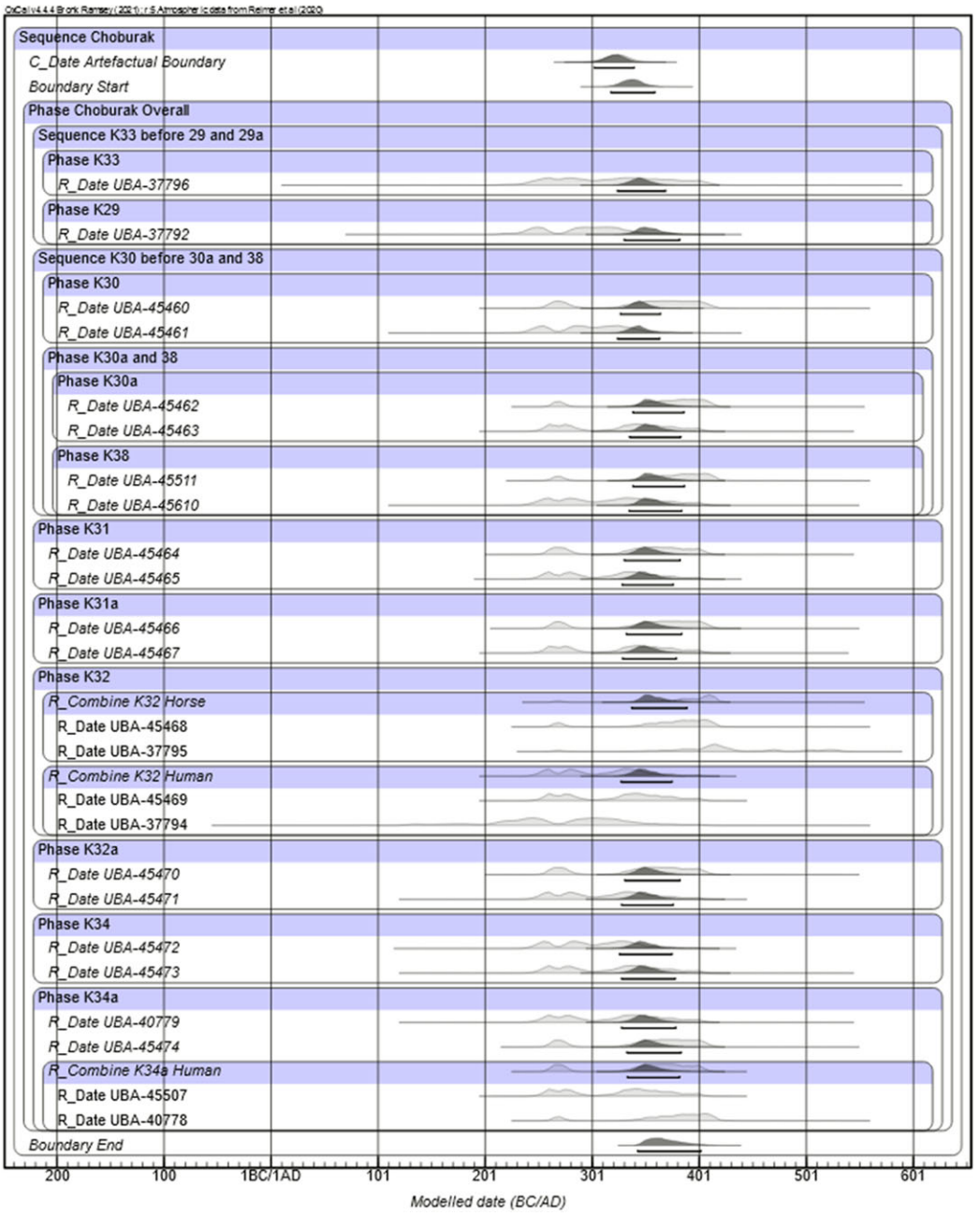

Figure 5. *Bayesian modeling results for human and animal bone samples from the Bulan-Koby Culture burials of Choburak-I. Multiple dates from individual kurgans are treated as being from the same phase. For consistency this has been maintained even for kurgans with a single date.*

slightly earlier commencement to the site than would be expected from the chronological indicators alone.

The correlation of the ^{14}C dates for humans and the associated herbivores (from the same graves) suggests the absence of reservoir offsets in the majority of human remains, with the exception of two individuals—kurgans 32 and 33. The ^{14}C dates of humans from these graves are older than the dates

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

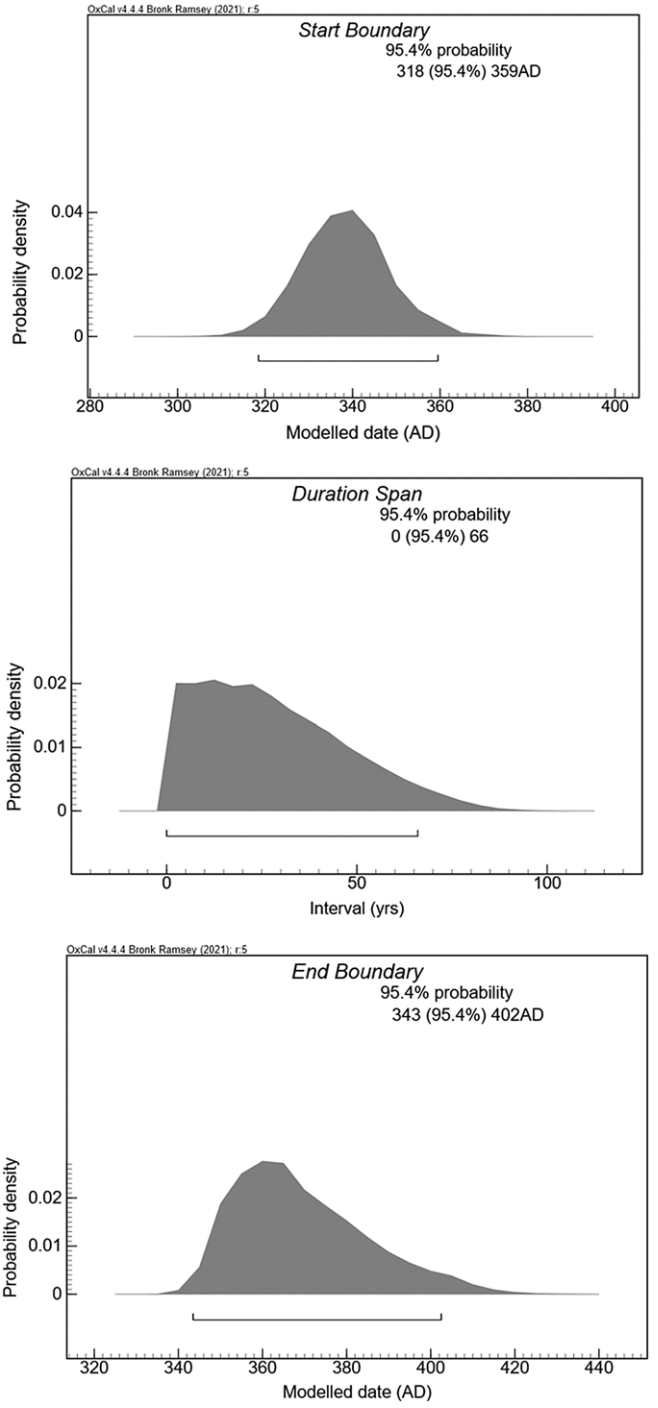

Figure 6. *Modeled Start, End and Span for human and animal bone samples from the Bulan-Koby Culture burials of Choburak-I.*

from the associated horses. However, for kurgan 33 it was the horse bone (UBA-37797) that was identified as an outlier in the Bayesian model, appearing too early relative to the overall chronology. As it has been mentioned previously, all burials of the Choburak-I cemetery were undisturbed, which

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

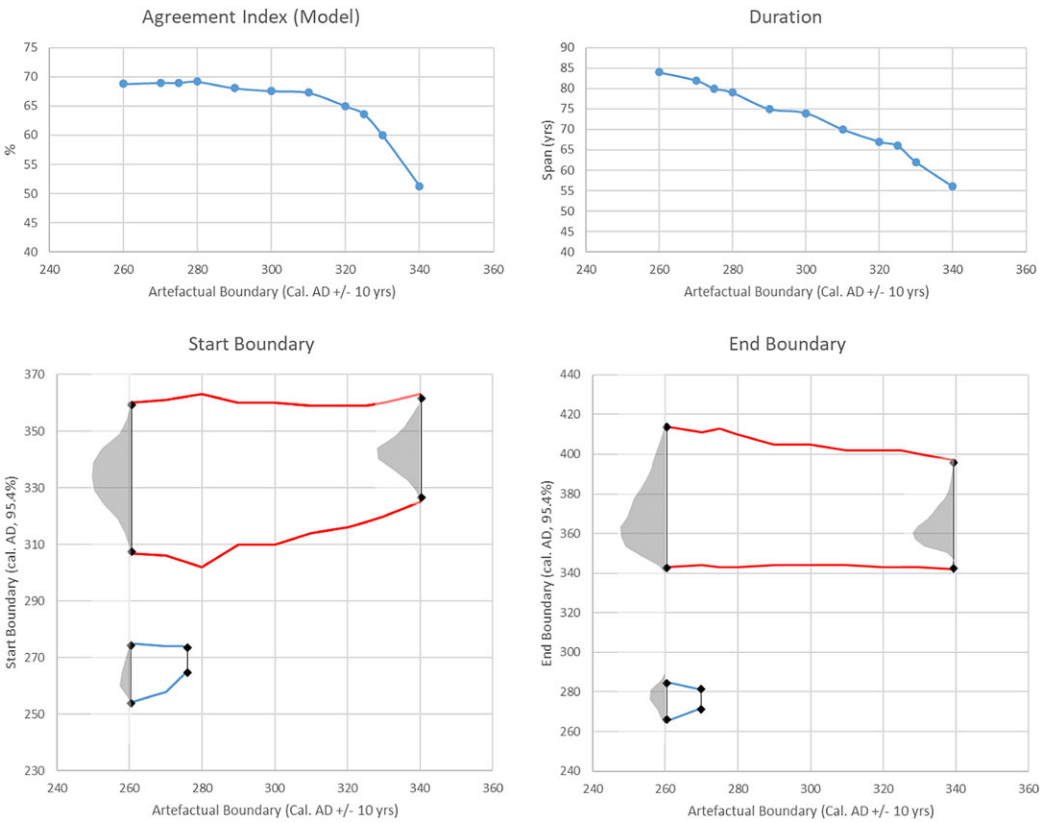

Figure 7. *Exploration of the sensitivity of Bayesian modeling results to the artifactual boundary constraint. Top left—Agreement Index. Top right—Span/Duration of activity. Bottom left/right—variation of start/end boundaries. Solid red/blue lines mark upper/lower limits of the modeled ranges. For lower limits of artifactual boundary the Start/End boundaries are bi-modal until 275±10 cal. AD after which there is a single mode only (bounded with red lines).*

eliminates the possibility of asynchronicity of the burials/samples. One of the explanations for any difference in the ^{14}C dates could be the freshwater reservoir effect on human samples. The effect is usually associated with the presence of freshwater fish in the diet of people, which results in their older ^{14}C dates as compared to purely terrestrial samples. However, the δ^{15}N values of these individuals do not clearly indicate the consumption of fish by these individuals or any of those analyzed from the group, with human δ^{15}N varying between 9.8 and 10.4‰, unless the consumed fish had δ^{15}N values indistinctive from herbivore protein. As such, unless strongly identified as an outlier during Bayesian modeling, dates were retained in the analysis.

The radiocarbon dates and Bayesian modeling provide strong support for the observation that the burials of the Bulan-Koby Culture in Choburak-I were made within a short period of time. Additional arguments for the short (probably within several generations) interval of functioning of this cemetery is a small number of burials, a highly uniform funeral rite and accompanying objects, as well as—circumstantially—the violent (weapon-based) death of three out of seven men.

Among the known sites of the Bulan-Koby Culture, the Choburak-I burial ground bears most similarity, by virtue of the recorded features of ritual practice (the design and shape of the mounds, inhumation with a horse at the feet and on top of the deceased with the northwest orientation, etc.) and accompanying goods, with the Rouran period complex of Dyalyan, also located in the Northern Altai (Kalinin and Teterin 1991; Mit'ko 2018, 2019; Teterin 1991). Taking into account the striking similarity

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

of the specified indicators, it is possible to assume the approximate synchronicity of these burial grounds, and to suggest that they were left by related local groups of nomads within the 2nd quarter to end of the 4th century CE.

Considering the intensity of the processes during the Rouran time, it appears reasonable now to use these latest radiocarbon results to further examine the chronology of the funerary complexes within the late stage of the Bulan-Koby Culture. However, within the body of material data of the second half of the 4th–first half of the 5th century CE assembled to date, no fundamentally significant differences in the accompanying goods have yet been identified to confidently distinguish the early and late funerary structures. The results of the radiocarbon dating thus only suggest that the Choburak-I burial ground belongs to the beginning of the late (Verkh-Uimon) stage of the Bulan-Koby Culture.

Conclusions

Dating of the archaeological, anthropological and archaeozoological materials of the Bulan-Koby Culture cemetery of Choburak-I makes it possible to determine the period of its functioning within the 2nd quarter to end of the 4th c. CE, which broadly corresponds to the beginning of the Rouran period in the history of Altai. From the available materials, this complex is close in time (perhaps synchronous?) to the Dyalyan burial ground in the Northern Altai, with which it reveals a striking similarity in the majority of features. The results of archaeological dating are supported by the largest set of AMS ^{14}C dates for the Bulan-Koby Culture, which, aided by Bayesian analysis, demonstrates the likely continuous existence of the necropolis between 318–402 cal CE (95.4% probability). The small number of burials, the rare uniformity of the funeral rite and accompanying goods, as well as the presence of lethal combat injuries, provide grounds for assuming a short interval in the existence of this cemetery (probably no more than several generations); modeling of the site suggest a maximum duration of 66 years (95.4%). The relative chronology (sequence of construction) of individual burials of the necropolis still remains open, although it could be suggested that the kurgans that went beyond the "straight" line of structures within the rows of mounds were the later ones. The presented results make it possible to consider the fully excavated Bulan-Koby Culture necropolis of Choburak-I as a chronologically defining monument of the Rouran period of the Northern Altai. The associated burial artifacts will permit a new level of relative and absolute chronological reconstructions for archaeological sites of this region and adjacent territories at the turn of late antiquity and early Middle Ages; this includes the reconstruction of various aspects of ethno-cultural and social history. We hope that the new data introduced will contribute to more intensive scientific research aimed at identifying the phases within the late stage of the Bulan-Koby Culture based on the extensive ^{14}C dating of both already known and new funerary monuments in different regions of the Altai mountainous country.

Acknowledgments. The study was supported by the Leverhulme Trust grant RPB-2019-372. We are grateful to the anonymous reviewers of the manuscript of this paper.

References

Arslanova FKh (1975) Kurgany s "usami" Vostocnogo Kazahstana [Kurgans with "moustache" of East Kazakhstan]. In Akishev KA (resp. editor), *Drevnosti Kazahstana [Antiquities of Kazakhstan]*. Alma-Ata: Izd-vo AN KazSSR, 116–129. In Russian.

Barfield T (2009) Opasnaya granitsa. Kochevye imperii i Kitaj (221 g. do n.e. – 1757 g. n.e.) [Dangerous border. Nomadic Empires and China (221 BC – 1757 AD)]. Saint-Petersburg: Faculty of Philology and Arts of Saint-Petersburg State University; Nestor-Istoriya, 488. In Russian.

Bazhan IA and Gay OA (1992) Otnositel'naja hronologija mogil'nikov chernjahovskoj kul'tury [The relative chronology of the Chernyakhov culture burial grounds]. In Shchukin MB and Gay OA (resp. editors). *Problemy hronologii jepohi latena i rimskogo vremeni. Po materialam Pervyh Tihanovskih chtenij (Leningrad, 1988 g.) [Problems of chronology of the era of the La Tène and Roman periods. Based on the materials of the First Tikhanov Readings (Leningrad, 1988)]*. Saint-Petersburg, NAO «Ojum» VMC, 122–157. In Russian.

Belikova OB and Pletneva LM (1983) Pamatniki Tomskogo Priob'a v V-VIII vv. n.e. [Monuments of the Tomsk Ob Region in the V–VIII c. AD]. Tomsk: Izd-vo Tom. University. 245 p. In Russian.

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

Bobrov VV, Vasjutin AS and Vasjutin SA (2003) Vostochnyj Altaj v jepohu Velikogo pereselenija narodov (III–VII veka) [Eastern Altai during the Great Migration Period (3rd-7th c.)]. Novosibirsk: IAET SO RAN, 224 p. In Russian.

Bogdanov ES, Murakami Y, Soloviev AI, Grishin AE, Solovyova EA and Gnezdilova IS (2018) Issledovanie syrodutnyh pecej okolo sela Balyktyul' (Respublika Altaj) v 2018 g. [Study of bloomery furnaces near the village of Balyktyyul (Altai Republic) in 2018]. In: Derevyanko AP, Molodin VI, Shunkov MV, et al. (editors). *Problems of Archaeology, Ethnography, Anthropology of Siberia and Neighboring Territories [Problemy arkheologii, etnografii, antropologii Sibiri i sopredelnykh territorii]*. Novosibirsk: IAET SB RAS Publ., Vol. XXIV, 224–228. In Russian.

Bronk Ramsey C (2009a) Bayesian analysis of radiocarbon dates. *Radiocarbon* **51**, 337–360.

Bronk Ramsey C (2009b) Dealing with outliers and offsets in radiocarbon dating. *Radiocarbon* **51**, 1023–1045.

Bronk Ramsey C, Higham T, Bowles A and Hedges R (2004) Improvements to the pretreatment of bone at Oxford. *Radiocarbon* **46**, 155–163.

Brown TA, Nelson DE, Vogel JS and Southon JR (1988) Improved collagen extraction by modified Longin method. *Radiocarbon* **30**, 171–177.

Drobyshev YI (2019) Zhuzhanskiy kaganat [Rouran Khanate]. In Bazarov BV, Kradin NN (resp. eds.), *Kochevye imperii Evrazii: osobennosti istoricheskoi dinamiki [Nomadic Empires of Eurasia: Features of Historical Dynamics]*. Moscow: Nauka; Vost. Lit., 133–142. In Russian.

Egorov YaV (1993) Novoe issledovanie pogrebenia voina epohi "Velikogo pereselenia narodov" na Altae [New study of the burial of a warrior of the "Great Migration" period in Altai]. In: Kiryushin YuF, Kungurov AL (resp. eds). *Kul'tura drevnih narodov Uznoj Sibiri [Culture of the Ancient Peoples of Southern Siberia]*. Barnaul: Altai University Press, 77–80. In Russian.

Gavrilova AA (1965) *Mogil'nik Kudyrge kak istocnik po istorii altajskih plemen* [Kudyrge Burial Ground as a Source on the History of the Altai Tribes]. Moscow; Leningrad, Nauka Publ. 146 p. In Russian.

Golden PB (1992) *An introduction to the history of the Turkic peoples: Ethnogenesis and state-formation in Medieval and Early Modern Eurasia and the Middle East*. Wiesbaden: Harrassowitz Verlag, 493 pp.

Gorbunov VV (1998) Tazelovooruzennaa konnica drevnih turok (po materialam naskal'nyh risunkov Gornogo Altaa) [Heavy Armed Cavalry of Ancient Turks (Based on the Materials of Rock Paintings of the Mountain Altai)]. In Kiryushin Yuf, Tishkin AA (resp. eds), *Snarazenie verhovogo kona na Altae v rannij zeleznyj vek i srednevekov'e* [Equipment of the Riding Horse in Altai in the Early Iron Age and the Middle Ages]. Barnaul: Altai University Press, 102–128. In Russian.

Gorbunov VV (2003) Voennoe delo naseleniya Altaya v III–XIV vv. [Military affairs of the Altai population in the 3rd–14th centuries]. Part I: Oboronitel`noe vooruzhenie (dospekh) [Defensive armament (armour)]. Barnaul: Altai University Press, 174. In Russian.

Gorbunov VV (2006) *Voennoe delo naselenija Altaja v III–XIV vv*. [Military affairs of the Altai population in the 3rd-14th c.]. Part 2: Nastupatel'noe vooruzhenie (oruzhie) [Offensive armament (weapons)]. Barnaul: Altai University Publ., 232 pp. In Russian.

Gryaznov MP (1956) *Istoria drevnih plemen Verhnej Obi po raskopkam bliz s. Bol'saa Recka* [History of the ancient tribes of the Upper Ob according to excavations near the village of Bolshaya Rechka]. *Materialy i issledovania po arheologii SSSR* 48. Moscow, Leningrad, USSR Academy of Sciences Publishing House. 162 pp. In Russian.

Handsuren Ts (1993) Zhuzhanskoe tsarstvo [The Rouran Kingdom]. In: Zoriktuev BR (ed.). Etnicheskaya istoriya narodov Yuzhnoi Sibiri i Tsentral'noi Azii [Ethnic history of the peoples of Southern Siberia and Central Asia]. Novosibirsk: Nauka Publ., 66–106. In Russian.

Kalinin IV and Teterin YuV (1991) *Voinskoe poburenie pre-Turkskogo vremya mogilnika Dyalyan* [Military burial of the pre-Turkic time of the Dyalyan burial ground], vol. 2. Krasnoyarsk: Krasnoyarsk University, 61–63.

Konstantinov N, Soenov V, Trifanova S and Svyatko S (2018) History and culture of the early Türkic period: A review of archaeological monuments in the Russian Altai from the 4th–6th century AD. *Archaeological Research in Asia* **16**:103–115.

Kradin NN (2000) Obshchestvennoe stroy Zhuzhansky kaganata [Public system of the Rouran kaganate]. In Kradin NN, Krupyanko AA, Sovasteev VV (resp. eds), *Istoria i arheologia Dal'nego Vostoka: k 70-letiu E.V. Savkunova* [History and Archaeology of the Far East: to the 70th anniversary of E.V. Shavkunov]. Vladivostok: State Far Eastern University Publ., 80–94. In Russian.

Kradin NN (2007) *Kochevniki Evrazii* [Nomads of Eurasia]. Almaty: Dyke-Press. 416 pp. In Russian.

Kubarev GV (2010) Uzdechnyy nabor v polychromenom stil'nom iz monumenta Arzhan-Buguzun (Yugo-Vostochny Altai) [Bridle set in polychrome style from the monument of Arzhan-Buguzun (South-Eastern Altai)]. In Tishkin AA (resp. editor), *Torevtika v drevnej i srednevejnykh kul'tury Evrazii [Toreutics in the ancient and medieval cultures of Eurasia]*. Barnaul: Azbuka, 27–31. In Russian.

Kychanov EI (2010) Istoriya prigranichnykh s Kitaem drevnikh i srednevekovykh gosudarstv (ot hunnov do manchurov) [History of ancient and medieval states bordering on China (from Huns to Manchus)]. Saint-Petersburg. Peterburgskoye lingvisticheskoye obshestvo, 364. In Russian.

Mamadakov JuT (1990) *Kul'tura naselenija Central'nogo Altaja v pervoj polovine I tys. n.e.* [Culture of the population of Central Altai in the first half of the 1st mil. AD]. Candidate of the historical sciences dissertation. Novosibirsk. 317 pp. In Russian.

Matrenin SS (2005) *Social'naa struktura naselenia Gornogo Altaa hunno-san'bijskogo vremeni (po materialam pogrebal'nyh pamatnikov bulan-kobinskoj kul'tury II v. do n.e. - V v.n.e.)* [Social structure of the population of Gornogo Altai of the Xiongnu-Xianbei time (based on the materials of the burial monuments of the Bulan-Koba culture of the 2nd century BC–5th century AD)]. Extended abstract of Cand. Sci. (History) Dissertation. Barnaul. 24 pp. In Russian.

Matrenin SS (2018) Hronologiceskie indikatory snarazenia verhovogo kona kocevnikov san'bijsko-zuzanskogo vremeni (po materialam pogrebal'nyh pamatnikov bulan-kobinskoj kul'tury) [Chronological Indicators of Equipment of the Riding Horse of

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

the Yanbei-Zhuzhan Time (Based on the Materials of the Funeral Monuments of the Bulan-Koba Culture)]. In Tishkin AA (resp. editor), *Sovremennye resenia aktual'nyh problem evrazijskoj arheologii* [Modern Solutions to Topical Problems of Eurasian Archaeology], vol. 2. Barnaul: Altai University Publ., 188–195. In Russian.

Matrenin SS and Tishkin AA (2016) Uzdechnye blyakhi iz pamyatnikov Altai hunnusko-san'bijsko-zuzanskogo vremeni: opyt klassifikatsii i tipologii [Bridle Plaques from the Altai Monuments of the Xiongnu-Xianbei-Rouran Period: Experience of Classification and Typology]. *Izvestia Altajskogo gosudarstvennogo universiteta* **2**(90), 220–228. In Russian.

Mit'ko OA (2018) Arheologiceskie svidetel'stva migracii altajskih plemen v vostocnoevropejskie stepi v konce pervoj poloviny I tys. n.e. [Archaeological Evidence of the Migration of Altai Tribes to East European Steppes at the End of the First Half of the 1st mil. AD]. In Sydykov EB (chairperson of the editorial board), *Aktual'nye voprosy izucenia istoriko-kul'turnogo nasledia narodov Evrazii* [Topical Issues of Studying the Historical and Cultural Heritage of the Peoples of Eurasia]. Astana: L.N. Gumilyov Eurasian National University, 26–39. In Russian.

Mit'ko OA (2019) Dalanovskaya pogrebal'naa tradicia naselenia Gornogo Altaa v materialah nekropolej kocevnikov Vostocnoj Evropy [Dyalyan burial tradition of the population of the Altai Mountains in the materials of the necropolises of nomads of Eastern Europe]. In: Molodin VI, Hansen S (resp. eds). *Mobil'nost' i migracii: koncepcii, metody, rezul'taty* [Mobility and migration: concepts, methods, results]. Novosibirsk: Institute of Archaeology and Ethnography of the Siberian Branch of the RAS Publ., 57–59. In Russian.

Murakami Y, Soenov VI, Trifanova SV, Ebel AV, Bogdanov ES and Soloviev AI (2019) Izucenie pamatnikov cernoj metallurgii na Altae v 2017 godu [Study of Ferrous Metallurgy Monuments in Altai in 2017]. *Bulletin of Tomsk State University* **60**, 167–174. In Russian.

Reimer P, Austin W, Bard E, Bayliss A, Blackwell PG, et al. (2020) The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon* **62**, 725–757. doi: 10.1017/RDC.2020.41.

Reimer P, Hoper S, Macdonald J, Reimer R and Thompson M (2015) Laboratory protocols used for AMS radiocarbon dating at the 14CHRONO Centre, The Queen's University Belfast. Swindon: English Heritage Research Report Series 5.

Savinov DG (1984) *Narody Uznoj Sibiri v drevneturkskuu epohu* [Peoples of Southern Siberia in the Ancient Turkic Era]. Leningrad, Leningrad State University Publ., 175 p. In Russian.

Seregin NN (2020) Ob odnoj "neizvestnoj" migracii: Altaj v seredine I tys. n.e. [On One "Unknown" Migration: Altai in the middle of the I millennium AD]. *Stratum Plus* 5: 115–127. In Russian.

Seregin NN and Matrenin SS (2016) Pogrebal'nyj obrjad kochevnikov Altaja vo II v. do n.e.–XI v. n.e. [The funeral rite of the nomads of Altai in the 2nd century BC–11th century AD]. Barnaul: Altai State university Publ. 272 p. In Russian.

Seregin NN and Matrenin SS. In press. Hronologiceskie indikatory predmetnogo kompleksa naselenia Severnogo Altaya zuzanskogo vremeni (po materialam nekropola Coburak-I) [Chronological Indicators of the Material Complex of the Population of the Northern Altai of the Rouran Time (Based on the Materials of the Choburak-I Necropolis)]. *Arheologiceskie vesti*. In Russian.

Seregin NN, Svyatko S, Barrett G, Demin M, Matrenin S, Papin D and Reimer P (2023) The first combined radiocarbon and archaeological dating of the Great Migration Period materials in northern Altai: the necropolis of Karban-I. *Radiocarbon* 1–15. doi:10.1017/RDC.2023.33.

Seregin NN, Tishkin AA, Matrenin SS and Parshikova TS (2021) Sedel'nye kanty iz raskopannyh kurganov Altaa zuzanskogo vremeni [Saddle Edges from the Excavated Kurgans of the Altai Zhuzhanskogo Vremeni]. *Narody i religii Evrazii* **1**, 25–36. In Russian.

Seregin NN, Tishkin AA, Matrenin SS and Parshikova TS (2022) Neordinarnoe pogrebenie podrostka s voinskim inventarem iz nekropola zuzanskogo vremeni Coburak-I (Severnyj Altaj) [Extraordinary burial of a teenager with military equipment from the Rouran period necropolis of Choburak-I (Northern Altai)]. *Vestnik arheologii, antropologii i etnografii* **1**, 122–133.

Shchukin MB (1978) Ob «Fuzkih» i «shirokih» datirovkah [On the "narrow" and "wide" dates]. In Artamonov MI and Klejn LS, editors, *Problemy arheologii* [Problems of archaeology]. Leningrad: Leningrad State University Publ. V. 2., 28–33. In Russian.

Shchukina LV (resp. ed.) (2005) Respublika Altaj: Atlas (Altai Republic: Atlas). Novosibirsk: FGUP "PO Inzhgeodezia". 84 pp. In Russian.

Sinor D (1969) *Inner Asia. History–Civilization–Languages*. Bloomington: Indiana University Publications; The Hague: Mouton & Co. 261 pp. (Uralic and Altaic Series. Vol. 96).

Slota JP, Jull A, Linick T, Toolin L (1987) Preparation of small samples for 14C accelerator targets by catalytic reduction of CO. *Radiocarbon* **44**, 167–180.

Soenov VI (1997) Pogrebal'nyj obrad naselenia Gornogo Altaa v gunno-sarmatskuu epohu [Funeral rite of the population of Gornogo Altai in the Hunno-Sarmatian epoch]. Extended abstract of Cand. Sci. (History) Dissertation. Barnaul. 22 pp. In Russian.

Soenov VI (2000) Rezul'taty raskopok na mogil'nike Verh-Ujmon v 1999 godu [Results of excavations at the Verkh-Uymon burial ground in 1999]. *Drevnosti Altaya* **5**, 48–62. In Russian.

Soenov VI (2017) Narusennoe voinskoe pogrebenie na mogil'nike Verh-Ujmon [Disturbed military burial at the Verkh-Uymon burial ground]. *Drevnosti Sibiri i Central'noj Azii* **8**, 117–142. In Russian.

Soenov VI and Ebel AV (1992) *Kurgany gunno-sarmatskoj jepohi na Verhnej Katuni* [Mounds of the Hun-Sarmatian period on Upper Katun]. Gorno-Altaysk: GAGPI. 116 pp. In Russian.

Teterin YV (1991) Mogilnik Dyalyan–novyi pamyatnik predturkskogo vremeni Gornogo Altai [Dyalyan burial ground—a new monument of the pre-Turkic time of Gornogo Altai]. In Kiryushin YuF (resp. editor), *Problemy hronologii i periodizacii*

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

arheologiceskih pamatnikov Uznoj Sibiri [Problems of chronology and periodization of archaeological monuments of South Siberia]. Barnaul: Altai University publ., 155–157. In Russian.
Teterin YV (2016) Rukoyati pletej kocevnikov hunnskogo vremeni Uznoj Sibiri [Handles of the whips of the nomads of the Xiongnu period of Southern Siberia]. *Vestnik Novosibirskogo gosudarstvennogo universiteta* **15**(3), 87–96. In Russian.
Teterin YV (2005) Ser'gi gunno-sarmatskoj epohi Uznoj Sibiri (problemy tipologii i hronologii) [Earrings of the Hunno-Sarmatian Epoch of Southern Siberia (Problems of Typology and Chronology)]. *Vestnik Novosibirskogo gosudarstvennogo universiteta* **4**(5): 52–64. In Russian.
Tishkin AA (2007) *Sozdanie periodizacionnyh i kul'turno-hronologiceskih shem: istoriceskij opyt i sovremennaa koncepcia izucenia drevnih i srednevekovyh narodov Altaya* [Creation of periodization and cultural-chronological schemes: historical experience and the modern concept of studying the ancient and medieval peoples of Altai]. Barnaul: Altai University publ. 356 pp. In Russian.
Tishkin AA (2017) Rezul'taty radiouglerodnogo datirovania kurganov zuzanskogo vremeni pamatnika Aloman-II (Central'nyj Altaj) [Results of Radiocarbon Dating of the Kurgans of the Rouran Time of the Yaloman-II Monument (Central Altai)]. *Vestnik Tomskogo universiteta* **49**, 54–59. In Russian.
Tishkin AA and Gorbunov VV (2005) *Kompleks arheologiceskih pamatnikov v doline r. Bijke (Gornyj Altaj)* [A complex of archaeological sites in the valley of the Biyke River (Altai Mountains)]. Barnaul: Altai University publ. 200 pp. In Russian.
Tishkin AA, Matrenin SS and Shmidt AV (2018) Altaj v sjan'bijsko-zhuzhanskoe vremja (po materialam pamjatnika Stepushka) [Altai in the Xianbei-Rouran period (on the materials of the Stepushka monument)]. Barnaul: Altai University Publ. 368 pp. In Russian.
Tishkin AA and Mylnikov V (2008) Wooden artifacts from Yaloman II mound 31, the Altai. *Archaeology, Ethnology and Anthropology of Eurasia* **33**, 93–102.
Tishkin AA and Mylnikov VP (2016) Derevoobrabotka na Altae vo II v. do n.e. – V v. n.e. (po materialam pamyatnikov Yaloman-II i Bosh-Tuu-I) [Woodworking in the Altai in the 2nd century BC – 5th century AD (based on the materials from the sites of Yaloman-II and Bosh-Tuu-I)]. Barnaul: Altai University Press, 192. In Russian.
Trifanova SV and Soenov VI (2019) *Ukrashenija naselenija Altaja gunno-sarmatskogo vremeni* [Jewellery of the Altai population of the Hun-Sarmatian time]. Gorno-Altaysk: B.I. 160 pp.
Tur SS, Matrenin SS and Soenov VI. 2018. Armed violence among the Altai Mountains Pastoralists of the Xiongnu-Sarmatian Age. *Archaeology, Ethnology & Anthropology of Eurasia* **46**(4), 132–139.
Vodyasov EV and Zaitseva OV (2020) Drevnejshie pamyatniki chernoi metallurgii v Gornom Altai: novye dannye iz doliny reki Yustyd [Ancient sites of ferrous metallurgy in the Altai Mountains: new data from the valley of the Yustyd River]. *Sibirskie istoricheskie issledovaniya* **2**: 125–147. In Russian.
Vodyasov EV and Zaitseva OV (2021) Pramougol'nye zelezoplavil'nye peci Gornogo Altaa: problemy genezisa i hronologii [Rectangular Iron Melting Furnaces of the Altai Mountains: Problems of Genesis and Chronology]. *Sohranenie i izucenie kul'turnogo nasledia Altajskogo kraya* [Preservation and study of the cultural heritage of the Altai Territory] 27, 158–167. In Russian.
Vodyasov EV, Zaitseva OV and Konstantinov NA (2019) Fenomen zelezoplavil'nyh pecej kos-agacskogo tipa v Gornom Altae [Phenomenon of Iron Melting Furnaces of the Kosh-Agach Type in Altai Mountains]. In Bazarov BV, Kradin NN (resp. eds), *Kocevye imperii Evrazii v svete arheologiceskih i mezdisciplinarnyh issledovanij*. [Nomadic Empires of Eurasia in the Light of Archaeological and Interdisciplinary Research]. Ulan-Ude: Buryat Scientific Centre of Siberian Branch of Russian Academy of Sciences Publ., 130–132. In Russian.
Vorobyov MV (1994) *Man'czuria i Vostocnaa Vnutrennaa Mongolia (s drevnejsih vremen do IX veka vklucitel'no)*. [Manchuria and Eastern Inner Mongolia (from ancient times to the 9th century inclusive)]. Vladivostok: Dalnauka. 410 pp. In Russian.
Wacker L, Němec M and Bourquin J (2010) A revolutionary graphitisation system: fully automated, compact and simple. *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms*, **268**, 931–934.
Ward GK and Wilson SR (1978) Procedures for comparing and combining radiocarbon age determinations: a critique. *Archaeometry* **20**, 19–31.
Yu Junyu (1997) Relics of the Former Yan Unearthed at Sanhecheng, Chaoyang. *Wenwu* **11**, 42–48. In Chinese.

Appendix 1. Burials of the Bulan-Koby Culture in the Choburak-I necropolis

Kurgan 29. Small oval-shaped mound of medium and small stones. The undisturbed grave contained the skeleton of a 9–11-y.o. child in anatomical order, extended on the back with the head to the northwest. Sparse accompanying goods included three iron tanged and one bone arrowheads, a fragment of iron knife and iron belt buckle.

Kurgan 29a. Oval-shaped stone mound with a crepidoma laying-out. The grave contained the skeleton of a 13–15-y.o. male in a wooden chamber. The deceased was lying extended on his back with his head to the northwest. A number of accompanying items included a bow with horn plates, seven iron arrowheads, two belt buckles, distributor, knife, fragment of a lash handle, comb, and horn clasps.

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

Kurgan 30. The largest structure of the complex. In the northwestern half of the grave, the remains of a wooden log were recorded, and the burial of a 30–35-y.o. male, extended on his back with his head to the northwest. The grave goods included weaponry (bow with horn plates, more than 40 iron arrowheads, sword, two combat knives), equipment (composite belt with numerous iron elements, fasteners), tools (short-bladed knife), and a metal ornament (tube-bead). In the southeastern part of the grave, there was a burial place of a horse with its head oriented to the northwest. Next to the horse, there were iron bits, bridle buckles, four plaques, bet clip, two fasteners, and a pair of bone horse hobble clasps.

Kurgan 30a. Oval mound with poorly preserved crepidoma laying-out. In the northwestern half of the grave, a decay of a wooden chamber (box or frame?) around a skeleton of a 30–40-y.o. male, positioned extended on the back with his head to the northwest, has been preserved. The deceased was accompanied by numerous implements (bow with horn plates, iron sword in a scabbard, five iron and three bone arrowheads, iron elements of a composite belt, bone saddle edging, horse hobble clasp, and an element of a lash). In the south-eastern part of the grave pit, there was a burial of a riding horse, laid almost perpendicular to the male, with its head to the northwest. In animal's jaws, iron bits with psalia were preserved, as well as, in different places, metal parts of the bridle (two buckles, fragments of a mane piece, seven plates-badges, and a bone (horn) girth buckle.

***Kurgan* 31.** Oval stone mound with a crepidoma laying-out. In the northwestern half of the grave, the inhumation of ca. 40-y.o. male was recorded, lying stretched out on his back with his head to the northwest. On different parts of the postcranial skeleton, incised and chopped wounds, inflicted by sword, without traces of healing, were observed. Weapons (a bow with horn pads, four iron arrowheads), military equipment (composite belt with a large number of garnitures), tools (iron knife, bone arrowhead, and a part of lash handle) were found with the male. In the southeastern part of the pit, there was a burial of a horse with its head to the northwest. The skeleton of the animal overlaid the human femora to the middle. A series of articles related to horseback riding (iron bits, bone girth buckle, three horse hobble clasps, clasp, part of a lash) has been found.

***Kurgan* 31a**. Stone mound with oval crepidoma laying-out. In the northwestern half of the grave, the skeleton of an elderly (over 55 y.o.) male was found in anatomical order–extended out on his back, with his head to the northwest. A relatively limited assemblage of grave goods was recovered: bow with horn pads, iron arrowhead, composite belt with iron sets, quiver hook-clasp, fasteners, and four bone arrowheads. Under the pelvis of the deceased, there were sheep vertebrae—the remains of ritual meat food. In the southeastern half of the pit, there was a riding horse, with its head oriented to the same direction as the male. The skeleton of the animal overlaid the human body up to the middle of the thigh bones. Iron bits, bridle and girth buckles, five plaques, belt clip, three plates (possibly belt tips) were found with the horse.

***Kurgan* 32.** Oval-shaped stone mound with crepidoma laying-out. In the northwestern half of the grave, a wooden bed was found, with the skeleton of a 25–30-y.o. male extended on his back, with his head to the northwest. Different categories of weapons (bow with horn pads, four iron arrowheads, combat knife), equipment (composite belt, quiver hook-clasp, fasteners) and tools (bone part of a lash, knife) were placed with the deceased. In the southeastern half of the pit, there was an accompanying burial of a horse with its head oriented to the same side as the male. Elements of horse ammunition (iron bits, bridle buckle, bone girth buckle, pair of clasps, end edging of two saddle bows) were found on different parts of the horse skeleton.

***Kurgan* 32a.** Oval mound with larger stones along the contour. In the northwestern half of the pit, the skeleton of a 40–50-y.o. female was found, lying on her back with her legs slightly bent, and her head oriented to the northwest. Six bronze sewn-on plates from a headdress, two earrings, stone spinning wheel, iron elements of a belt, awl, and a pendant made of maral tooth were found. In addition, the accumulation of sheep bones, representing the remains of ritual meat food, was recorded within the grave. In the southeastern half, there was a burial of a riding horse with its head pointing to the same direction as the woman. With the animal, various items of equipment were found (iron bits, bridle buckle, belt clip, plates, bone girth buckles, and edgings from two saddle bows).

https://doi.org/10.1017/RDC.2024.72 Published online by Cambridge University Press

***Kurgan* 33.** Oval-shaped mound with central part built of small and medium-sized stones and larger ones around the contour. The grave contained massive wooden poles, and a wooden log in the northwestern half. Inside the chamber, there was the skeleton of a 20–25-y.o. female, laid on her back in extended position, with her head to the northwest. A bronze earring, iron armor plate, short-bladed knife, awl, badge-plate, pendant, fragment of a tool, and an ornament made of maral tooth were found with the deceased. In the southeastern half of the pit, there was a burial of a riding horse with its head oriented to the northwest. The jaws of the animal were holding iron bits with ringed psalia. Numerous iron elements of the bridle (buckle, badge-plates, tips, distributors, belt clip and other items) were found on different parts of its skull.

***Kurgan* 34.** The mound with larger stones along the outer lane, which formed an oval crepidoma laying-out. In the northwestern half of the grave, the decay of a wooden burial chamber was traced, which contained a skeleton of a 30–35-y.o. female, laid extended on her back with her head to the northwest. A number of decorative items related to headdress (rounded plaque made of precious metal, eight sewn-on plates made of non-ferrous metal, braid piece, earrings) and outerwear (four bronze bell-shaped sewn-on plaques, two oval-shaped sewn-on plaques, pendant made of a maral tooth), as well as items for other functional purposes (iron belt buckles, knife, stone spinning wheel, bone hygienic brush) were found. In the southeastern half of the pit, there was a burial of a horse with its head oriented to the northwest, with numerous items made of iron (bits with psalia, three bridle and one girth buckles, 23 plates, fastenings) and bone (girth buckle).

***Kurgan* 34a.** Oval-shaped stone mound with crepidoma laying-out on the outer line. In the northwestern half of the grave, there was a skeleton of a 30–35-y.o. male on his back with his legs extended. In place of the head of the deceased, there was a skull of young ram, mounted on a base and thus imitating a single whole with the postcranial skeleton of the male. Incised injuries without signs of healing were recorded on some of the bones of the male. A bow with horn plates, at least ten iron arrowheads, quiver hook-clasp, two short-bladed knives, awl, and fasteners were found with the deceased. An unusual find was the iron round-bottomed cauldron. In the southeastern part of the pit, there was a horse burial, oriented with its head to the northwest, which almost half covered the skeleton of the male. Items of equipment made of iron (bits, bridle buckles, two plates, fasteners) and bone (horn) (girth buckle, clasp, edging from the bow of a saddle) were found with the animal.

Kurgan 38. Oval-shaped stone mound with a crepidoma laying-out. In the northwestern half of the grave, there were skeletal remains of a 25–30-y.o. male, laid extended on his back with his head to the northwest. The grave goods included a bow with horn plates, nine iron arrowheads, two long-bladed knives, sword, composite belt with diverse iron set, fasteners, seven bone arrowheads, two knives, awl, bone parts of lashes, and a bronze plate. In addition, the remains of ritual meat food in the form of sheep bones have been recorded. The south-eastern part of the grave pit was occupied by the burial of a riding horse with its neck twisted in the northwestern direction. Various pieces of equipment were found with the animal (iron bits, bridle buckle, fastening, seven bridle plates, bone edging from the bow of the saddle).

Cite this article: Seregin NN, Svyatko SV, Barrett G, Matrenin SS, and Reimer PJ (2024). Combined AMS ^{14}C and archaeological dating of the Rouran period cemetery of Choburak-I (Northern Altai). *Radiocarbon* **66**, 532–551. https://doi.org/10.1017/RDC.2024.72