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The Early Neolithic Complex on the Tartas-1 Site: Results of the AMS Radiocarbon Dating

AMS radiocarbon dating was applied to seven samples from Tartas-1, an Early Neolithic site in the Barabinskaya forest-steppe, southwestern Siberia: four from pit 938, one from pit 990, and two from structure 6. Pits had been destined for fermenting fish, and contained offerings, such as corpses of animals (fox, hare, wolverine, dog), stone and bone artifacts, and flat-bottomed clay vessels. On the basis of these finds, the Barabinskaya culture was described. The results of the AMS radiocarbon analysis support the previous conclusion regarding the date of the complex—7th millennium BC. A series of dates generated at the Curt Engelhorn Center for Archaeometry in Mannheim, Germany, for the Neolithic materials from Tartas-1 mostly fall within the 7th millennium, and the same applies to the dates relating to the Neolithic site of Vengerovo-2. The dates for structure 6 from Tartas-1 were generated at the Institute of Nuclear Physics SB RAS in Novosibirsk as well, agreeing with those from the Mannheim Center (for two samples, the results being virtually identical). In sum, the data obtained confirm the correctness of dating the Early Neolithic complex from Tartas-1 to the 7th millennium BC. The Barabinskaya culture is also dated to this time.

Keywords: *Barabinskaya forest-steppe, Neolithic, radiocarbon analysis, Barabinskaya culture.*

Introduction

Distinguishing new archaeological cultural formations always requires thorough justification. This is especially important for well studied regions, where materials of archaeological sites have already been attributed to a certain culture. A unique complex has been discovered at the multi-layered site of Tartas-1 (Fig. 1) by the

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Fig. 1. Location of the Tartas-1 site.

West Siberian team of the Institute of Archaeology and Ethnography SB RAS in 2015. The complex consisted of two residential structures, and several peculiar pits for fermenting fish (Fig. 2–4). The latter showed manifestations of ritual activities: corpses of animals had been placed there as offerings (Molodin, Kobeleva, Mylnikova, 2017a, b; Molodin, Nenakhov, Nesterova et al., 2017; Molodin, Hansen, Mylnikova et al., in press; Molodin, Hansen, Nenakhov et al., 2016). Studying the Neolithic assemblages containing various stone and bone artifacts, as well as flat-bottomed clay vessels, discovered at the Tartas-1 site, allowed us to suggest the existence of a specific Early Neolithic Barabinskaya culture in the southern part of the West Siberian Plain (Molodin, Kobeleva, Durakov et al., 2017; Molodin, Kobeleva, Mylnikova, 2017b; Molodin, Reinhold, Mylnikova et al., 2018). A series of radiocarbon dates generated at the Curt Engelhorn Center for Archaeometry in Mannheim, Germany fall mostly within the period from the late 8th to early 6th millennium BC (Molodin, Reinhold, Mylnikova et al., 2018). The said definitions have been confirmed by the results of dating the samples from the Neolithic site of Vengerovo-2 at the same center: for 1 σ—6426–6385 BC, for 2 σ—6440–6266 BC (Ibid.: 47). They correspond to the time of Neolithic complexes at Tartas-1. Currently, a few more samples taken from the Neolithic features at Tartas-1 are under scientific scrutiny at the Curt Engelhorn Center for Archaeometry.

The problem of dating the identified Early Neolithic Barabinskaya culture has not so far been resolved. Some specialists consider that the chronological and cultural attribution of the Neolithic complexes at Tartas-1 is debatable (Bobrov, Marochkin, 2018: 11) and attribute the said features to the Boborykino culture (Bobrov, Marochkin, 2013; Bobrov, Marochkin, Yurakova, 2012a, b; Bobrov, Yurakova, 2014; Yurakova, 2017; Zakh, 2018). Therefore, an additional series of samples from the Neolithic features of the Tartas-1 site was transferred to the Laboratory of Sample Preparation and Isotope Analysis of the *Cenozoic Geochronology* Center for Collective Use of the Institute of Archaeology and Ethnography SB RAS, to conduct dating using a unique research installation, the "Accelerator Mass-Spectrometer of the INP SB RAS". Samples were taken from structure 6, and from pits for fermenting fish and performing ritual actions*.

Preparation of bone samples

Isolation of collagen from bone samples was conducted at the Laboratory of Sample Preparation and Isotope Analysis of the *Cenozoic Geochronology* Center for Collective Use of the IAET SB RAS by chemical treatment of samples. A bone sample was cleaned, washed out, and ground to powder. Then, 2–3 g of the sample were placed into a glass, following which 20–30 ml of dichloromethane were poured therein, and held at room temperature while stirring for 12 hours. After this, the solution was poured out, the residual matter was dried first at room temperature, and then at 70 °C for 10 and 5 minutes, consecutively. The resulting dry powder was covered with 20 ml of 1 mol/L HCl solution and stirred for 30 minutes at room temperature; in so doing, the acidity of solution was brought to pH = 2–3 by means of solution replacement, if necessary. Following that, the mixture was centrifuged for 3 minutes, then the solution was poured out, and the residual matter was washed out with distilled water up to a value of pH = 7. The resulting residual matter was mixed with 20 ml of 1 mol/L NaOH solution and held for 20 minutes while stirring; in so doing, the acidity of solution was brought to pH = 9–10 by means of alkali solution replacement, if necessary. Next, the residual matter was washed out with distilled water up to pH = 7–8, covered with 20 ml of 1 mol/L HCl solution again, and held for 15 minutes while stirring; then it was washed out with distilled water

*After finalization of the article, the following date was also obtained for a bone sample from pit 1383 at Tartas-1: MAMS 38065 for 1 σ—7583–7553; for 2 σ—7589–7537 BC.

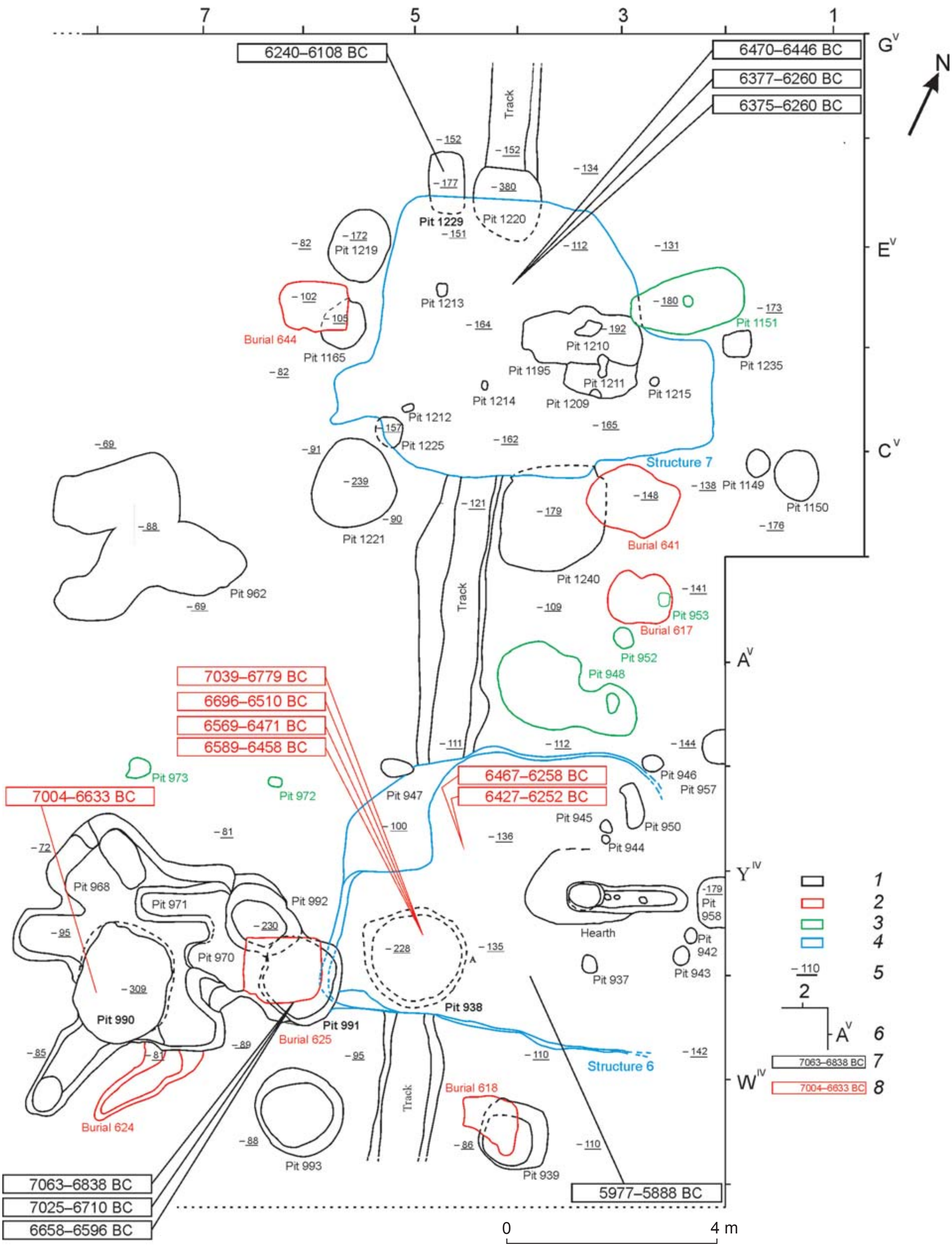

Fig. 2. Plan of the excavation area with Neolithic complex at Tartas-1.
1 – Neolithic pits; *2* – burials belonging to the Andronovo (Fedorovka) culture; *3* – Bronze Age artifacts; *4* – Neolithic structures; *5* – bench-marks; *6* – excavation boundary; *7* – ^{14}C-date obtained at the Curt Engelhorn Center for Archaeometry; *8* – ^{14}C-date obtained at the INP SB RAS laboratory (*7*, *8* – dates are given for 1 σ).

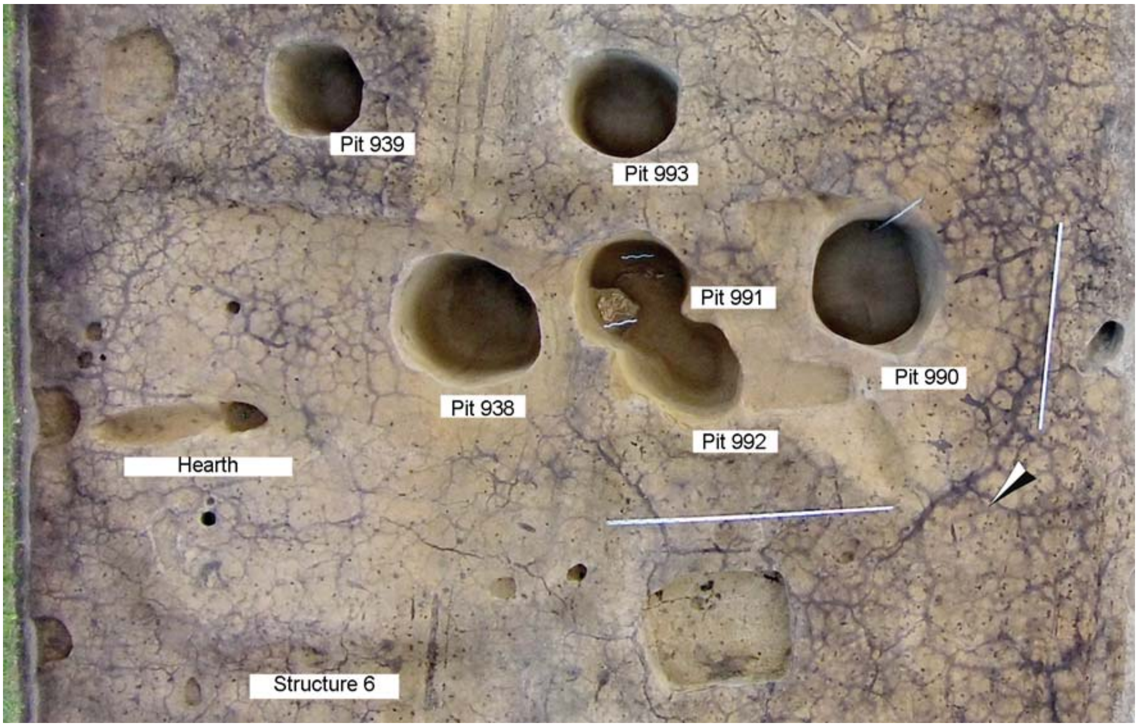

Fig. 3. Structure 6 and adjacent Neolithic pits.

Fig. 4. Pit 1220. Studying the stratigraphic section during excavation of the filling.

to produce a suspension with pH = 3. The suspension was thermostated at 70 °C for 24 hours. Then, the solution was separated from the residual matter by centrifuging and, purified in such a way, it was dried up at 70 °C to produce collagen powder.

Carbonizaton of the resulting collagen for further analysis at the accelerator mass-spectrometer AMS was performed at the NSU radiocarbon laboratory, using an absorption catalytic unit. The procedure included stages of combustion, sorption of carbon dioxide at selective sorbent, desorption, and catalytic reduction of CO_2 with nitrogen (Lysikov et al., 2018). A carbon-containing sample (4–10 mg) was burnt with the IKT-12-8 catalyst at 900 °C. Adsorption using the CO_2 (CaO) sorbent was conducted at a temperature of 550 °C, then the line was evacuated, and desorption of CO_2 was carried out at 920 °C. Isolated CO_2 was frozen out in a quartz or pyrex tube containing 7–8 mg of α-Fe (Aldrich-325 mesh) powder, gas pressure was measured, the required stoichiometric amount of hydrogen was injected, and carbonizaton was conducted at 550 °C and the total pressure of ca 1.2 bar for 5–6 hours. The cold zone of the carbonizaton tube contained drying agent (magnesium perchlorate) to remove the resulting water and to shift equilibrium towards formation of elemental carbon. After completion of the process, the powder, containing 2–3 mg of carbon, was pressed to form tablets and delivered to the AMS-analysis. Apart from the samples under investigation, the carbonizaton procedure was applied to standard samples of ethane diacid, such as OxI and SRM 4990C (OxII). The content ratio of radiocarbon $^{14}C/^{13}C$ in the samples was normalized to the content of $^{14}C/^{13}C$ in modern carbon, determined according to standard samples. The radiocarbon content was determined using the research installation "Accelerator Mass-Spectrometer of the INP SB RAS" (Parkhomchuk, Rastigeev, 2011).

Discussion

As a result of study of materials from the Neolithic complexes of the Tartas-1 site, data for seven samples from three features were obtained (Table 1). Four samples date pit 938, one sample pit 990, and two of them structure 6 (see Fig. 2, 3). For dating the pits, the bones of birds and animals were used (definitions were made by S.K. Vasiliev), while structure 6 was dated using two bone tools from its filling (Fig. 5). For structure 6, a date established at the Curt Engelhorn Center for Archaeometry is also available, which allows us to compare the results obtained in different laboratories.

Comparison of the stratigraphic positions of pit 938 and structure 6 suggests that the structure was built after the pit had stopped functioning and had been fully filled with soil. The spread in values of samples 4–7 from pit 938 is within the limits of approximately 300 years, and corresponds to the 8th millennium BC; however, taking the possible corrections into account (Table 1), this variation may be smaller.

Table 1. **Results of radiocarbon dating of samples from Tartas-1**

Sample No.	Sample code	Radiocarbon age, BP
1	NSKA 01644	7875 ± 81
2	NSKA 01645	7532 ± 97
3	NSKA 01646	7479 ± 92
4	NSKA 01647	7972 ± 70
5	NSKA 01648	7803 ± 66
6	NSKA 01649	7702 ± 71
7	NSKA 01650	7670 ± 73

According to the data on the burial depth of the finds, the last of these were separated only by 18 cm. The ^{14}C-age

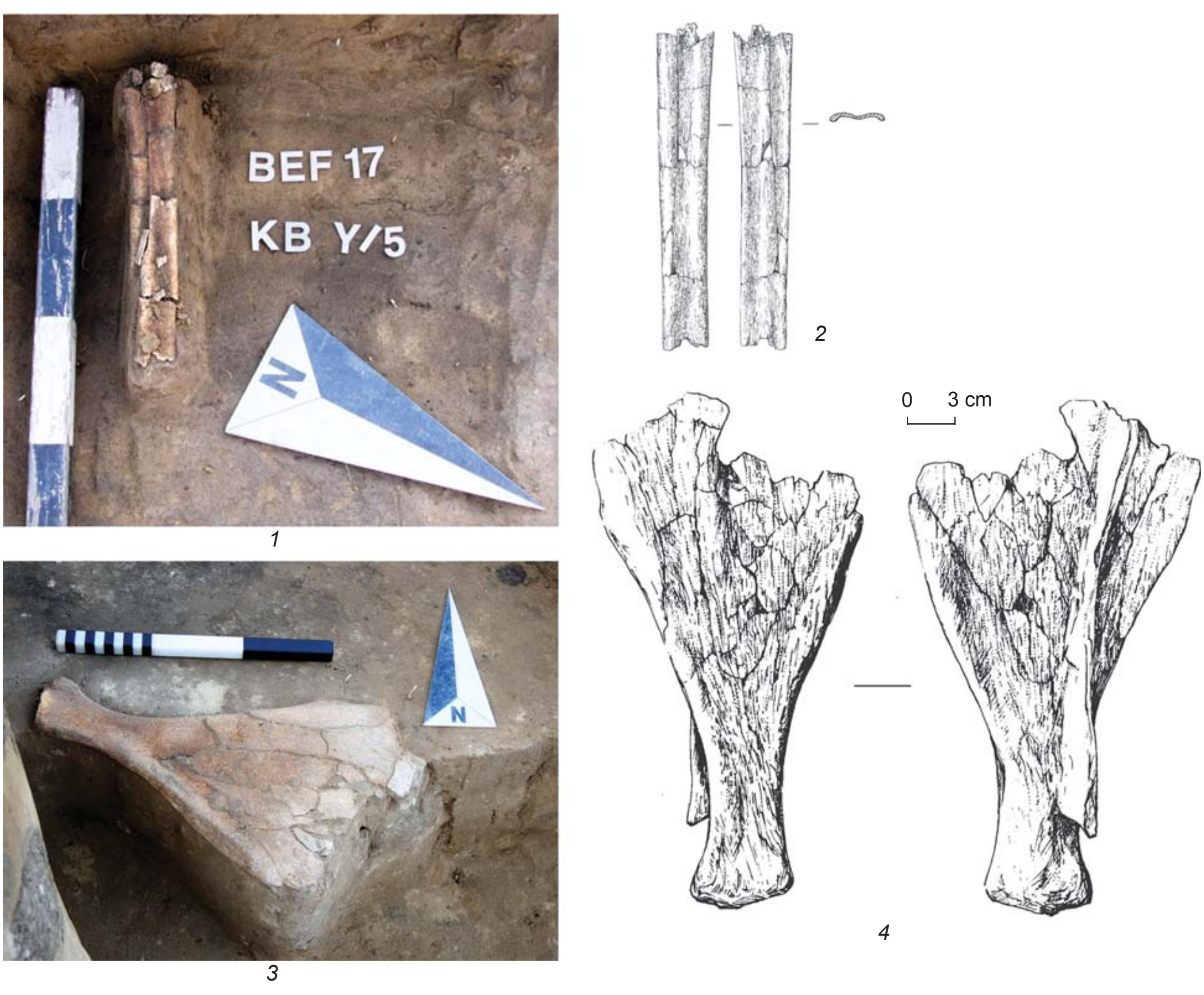

Fig. 5. Tools from the Neolithic complex at Tartas-1.
1, *2* – from the elk bone, structure 6; *3*, *4* – scapula of elk (?) with traces of working, pit 1229.

Table 2. **Radiocarbon dates of samples from the Early Neolithic features (the Barabinskaya Neolithic culture) of Tartas-1**

Feature	Samples	Sample code	Radiocarbon age, BP	Calendar date, BC		Research laboratory
				1 σ	2 σ	
Pit 938	Ermine bone	NSKA 01647	7972 ± 70	7039–6779	7061–6661	INP SB RAS
	Fox bone 2	NSKA 01648	7803 ± 66	6696–6510	6982–6469	″
	Fox bone 1	NSKA 01649	7702 ± 71	6596–6471	6655–6433	″
	Hare (white) bone	NSKA 01650	7670 ± 73	6589–6458	6645–6418	″
Pit 990	Bird bone	NSKA 01644	7875 ± 81	7004–6633	7046–6535	″
Pit 991	Bones from the layer	MAMS 26158	8034 ± 36	7063–6838	7071–6825	Curt Engelhorn Center for Archaeometry
	Dog	MAMS 26156	7804 ± 37	6658–6596	6696–6509	″
	Wolverine	MAMS 26157	7946 ± 37	7025–6710	7031–6695	″
Pit 1229	Elk scapula (tool?)	MAMS 29407	7344 ± 24	6240–6108	6249–6093	″
Structure 6	Fragment of elk bone (article)	NSKA 01645	7532 ± 97	6467–6258	6593–6220	INP SB RAS
	″	NSKA 01646	7479 ± 92	6427–6252	6486–6100	″
	Animal bone	MAMS 29405	7019 ± 23	5977–5888	5982–5846	Curt Engelhorn Center for Archaeometry
Structure 7/1, horizon	Animal rib (elk)	MAMS 29402	7621 ± 22	6470–6446	6492–6435	″
Structure 7/2, horizon	″	MAMS 29403	7449 ± 23	6377–6260	6391–6249	″
Structure 7/3, horizon	″	MAMS 29404	7446 ± 23	6375–6260	6390–6248	″

of the most ancient find (ermine bone, NSKA 01647) from a depth of 320 cm* is 7972 ± 70 BP. A hare bone was buried higher by 5 cm (at a depth of 315 cm). Its (NSKA 01650) ^{14}C-age (7670 ± 73 BP) is in good agreement with the previous estimate. Even higher, at a depth of 304 cm, a fox bone (NSKA 01648) taken for analysis was located. Its date is 7803 ± 66 BP, i.e. this find is somewhat older than the previous one, and also than the date obtained from the fox bone (NSKA 01649) found higher by another 2 cm (7702 ± 71 BP). However, if possible corrections are taken into consideration, it becomes apparent that the two last dates, corresponding to the samples separated by 2 cm, belong to the same period, while time differences should be attributed to the imperfection of the method. It is also obvious that the more ancient date correlates to the earliest date in terms of the epoch.

*All measurements were made from a single reference point.

The date 7875 ± 81 of pit 990 (NSKA 01644) coincides with the date of sample NSKA 01648 from the above-described pit 938 (7803 ± 66 BP), which is indicative of their contemporaneousness.

Two following dates for structure 6 are absolutely coincident: NSKA 01645 – 7532 ± 97 BP, NSKA 01646 – 7479 ± 91 BP (Table 2). They are separated by only 53 years, which can be neglected when taking into account possible corrections. These dates are not fully correlated with the date of structure 6 obtained at the Curt Engelhorn Center for Archaeometry (7019 ± 23 BP); they are older by more than 400 years, but the total spread in dates obtained in this center (Molodin, Reinhold, Mylnikova et al., 2018: Tab. 1) reaches ca 1 thousand years.

Calibration of the obtained series of dates for 1 σ and 2 σ (Table 2) demonstrates total correlation with the dates submitted by the Curt Engelhorn Center. Meanwhile, some of them are identical. For example, the date of the animal bone (a tool?) that was discovered in one of the utility pits (No. 1229) that surrounded structure 7 (see Fig. 2, 3) is 7344 ± 24 BP. Since the lowest date of structure 7 itself is 7449 ± 23 BP, it can be assumed that the pit and structure 7 functioned around the same time. This circumstance "narrows the distance" between pit 1229 and pit 938 in structure 6. Most probably, the utility pits were located not far from the structures. As a result of frequent rebuilding, renovation of walls, displacement and reconstruction of the hearth (judging by the planigraphy of structures), the trench, shifting sideways, covered the pits that did not function by this time.

Conclusions

The results of radiocarbon dating of samples from the Early Neolithic complexes at Tartas-1 in the laboratory of the Institute of Nuclear Physics SB RAS, using the unique research installation "Accelerator Mass-Spectrometer of the INP SB RAS", are almost completely coincident with the dates obtained earlier at the Curt Engelhorn Center for Archaeometry*. Notably, the two dates were determined in different laboratories, for bone tools from the filling of structure 6. Their identity confirms the correctness of the conclusions: the earlier distinguished Barabinskaya Neolithic culture can be confidently attributed to the 7th millennium BC.

During excavation of a Neolithic site at Tartas-1 in 2018 and as a result of study of the Ust-Tartas-1 complex discovered in 2017 (Molodin, Kobeleva, Mylnikova, 2017b; Molodin, Hansen, Mylnikova et al., 2018), new materials were obtained, which holds out a hope of clarifying the chronological framework of the Barabinskaya Early Neolithic culture in future.

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*Curt Engelhorn Center for Archaeometry in Mannheim unites several laboratories, including the Laboratory of the Heidelberg University, where the samples from Tartas-1 were earlier analyzed.

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