

## Verifying the chronology of Ukrainian Neolithic

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and herding in Ukraine during the second half of the VIth millennium BC.

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Keywords: Neolithic, Linear Pottery culture, Azov-Dnieper culture, chronology, Ukraine

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## Introduction

The earliest Neolithic phases in Ukraine are subject to ongoing discussion<sup>1</sup>. While the earliest clearly attested agriculture relates to the time of Linear Pottery culture<sup>2</sup>, traces of pre-Linear Pottery culture (Linearbandkeramik; further LBK) farming and herding will likely be uncovered in future. On the other hand, Ukraine encompasses numerous ecozones from south to north, from Black and Azov coasts, steppe, forest-steppe, mixed and deciduous forests to alpine uplands. Therefore, it is reasonable to assume that the ways and timing of Neolithisation vary greatly according to the ecological situation, with a tendency toward delayed agricultural colonisation in less productive or less accessible zones through time. Poor chronological detail precludes a meaningful interpretation of the available data and hampers synthesis in the Neolithic archaeology of Ukraine.

Since 1998 the Kyiv laboratory has produced hundreds of dates related to the Late Stone Age of Ukraine and adjacent territories<sup>3</sup>. They were welcomed with enthusiasm by some researchers<sup>4</sup>, whilst doubted by others<sup>5</sup>. In 2014, the state of discussion was summed up by D.L. Haskevych (Gaskevych)<sup>6</sup>, who suggested that there were two coherent sets of dates, “old” and “new”. The “old” chronology was built on the conventional dates obtained mostly from charcoal until 1998. The “new” chronology applied a more numerically solid base of <sup>14</sup>C conventional analyses carried out in the Kyiv radiocarbon facility between 1998 and 2008. They were consistent systems that correctly reflected the relative chronology (typological seriations, stratigraphies of the sites etc.). The difference between the two data sets was systematic and could be as high as four hundred years for some of the sites in question. Thus, D. Haskevych concluded that two chronologies cannot be used for the same analysis<sup>7</sup> and are equally probable. Thus, the sites and cultural aspects of Neolithic and Eneolithic in Ukraine obtained two contradicting chronological scales. This fact hampers our understanding of Ukrainian prehistory. The first ceramic technology, the Neolithisation, and the introduction of the first metals are important events that play a key role, not only in Ukrainian prehistory but also in the pan-European understanding of these processes. These events were dated differently according to different timescales<sup>8</sup>.

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<sup>1</sup> Lillie / Potekhina 2020; Motuzaitė-Matuzevičiute 2020; Kiosak et al. 2021; Endo et al. 2022.

<sup>2</sup> Motuzaitė-Matuzevičiute / Telizhenko 2016; Salavert et al. 2021.

<sup>3</sup> Kovaliukh et al. 2007.

<sup>4</sup> Burdo 2003; Kotova 2003; Kotova / Videiko 2004; Videiko 2004.

<sup>5</sup> Tovkailo 2004; Gaskevych 2007.

<sup>6</sup> Gaskevych 2014.

<sup>7</sup> Gaskevych 2007, 2014.

<sup>8</sup> Compare Kotova 2015 and Tovkailo 2014; Rassamakin 2012 and Videiko 2004 etc.

Since then, several important results have been obtained. Various studies undermined the validity of the Kyiv radiocarbon dataset<sup>9</sup>, while others showed an overall good agreement between Kyiv dates and AMS dates from other laboratories<sup>10</sup>. The discussion is far from over, as chronologies for certain periods of Ukrainian prehistory are based almost exclusively on Kyiv dates of the “problematic” series<sup>11</sup>. Thus, there is an evident need for a re-dating and validation program. Such a vast program is beyond scope of this paper and instead we turn our attention to a site-oriented approach. Previous comparative studies<sup>12</sup> relied heavily on the typo-chronology in order to confront two datasets and the dates for a single culture or a period of culture were treated one against another. Here, we aim at a small series of AMS dates from well-defined contexts of four sites, which were antecedently dated by the Kyiv radiocarbon facility. The obtained results are compared with existing dates in order to establish the validity of existing chronologies for the Neolithic of Ukraine.

## Materials and methods

All new AMS measurements were performed at Poznan Radiocarbon Laboratory, which is equipped with the 1.5 SDH-Pelletron Model “Compact Carbon AMS” ser. no. 003 produced by the National Electrostatics Corporation, Middleton, USA. Portions of CO<sub>2</sub> resulting from the combustion of collagen or decomposition of structural carbonate were graphitized with hydrogen (H<sub>2</sub>), and isotopic ratios <sup>14</sup>C/ <sup>12</sup>C and <sup>13</sup>C/ <sup>12</sup>C in the acquired graphite was measured using the “Compact Carbon AMS” spectrometer<sup>13</sup>. Radiocarbon dates were calibrated using the online calibration program OxCal 4.4.2 provided by Bronk Ramsey and Lee (2013)<sup>14</sup> using atmospheric data from Reimer et al.<sup>15</sup> (2020)

All radiocarbon dates were obtained from fragments of bones and all results are conventional radiocarbon ages<sup>16</sup> (see Table 1). The samples were obtained from four Neolithic sites (see Fig. 1 and 2).

The **Semenivka (Semenovka) 1** site was investigated by Nadezhda Kotova and Oleg Tuboltsev near Melitopol, Zaporizhzhia Region in 1991, 1992<sup>17</sup>. It stands on the first terrace of the right bank of the Molochna river. The excavated area is 276 sq.m. The stratified site contained layers from

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<sup>9</sup>Motuzaitė Matuzeviciute et al. 2015; Haskevych et al. 2019.

<sup>10</sup>Lillie et al., 2009; N. Kotova, 2018; Lillie et al., 2020.

<sup>11</sup> Kotova / Videiko 2004; Kotova 2013.

<sup>12</sup>Gaskevych, 2014; Rassamakin, 2009, 2012; Tovkailo, 2004, 2014.

<sup>13</sup> Goslar et al. 2004.

<sup>14</sup> Bronk Ramsey / Lee 2013.

<sup>15</sup> Reimer et al. 2020.

<sup>16</sup> Stuiver / Polach 1977.

<sup>17</sup> Kotova / Tuboltsev 1996.

Mesolithic to the Middle Ages, with a general depth of 2 m. However, during the excavations the upper layers were mostly removed, so horizons of Mesolithic and some pottery-bearing cultures (Surskyi, Azov-Dnieper) were investigated in some better preserved zones. Other zones were heavily contaminated by the content of the upper layers. The mixed sediments yielded an outstanding Eneolithic collection of the Skelia phase of Serebny Stog culture (first published as belonging to the Skelianska culture<sup>18</sup>). The further re-analysis helped to establish a stratigraphic unit with Serebny Stog materials in the southern part of the site. Later, another group of Eneolithic materials was defined in the eastern part of the site. It was attributed to the Dereivka culture<sup>19</sup>. The **Chapaevka site** was investigated by Nadezhda Kotova and Yuriy Rassamakin in 1989-1990 near the village of Chapaevka in Tokmak District, Zaporizhzhia Region<sup>20</sup>. A new excavation took place in 2019<sup>21</sup>. The site occupies the northern slope of the cape of the right bank of the Molochna River. The excavation measured 160 sq.m. The site yielded a single layer of Azov-Dnieper culture covered by over a meter of sterile sediments. The lithic complex is characterised by a developed macro-blade and blade component, an absence of cores, a series of retouching chips and a high percentage of tools. The tool-set mostly comprises retouched blades, also with convergent semi-abrupt retouch, and “fan-shaped” end-scrapers. The potsherds came from one high bowl with the imprints of a short comb stamp and, maybe, one more vessel of unspecified shape with similar decoration.

**The Lysa Hora (Lysaya Gora) cemetery** was explored by O. Bodianskyi in 1959 on the first terrace of the left bank of the Dnieper River, a 5 km to the west of the town of Vasylivka in Zaporizhzhia Region<sup>22</sup>. A soil lens, enriched with ochre, was traced at a depth of 70-90 cm on an area of about 21 sq.m. The fragments of vessels, human and animal bones, shells, flint and bone tools were found within its filling. The ochre spot contained remains of several single graves, five pits for collective burials and remains of other ritual activities partially covering the inhumations. According to the grave goods from this cemetery, it belongs to the second period of the Azov-Dnieper culture<sup>23</sup>.

The **site of Rovantsi – Hnidavska Hirka (Hnidava, Gnidava)** is situated on the high floodplain terrace of the Styr river. It is situated in a densely settled region of the LBK area – along with two rivers flowing to Styr (Chornohyzka and Serna) and both banks of Styr itself between confluences with the afore-mentioned rivers. The site was excavated on numerous occasions with partially

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<sup>18</sup> Ibid, 45-46.

<sup>19</sup> Kotova 2013, 40-41.

<sup>20</sup> Kotova / Rassamakin 2001.

<sup>21</sup> Kotova et al. 2021a.

<sup>22</sup> Bodianskyi 1961.

<sup>23</sup> Kotova 2015, 35.

incomplete field documentation. The last works were conducted by Lutsk rescue archaeological expedition (O.E. Zlatohorskyi). The chief of excavations was A.B. Bardetskyi<sup>24</sup>. An area of 1350 sq. m was excavated in the last period of excavations. The excavation-pits 10 and 12 revealed a scatter of LBK objects, including four typical long pits. The typological analysis of pottery indicates that the site belonged to the latest phase of the LBK in Ukraine, contemporaneous with the Želiezovce phase of Central Europe. The site yielded numerous obsidian finds, Alföld and Bükk potsherds, potsherds of Šarka type as well as Spondylus shells and a partial human skull<sup>25</sup>.

## Results

The chronology of the **Semenivka 1** site is based on stratigraphical observations (Fig. 3). There were four distinct stratigraphical units<sup>26</sup>. The Mesolithic (lowermost) layer was found under sterile soil 35-60 cm thick in the sq. 34b, 35, 36 of excavation pit 1. In other squares, the sterile soil horizon was reduced and a certain Mesolithic admixture in the upper units can be expected. The auroch bone from the Mesolithic unit brought a date of 8058±55 BP (UA-42032, published for the first time).

The lower layer (the second from the bottom of excavations, above the lowermost layer) yielded over 200 potsherds and was therefore defined as “Neolithic”<sup>27</sup>. It was revealed in the sq. 1-6 of excavation pit 2 in the yellow loam between 140/170 – 150/180 cm deep (depending on the local ancient relief). The potsherds came from at least 22 vessels. They were tempered with plant remains, crushed shells and sand. Vessels had pointed bottoms and can be divided into bowls (vessels without necks) and vessels with a well-defined neck. They were decorated by pits, pinches, incised lines, and sometimes – short (2-3 teeth) comb imprints. There were fragments of stone vessels found in this stratigraphic unit. The lithic industry was blade-oriented. Tools (27%) included end-scrapers (on ends of blades, as well as flakes, oval, circular etc.), burins (simple, multiple etc.), backed points on microblades, trapezes, oblique points and other retouched items. This stratigraphic unit was attributed to early Surskyi culture<sup>28</sup>.

The animal bones of this stratigraphic unit were dated in the Kyiv radiocarbon facility<sup>29</sup>. They placed this layer into the time slot of 6358-5625 calBC (2σ). The earliest date (Ki-7679, 7285±70 BP) is an outlier (according to OxCal software analysis), while the other three dates form a continuous sequence from 6083 till 5625 calBC (2σ). The pairs of dates (1: Ki-6689 and Ki-6688

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<sup>24</sup> Bardetskiy, 2012; Zlatohorskyi / Bardetskyi, 2010.

<sup>25</sup> Bardec'kyi et al. 2016, 2018; Bardetskiy et al. 2017; Becker et al. 2018; Mazanec et al. 2020; Saile 2020.

<sup>26</sup> Kotova / Tuboltsev 1996, 29-44 (primary publication), the most recent summary – Kotova 2013, 40.

<sup>27</sup> Kotova / Tuboltsev 1996, 30.

<sup>28</sup> Kotova 2003, 33.

<sup>29</sup> Ibid, 134-135.

and 2: Ki-6688 and Ki-7678) can be combined, while Ki-6689 and Ki-7678 are mutually exclusive and their combination fails on  $X^2$  test. The first pair can be combined to the timeslot of 5988-5841 calBC ( $2\sigma$ ) and the second – 5969-5718 calBC ( $2\sigma$ ). Thus, we can effectively assume that the majority of lower layer's anthropogenic remains were deposited during the first quarter of the VI mill. BC. The obtained date (sample Sem-1, see Fig. 3) fits well into the combination of Kyiv dates Ki-6689 and Ki-6688 ("first pair" from above). It combines both intermediate dates for this stratigraphic unit and could even be contemporaneous (with lesser likelihood) with the earliest and the latest Kyiv dates from this unit (but obviously not with both dates at the same time). Thus, we must conclude that the AMS-dating is in reasonable correspondence with conventional radiocarbon analysis of Kyiv laboratory for the lower stratigraphic unit of Semenivka 1. The combined dataset places the main habitation of this layer into the first quarter of the VIth mill. BC.

The upper stratigraphic unit contained materials of the second period of the Azov-Dnieper culture<sup>30</sup>. The Azov-Dnieper potsherds came from at least nine vessels and were made of clay paste tempered by sand, sometimes joined by a crushed shell. The vessels had rounded bodies, flat bottoms and "collar" (having an extension protruding inside) rims and were decorated with triangular and rectangular pits, incised lines and comb imprints. The single vessel brought a complex composition of stripes filled with comb imprints. The lithic assemblage is made up of blades and tools on blades and large flakes. There was a fragmented polished stone axe in this layer<sup>31</sup>.

Several animal bones of this stratigraphic unit were dated in the Kyiv laboratory<sup>32</sup>. The dates were somewhat contradictory. A single date (Ki-7675,  $6360\pm 70$  BP, 5475-5210 calBC,  $2\sigma$ ) corresponds well with the multiple dates of various laboratories made for the sites of the second period of Azov-Dnieper culture, while three other dates (Ki-7672-74) were some 1000 years later (4656-4056 calBC,  $2\sigma$ ), corresponding to the chronology of Eneolithic cultural groups. Thus, the upper layer was contaminated in the dated squares (1, 4 and 6) by the materials of the upper stratigraphic units. The novel date (sample Sem-2, see Fig. 3,  $6480\pm 40$  BP) is calibrated to the time-slot 5524-5336 calBC ( $2\sigma$ ) and is roughly consistent with the date obtained in the Kyiv lab for this unit (Ki-7675). They can be combined to 5479-5332 calBC ( $2\sigma$ ) with a good overall correspondence on  $X^2$  test ( $df=1$   $T=2.2(5\% 3.8)$ ).

Thus, the main habitation of this layer likely happened in the third quarter of the VI mill. BC, and it is important to note a gap of 300-600 years between these two habitations.

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<sup>30</sup> Ibid, 41.

<sup>31</sup> Kotova / Tuboltsev 1996, 40-43.

<sup>32</sup> Kotova 2003, 135.

The site of **Chapaevka** yielded a single cultural layer of Azov-Dnieper culture covered by over 1 meter of sterile deposits<sup>33</sup> (Fig. 4), a fact that makes it a reference site for understanding the Azov-Dnieper occupation in Eastern Ukraine. A pair of Kyiv dates were obtained for the site on animal bones<sup>34</sup>. They are consistent and can be calibrated to 6023-5669 calBC, 2 $\sigma$  or even combined into a time-slot of 5977-5736 calBC, 2 $\sigma$ . The new AMS dates are some 1000 years younger. They encompass 5203-4718 calBC. They cannot be combined ( $X^2$ -test fails), however, there is a timespan, when they can be contemporaneous: 4934-4847 calBC (2 $\sigma$ ). Taking into account the stratigraphic situation it is probable that the dates actually should be combined despite the statistical considerations mentioned above. Additionally, the radiocarbon “plateau” of the late Vth mill BCE<sup>35</sup> affects the earlier date extending its calibration well into the VIth mill. BCE. The early Vth mill. BCE date seems much more likely from this point of view.

**Lysa Hora** cemetery contained three groups of burials in stratigraphic succession<sup>36</sup>. The earliest group is represented by six supine burials facing southeast. The intermediate horizon yielded five pits containing multiple partial inhumations each. The third horizon was formed by partially burnt skeletons found above pit 3 in two scatters. One radiocarbon date was obtained in the Kyiv Laboratory on human bones from the pit 4: 5890 $\pm$ 70 BP (Ki-8181)<sup>37</sup>. Two new dates were made in the Poznan Radiocarbon Laboratory: one of them was for the partly burnt skeleton 17, which was found above pit 3 (Fig. 5). It yielded an age of 6010 $\pm$ 40 BP and can be combined with the Kyiv date on human bone indicating the existence of the cemetery between 4988-4784 calBC, 2 $\sigma$ . Thus, in this case, dates of both laboratories are in reasonable agreement. The second date – for an animal bone from the cultural layer above pit 4 is notably later. It encompasses 3769-3637 calBC, 2 $\sigma$ , when calibrated. This dating confirms the complex stratigraphy of the cemetery observed by O. Bodianskyi<sup>38</sup>.

The site of **Rovantsi** (also Hnidava/Gnidava) was dated on numerous occasions<sup>39</sup>. It is the Ukrainian LBK site with the largest number of radiocarbon dates obtained on various materials (animal and human bones, potsherds). The first attempt of dating was made in the Kyiv radiocarbon facility. The organic content of the potsherd was analyzed resulting in the age of 5825 $\pm$ 90 (Ki-

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<sup>33</sup> Kotova et al. 2021a.

<sup>34</sup> Kotova 2015, 34.

<sup>35</sup> Lenneis / Stadler 1995.

<sup>36</sup> Bodianskyi 1961; Telegin & Potekhina, 1987)

<sup>37</sup> Kotova 2003, 135

<sup>38</sup> Bodianskyi 1961.

<sup>39</sup> Kovaliukh et al., 2007; Saile, 2020.

12504)<sup>40</sup>. Its calibrated range (4902-4456 calBC, 2σ) is far from the widely recognized chronological frame of LBK and rather corresponds to post-LBK period. Two dates were obtained in different laboratories on the parts of the human skull found in pit 19 of the Rovantsi site<sup>41</sup> (Fig. 6). They can be combined to the time-slot of 5307-5213 calBC. The obtained date is earlier than the supposed chronological position of the site due to typological observations relating Rovantsi to the latest phases of LBK in Ukraine (already influenced by Želizovice style)<sup>42</sup>. The discrepancy is explained by a reference to possible prolonged use of the body of the deceased<sup>43</sup>. And two new dates fell into the later period: 5209-5007 calBC (2σ, when combined). The difference between these two pairs of dates (on human bones and animal bones) can reach 200 years. The prolonged use of the dead body is possible, but we cannot exclude the reservoir effect until isotope analysis is carried out on the human remains from Rovantsi.

## Discussion

The Kyiv radiocarbon facility has produced a large number of dates since the 1980s. The first Kyiv dates were applied jointly with some Berlin and Oxford queries for the construction of the first reliable schemes of absolute chronology for Ukrainian Neolithic<sup>44</sup>. The availability of radioactive isotope counting in the Kyiv lab made it extremely attractive for researchers of the Stone Age in Eastern Europe, especially during the financial hardships of the 1990s and early 2000s. Since 1998

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e Since roughly from 2008 onwards the Kyiv laboratory produced a certain amount of conventional dates that are in good correspondence with "old" chronology<sup>46</sup>. Some series of AMS dates were obtained for sites from the region under study<sup>47</sup>. Thus, the radiocarbon database became diversified, so dates of different origins can be crosschecked in order to validate the results.

i The most iconic cases of discrepancies between the dates of the Kyiv (1998-2008) radiocarbon facility and all the other dates are related to the phenomena of Buh-Dniester para-

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<sup>40</sup> Kovaliukh et al., 2007.

<sup>41</sup> Saile 2020.

<sup>42</sup> Bardec'kyi et al., 2018; Bardetskiy, 2012; Saile, 2020.

<sup>43</sup> Saile 2020, 212.

<sup>44</sup> Telegin 1987; Potekhina / Telegin 1995; Telegin et al. 2000; Telegin et al. 2003; Kotova, 2003.

<sup>45</sup> Gaskevych 2007, 2014; Rassamakin 2012; Motuzaitė-Matuzeviciute 2013.

<sup>46</sup> Kotova & Tuboltsev, 2013; Tovkailo, 2014; Kotova, 2015.

<sup>47</sup> Lillie et al., 2009; Biagi / Kiosak 2010; Motuzaitė-Matuzeviciute et al., 2015; Kiosak & Salavert, 2018; Haskevych et al., 2019; Saile, 2020; Lillie et al., 2020; Kiosak et al., 2021.

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Neolithic and Early Trypillian culture. These dates were analysed in detail by Yu. Rassamakin and D. Haskevych<sup>48</sup>.

Another case study is related to the Dnieper Rapids cemeteries. These archaeological objects produced hundreds of burials dating from the Final Paleolithic until the Iron Age. The cemeteries of the period of interest are well-known. They were extensively dated and at the moment the Dnieper Rapids region is the best dated region of Ukrainian archaeology thus far. However, as the dates were mostly recovered from cemeteries it hampers direct comparison with other regions not so rich in burial sites. And as far as human bones were the most common material for analysis, the issue of the reservoir effect cannot be ignored. The Dnieper Rapids cemeteries chronology showed a striking agreement between the problematic Kyiv series of dates with those from Oxford AMS-facility's. Firstly, there are burials dated by both laboratories with a reasonable agreement, and the overall chronology of cemeteries, when studied as sums of two available datasets, shows that there is no

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Four dates were obtained for animal bones (sampled by N.K.) from the Rivne site, which

belongs to the Transition phase ("Flomborn" or "Ačkovy" or "Zofopole") from the Vornotenkopf to

<sup>48</sup> Rassamakin 2012; Gaskevych 2014.

<sup>49</sup> Rassamakin 2012, 37; Gaskevych 2014, 13.

<sup>50</sup> Burdo 2003.

<sup>51</sup> Gaskevych 2014, 13.

<sup>52</sup> Ibid, 13.

<sup>53</sup> Kotova et al. 2017a, 92.

<sup>54</sup> Kotova 2018; Lillie et al. 2020.

<sup>55</sup> Stadler et al. 2021.

The Early Trypillian site of Hrebeniukiv Iar (Grebeniukov Yar) was dated to 5295-4735 calBCE, 2 $\sigma$ , by three Kyiv laboratory dates (Ki-6272-74)<sup>56</sup>. New set of AMS dates (Poz-87462-64,

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The site obtained Kyiv dates<sup>58</sup> spanning in-between 4800-4401calBC (2 $\sigma$ ). Two more AMS dates calBC; 2 $\sigma$ ) from the dates which come from the Kyiv laboratory<sup>59</sup>. New dates contradict the Kyiv conventional dates and are in reasonable correspondence with the radiocarbon chronology of the Romanian sites of Cucuteni A.

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This study adds four new cases of crosschecked chronology between “Kyiv” and AMS

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We can state that there were no systematic offsets or errors related to the “suspicious” series

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66 Burdo 2003.

67 Shatilo 2021.

68 Burdo 2003.

69 Kiosak / Lobanova 2021.

60 Compare Kotova et al. 2021a.

61 Kotova 2003, 26; Gaskevych / Kiosak 2011; Gaskevych 2014; Kiosak / Salavert, 2018;

62 Tovkailo 2014.

63 Kiosak / Salavert 2018.

64 Gaskevych 2014, 14.

65 Kotova et al. 2017b; Kiosak et al. 2022.

66 Meadows 2020.

67 Boudin et al. 2009.

68 Douka et al. 2010.

69 Stadler et al. 2021.

70 Kotova 2015.

71 Kotova 2018.

72 Haskevych et al. 2019.

73 Kotova et al. 2021b.

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example, a series of dates for Holyshiv and a single determination from Rovantsi – Hnidavska

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Thus, we suggest treating the Kyiv dates not as inherently “wrong”, instead, a case-specific microstratigraphic excavations or by a critical assessment of the available field documentation of the historical field-work. The preference should be given to dating the “homogeneous” stratigraphic likely to be “palimpsests” and result from many spatially limited repeated habitations. When

Additionally to the above-stated general observations, the obtained results have some important implications for the regional chronology of the studied cultural aspects.

The LBK sites of Ukraine are dated to the timespan 5450-4960 calBCE<sup>75</sup>. These dates are in reasonable correspondence with the chronology of the relative phases of Central European periodisation<sup>76</sup>. Another important factors to be considered, regarding the absolute chronology of this period, are the winding characteristics of the calibration curve at present available for this period. It shows an uninterrupted series of up-and-downs, which unfortunately greatly elongates the calibration results to ca 400 years. Meanwhile, the typochronological considerations indicate that the latest LBK sites with elements of Šarka and Želiesovce like Rovantsi-Hnidavska Hrika or Hirka Polonka should be dated to the later timespan. However, it is impossible to demonstrate with the available dataset of AMS dates for the western Ukrainian territory.

The Azov-Dnieper archaeological culture (“Neolithic”) is one of the most dated in Ukraine. It is characterized by numerous richly comb-decorated ceramic vessels with flat bottoms and “collar” rims, established settlements and numerous cemeteries<sup>77</sup>. Several series of dates were made on human bones of cemeteries from the Dnieper Rapids region associated with this cultural aspect. However, when compared to dates on deer teeth and other animal bones, the chronology based on human bones appeared far too early. Thus, a freshwater reservoir effect affected the dating<sup>78</sup>. The

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<sup>74</sup> Lillie et al. 2009; Kotova 2018.

<sup>75</sup> Saile 2020, 212; Kiosak et al. 2021.

<sup>76</sup> Stadler et al. 2021.

<sup>77</sup> Kotova 2015.

<sup>78</sup> Kotova 2018.

presented series of dates from Chapaevka, Semenivka 1 and Lysa Hora, therefore, is an important addition to the scientific grounds for the chronology of this culture.

Novel dates on the site of Chapaevka shed doubt on the chronology of the early phases of the Azov-Dnieper culture (believed to start from the early VIth mill. BCE previously)<sup>79</sup>. The series of dates (both Kyiv and Uppsala laboratories) were made on the early Azov-Dnieper complexes of the Razdolnoe site. They firmly establish the existence of this cultural aspect by the middle of the VIth mill. BCE<sup>80</sup>. Moreover, the date from lower stratigraphic unit of Semenivka 1 provides *terminus post quem* for the Azov-Dnieper stratigraphic unit of this site, which is also placed into the third quarter of the VI mill. BCE by the other new date. Thus, the new results make Azov-Dnieper culture “an eastern” contemporary of the LBK culture.

The Lysa Hora cemetery chronology sheds new light on the chronology of the latest complexes of the Azov-Dnieper aspect. They seem to last deep into the Vth millennium BC making Azov-Dnieper culture a likely component of the formation of the Steppe Eneolithic<sup>81</sup>. Interestingly enough, a similar date ( 4949–4799 BC) was obtained for a skeleton from Dereivka cemetery. This individual (I3719, burial 102) had entirely northwestern-Anatolian-Neolithic-related ancestry<sup>82</sup> and, probably, is the easternmost case of early farming ancestry found in Vth mill. BC. The Dereivka cemetery contained burials of many periods, however Azov-Dnieper culture tombs are well represented there. Indirect evidence suggests that burial 102 could be related to the same cultural aspect. Thus, dating of Lysa Hora places another Azov-Dnieper cemetery in the time when evidently certain interaction with populations of “genetic” early farmers took place in the Dnieper valley.

## Conclusion

In the area of present-day Ukraine researchers separated several Neolithic archaeological cultures. The key issue remains the specification of their chronology in terms of absolute chronology. It is over a decade since the first publication presenting the issue of radiocarbon dates from the Kyiv facility. The small cycle of AMS dates presented above from well-defined contexts of four Neolithic sites allowed us to put another "brick" in the ongoing discussion on establishing the chronology for the Ukrainian Neolithic. The conducted analysis allows us to draw conclusions not to treat the Kyiv dates as obligatorily "incorrect", but a cross-laboratory comparison seems necessary in every conclusion drawn from the inquiries of Kyiv facility done between 1998-2008.

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<sup>79</sup> Kotova et al. 2021a.

<sup>80</sup> Kotova et al. 2017a.

<sup>81</sup> Kotova / Videiko 2004.

<sup>82</sup> Mathieson et al. 2018.

Moreover, the novel dates reveal a complex picture in Ukraine during the second half of the VIth millennium BCE. In the west, vast territories were subjected to LBK colonisation (see Fig. 10). The Danubian newcomers spread as far as the outskirts of Kyiv (Vita-Poshtova)<sup>83</sup> and middle Southern Buh stretches (Kamyane-Zavallia)<sup>84</sup>. They brought agriculture (attested by direct dating of charred remains of domestic plants found in flotation)<sup>85</sup> and herding (attested by finds of bones of definitely domestic animals)<sup>86</sup>. They built consistent settlements with long houses<sup>87</sup> and cleared landscapes for fields<sup>88</sup>.

During the same time period, on the other, eastern, shore of the Dnieper river flourished sites of Azov-Dnieper culture<sup>89</sup>. There are dozens of settlement structures as well as cemeteries. The sites of the Azov-Dnieper often brought latent structures, which could be interpreted as dwellings after spatial analysis<sup>90</sup>. Pottery assemblages are characterized by flat-bottomed comb-ornamented pots and jars, and could be extremely rich in some sites<sup>91</sup>. However, direct evidence of a productive economy is missing or not yet found here. Domestic cow bones were reported from Razdolnoe<sup>92</sup>, while some imprints of the chaff of domestic plants were detected on the potsherds of Azov-Dnieper culture<sup>93</sup>. Further research is needed in order to establish whether eastern contemporaries of LBK were practicing farming and herding with certainty or if this particular cultural aspect was created by the groups with the most extractive economy.

## Acknowledgements

The sites of Semenivka 1, Chapaevka, and Lysa Hora are on the territory currently occupied by Russians. We express our gratitude and support to museum curators and cultural heritage specialists of the Zaporizhzhia region who continued hard work on the protection of these sites under these difficult circumstances. New radiocarbon analyses were financed by the National Science Centre (OPUS 15 2018/29/B/HS3/01540; research project "Investigation of the Sources and Uses of Obsidian during the Neolithic in Poland", led by Dagmara H. Werra). The interpretation was partially supported by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 891737. The authors wish to express their

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<sup>83</sup> Gaskevych 2006.

<sup>84</sup> Kiosak 2017.

<sup>85</sup> Motuzaite Motuzaviciute 2020, Salavert et al. 2021.

<sup>86</sup> Kiosak 2017, 264.

<sup>87</sup> Saile 2020.

<sup>88</sup> Salavert et al. 2021.

<sup>89</sup> Kotova 2015.

<sup>90</sup> Kotova / Tuboltsev 2013.

<sup>91</sup> Ibid, 34-35.

<sup>92</sup> Kotova et al. 2017a.

<sup>93</sup> Kotova / Pashkevich 2003.

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## List of figures

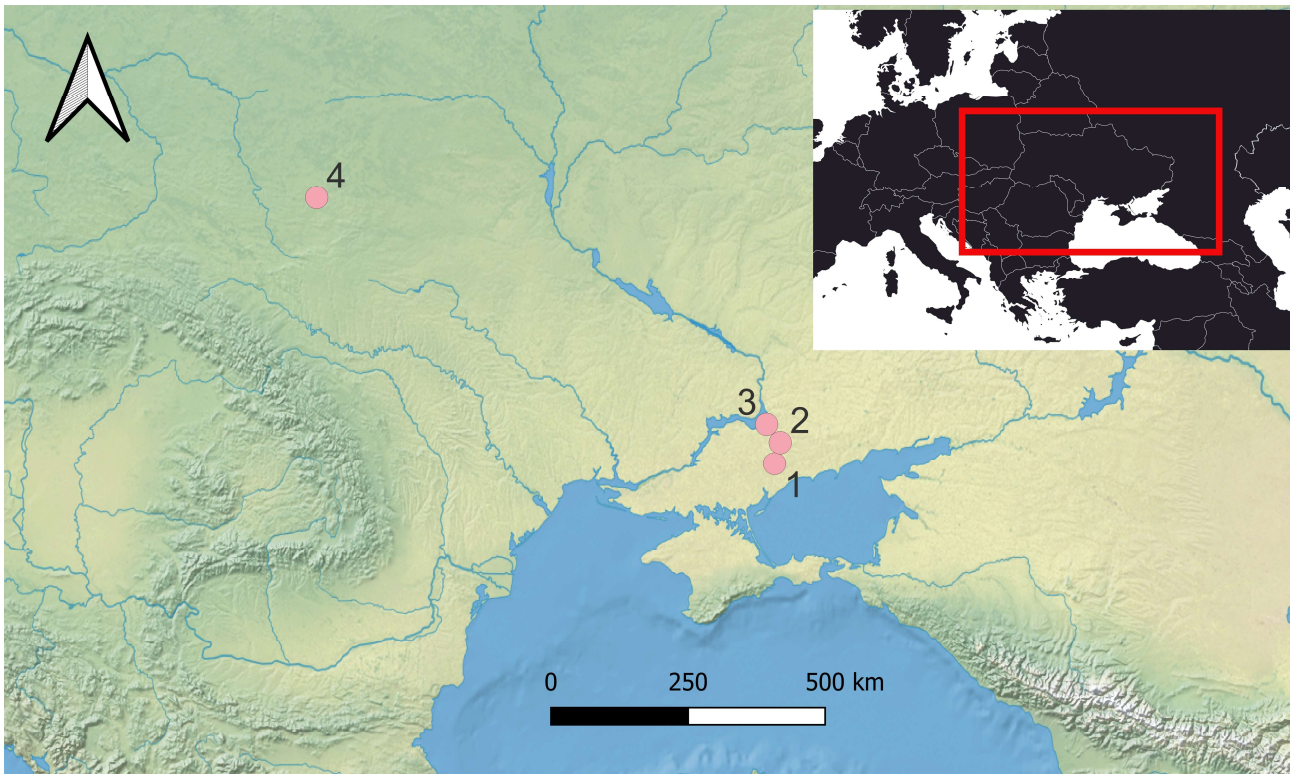


Fig. 1. Localisation of archaeological sites mentioned in the text: 1) Semenovka (Semenovka) site 1; 2) Chapaevka; 3) Lysaya Gora (Lysaya Gora); 4) Rovantsi – Hnidavska Hirka (Hnidava, Gnidava).

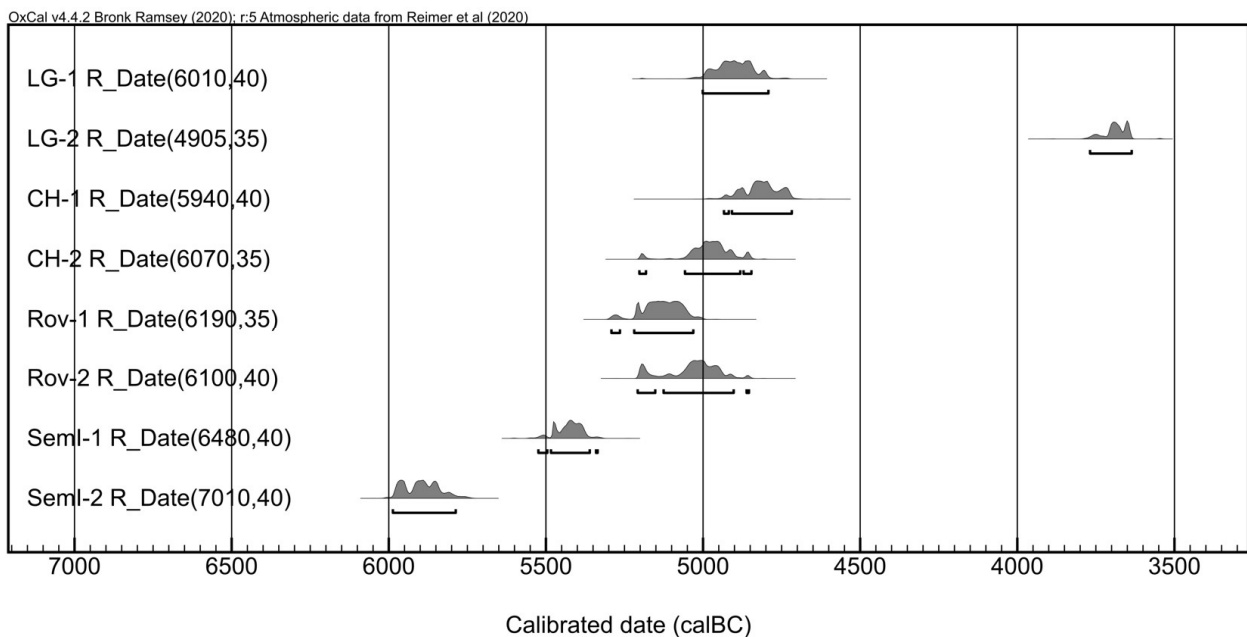


Fig. 2. Plot of new radiocarbon dates discussed in the text (graphic elaboration by D. Kiosak with OxCal v4.4.2).

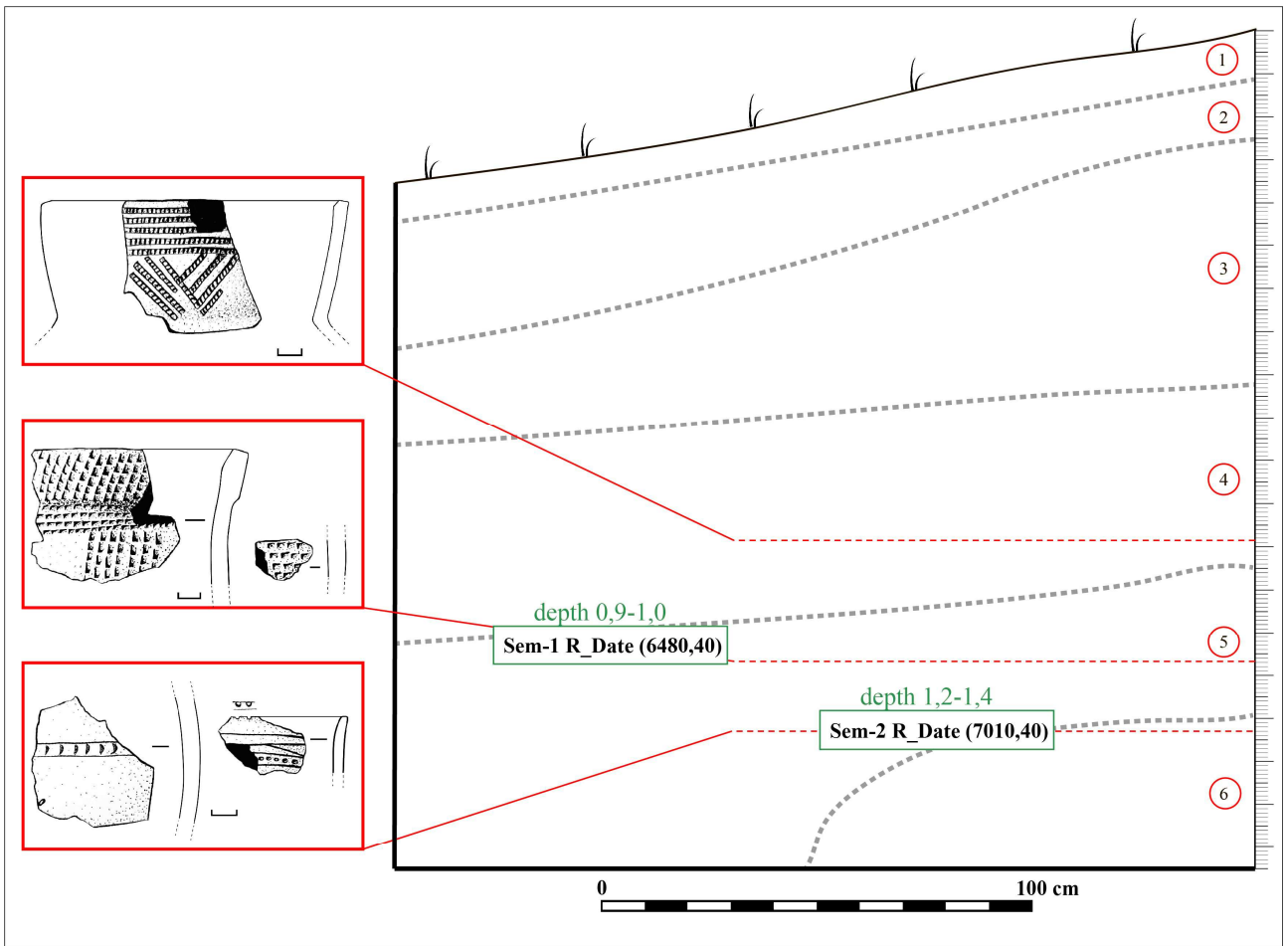


Fig. 3. Sampling and context: sections of Semenivka 1 (graphic elaboration by O. Demchenko and A. Bardeckyi).

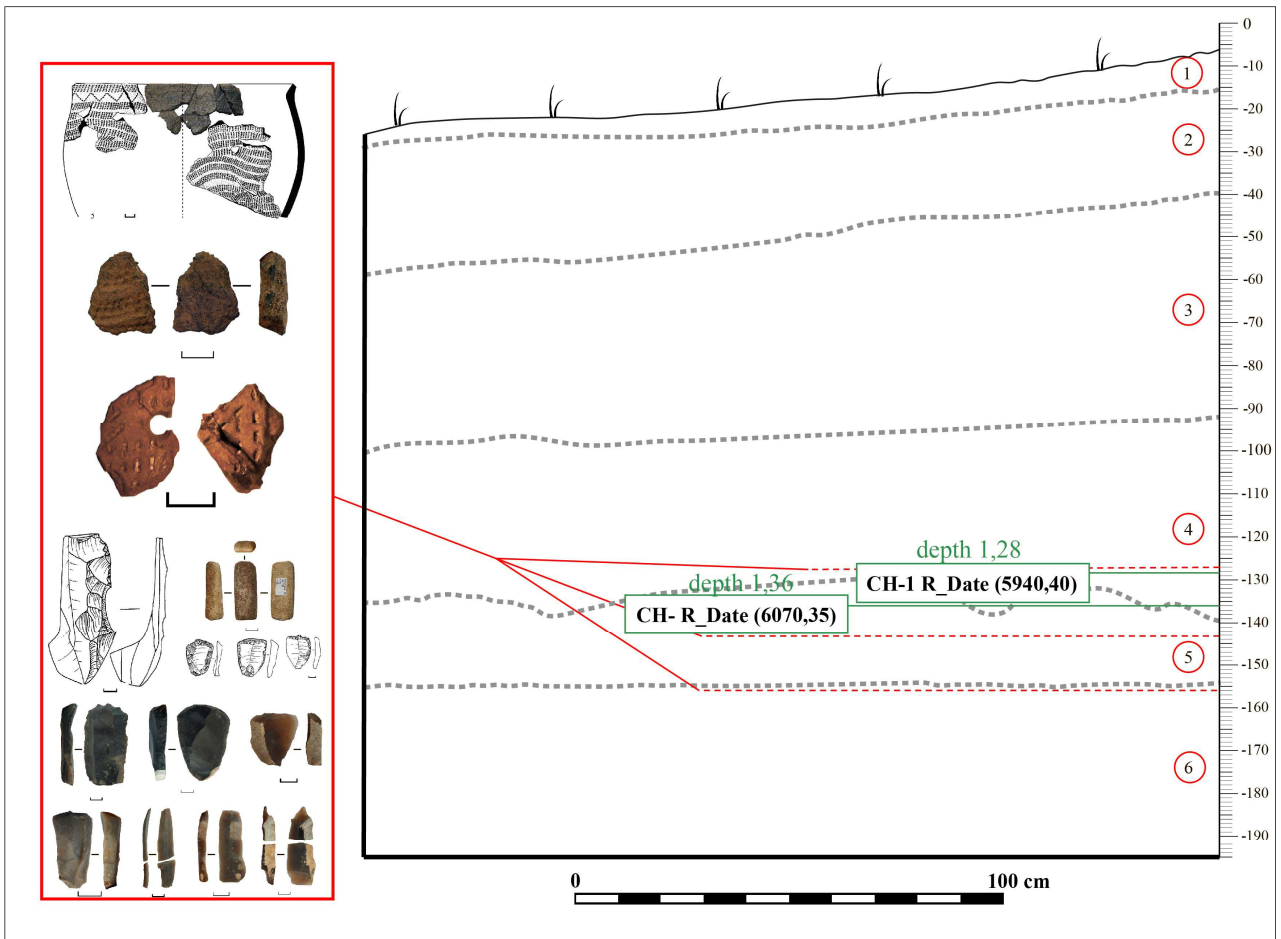


Fig. 4. Sampling and context: sections of Chapaevka (graphic elaboration by O. Demchenko and A. Bardeckyi).

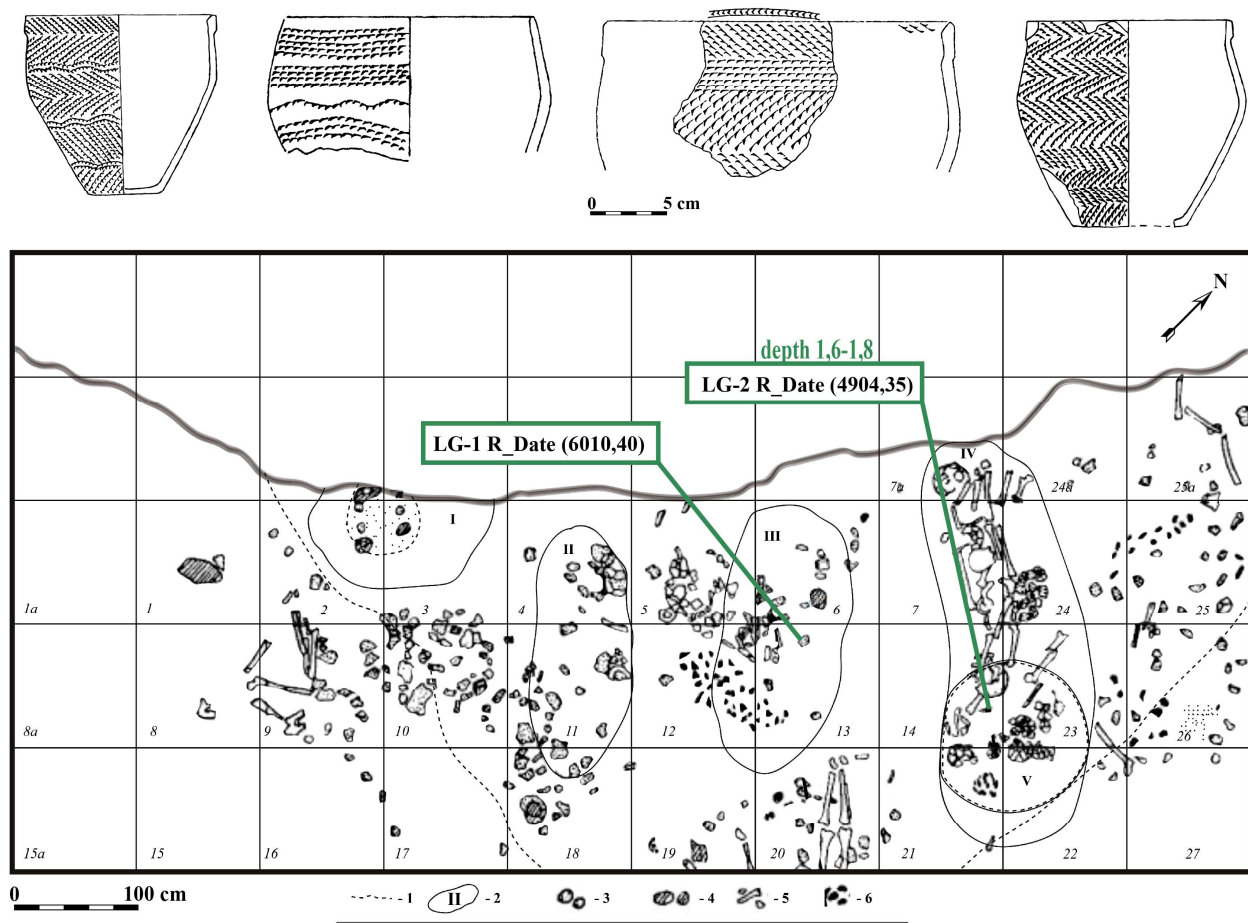


Fig. 5. Sampling and context: plans of Lysa Hora (graphic elaboration by O. Demchenko and A. Bardeckyi).



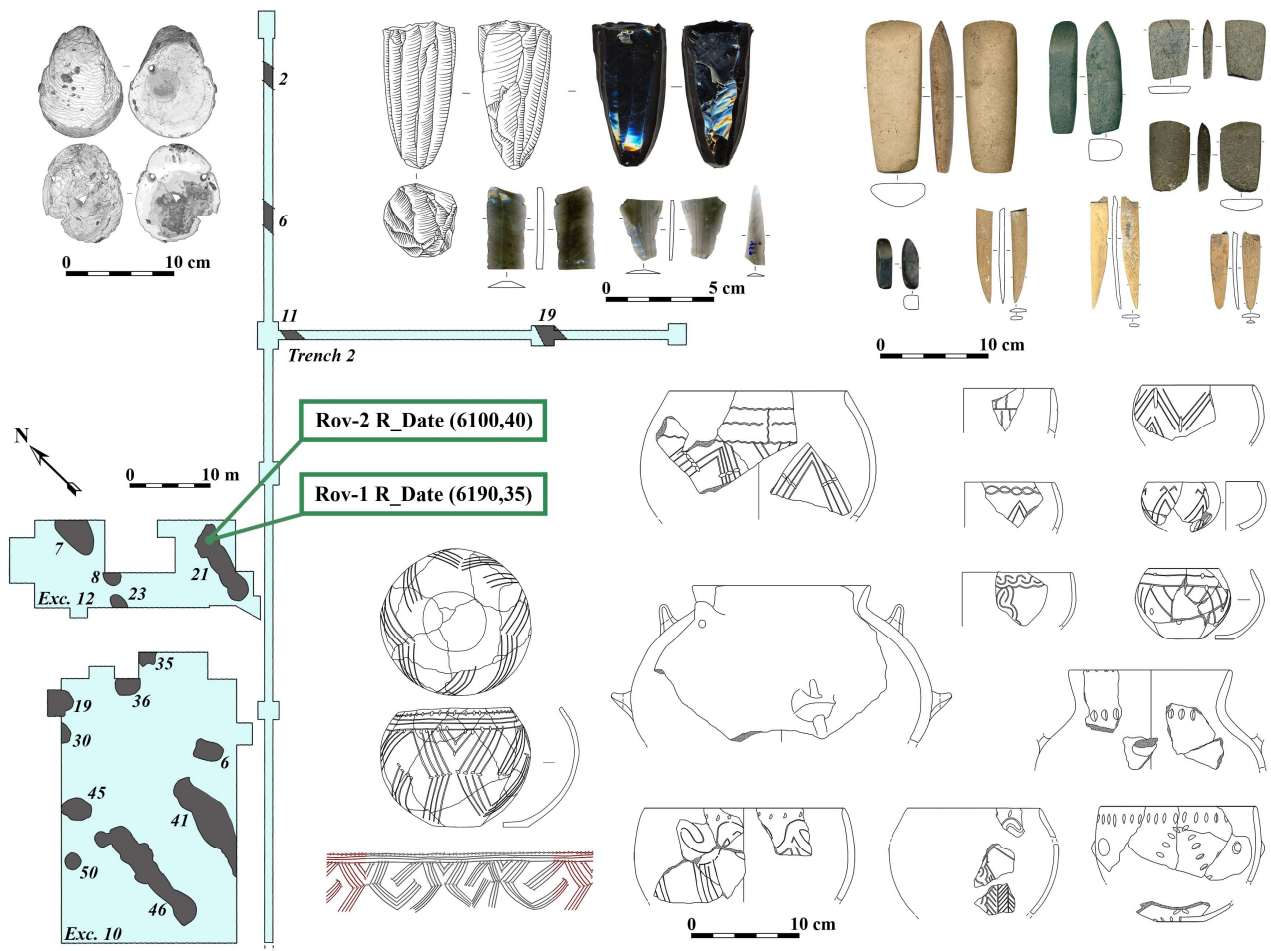


Fig. 6. Sampling and context: plans of Rovantsi (graphic elaboration by O. Demchenko and A. Bardeckyi).

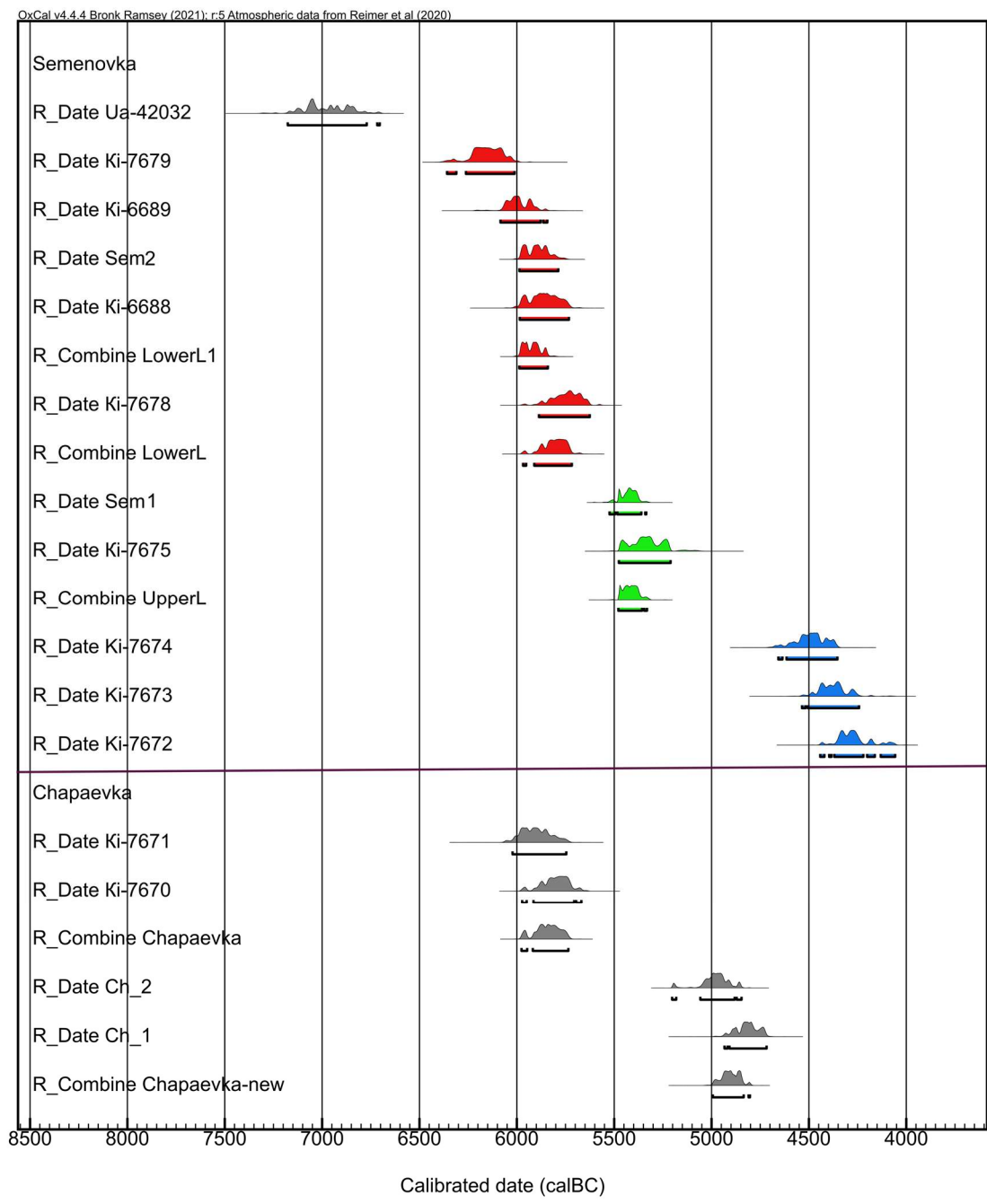


Fig. 7. “Kyiv” dates versus other datasets: summation approach for Semenivka (Semenovka) site 1 and Chapaevka (graphic elaboration by D. Kiosak with OxCal v4.4.4). Red – Semenivka 1 lower stratigraphic unit, green – Semenivka 1, upper stratigraphic unit; blue – Semenivka 1, Eneolithic dates.

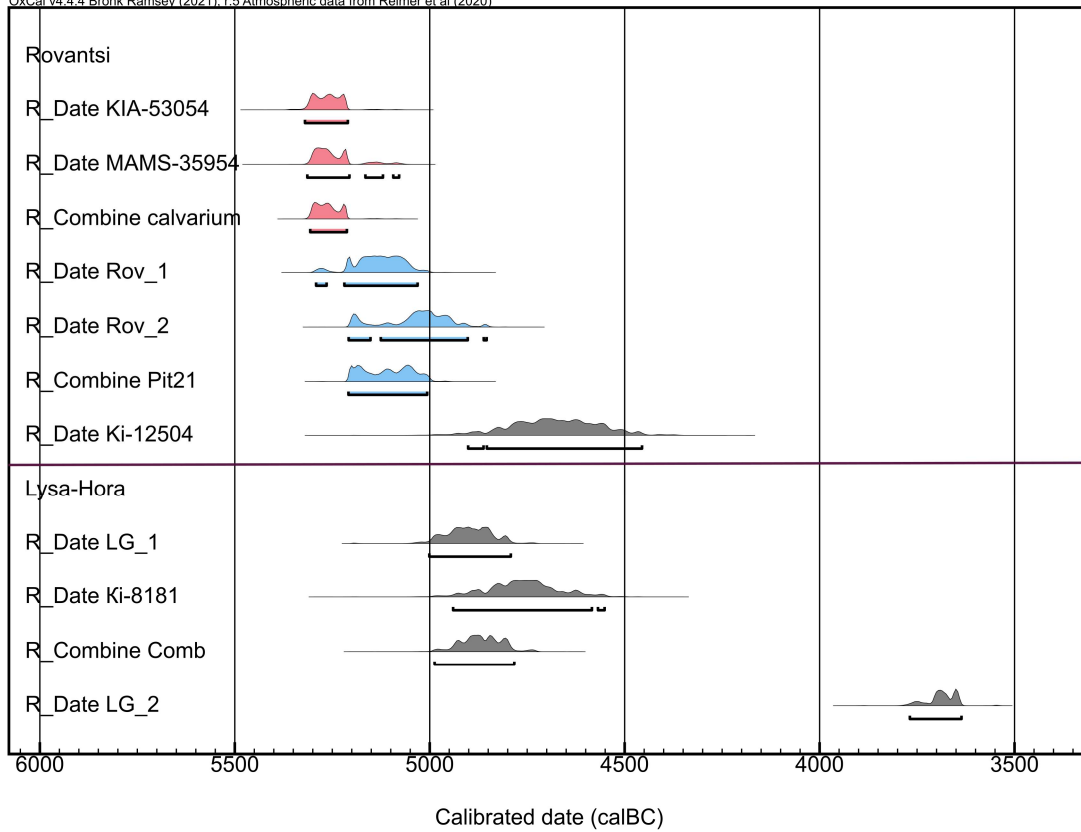


Fig. 8. “Kyiv” dates versus other datasets: summation approach for Lysa Hora (Lysaya Gora); Rovantsi – Hnidavska Hirka (graphic elaboration by D. Kiosak with OxCal v4.4.4). Red – Rovantsi, dates on human bone, blue – Rovantsi, dates on animal bones.

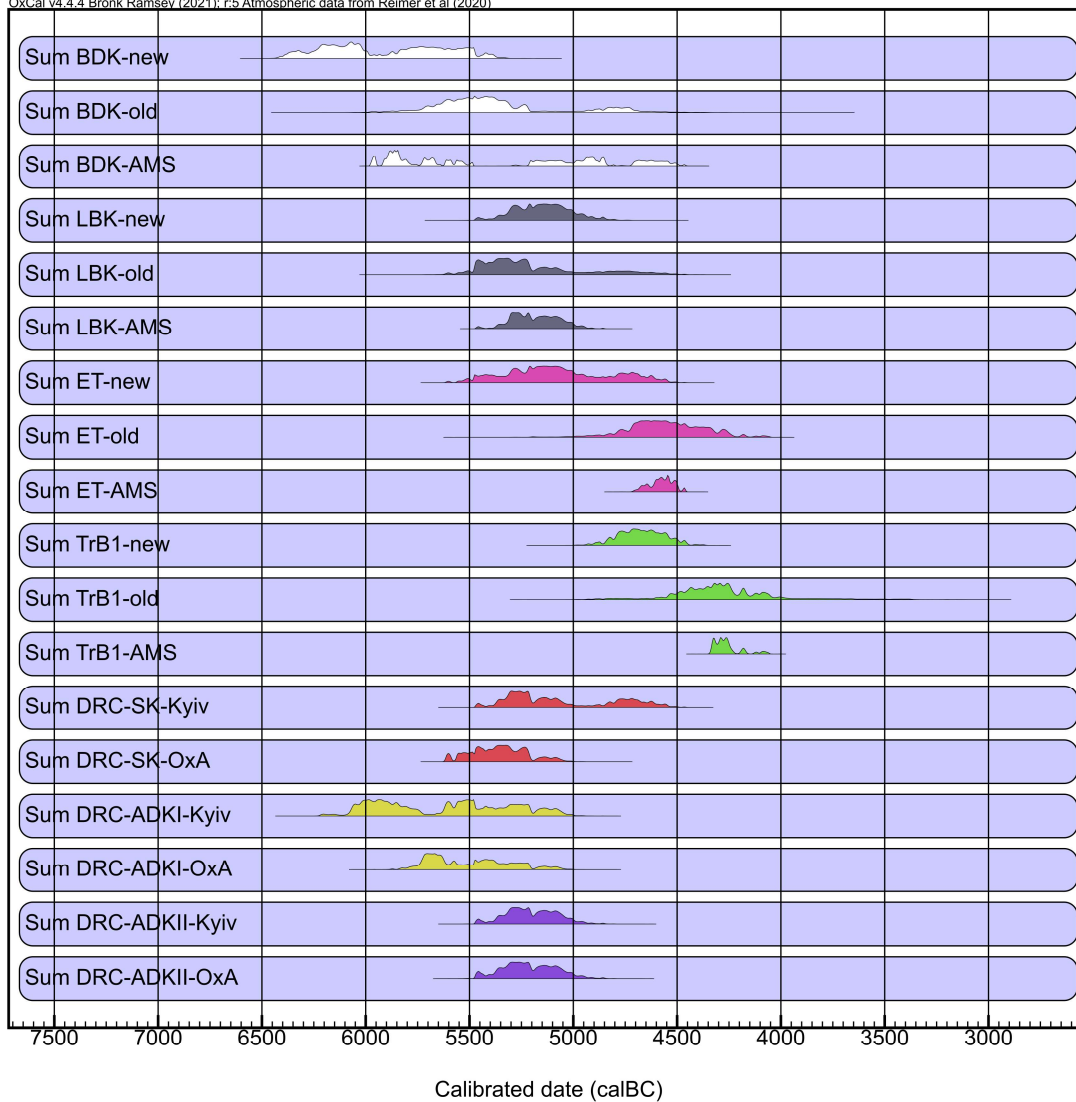


Fig. 9. Old versus new dates: the model of the ages of samples from Neolithic sites representing the Neolithic cultures discussed in the text. BDK – “Buh-Dniester culture”, LBK – Linear Pottery Culture, ET – Early Trypillia, TrB1 – Trypillia B1, DRC – Dnieper Rapids cemeteries, SK – Surskyi culture, ADK – Azov-Dnieper culture with two subsequent periods – I and II. Old and new – “old” and “new” conventional chronologies as defined by Gaskevych 2014. AMS – AMS dates. Kyiv – dates done in Kyiv radiocarbon facility. OxA – Oxford AMS dates.

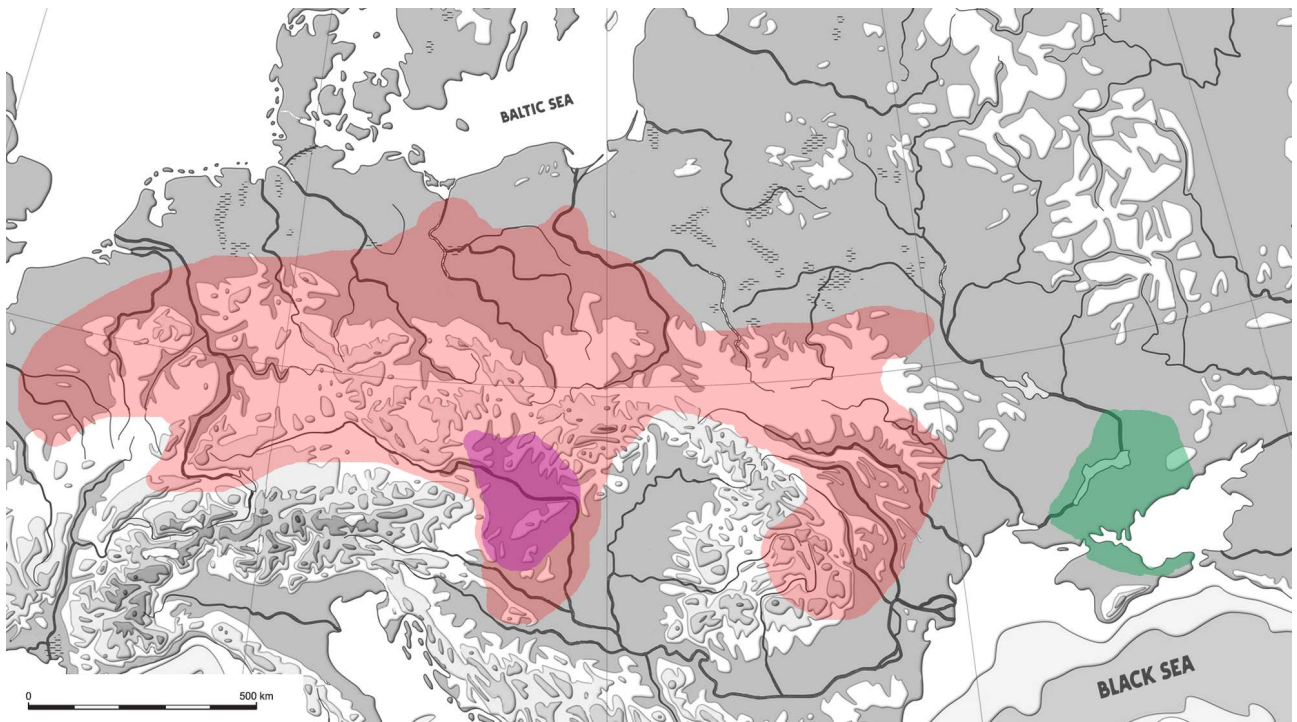


Fig. 10. Map showing the area of LBK origin (purple colour) and the maximum extent of the cultural network (red colour) versus the area of Azov-Dnieper Culture origin (green colour; after Saile 2020; Tovkailo 2020; Brychova et al., 2021).