

POTENTIAL OF THE RADIOCARBON METHOD FOR DATING KNOWN HISTORICAL EVENTS: THE CASE OF YAROSLAVL, RUSSIA

A V Engovatova^{1,2} • G I Zaitseva³ • M V Dobrovolskaya¹ • N D Burova³

ABSTRACT. We address here the methodological question of potentially using the radiocarbon method for dating historical events. The archaeological investigations in Yaroslavl (central Russia) provide an example. The Institute of Archaeology of the Russian Academy of Sciences (IARAS) has been conducting excavations at the site for many years, and many archaeological complexes dating to different times have come to light. The most interesting of these are connected with the founding of the city by Prince Yaroslav the Wise in AD 1010 (the first fortifications) and with the devastation of the city by the Tatar Mongols in 1238 (evidenced by sanitary mass burials of Yaroslavl's inhabitants). We have conducted a certain experiment, a "reverse" investigation of the chronology of the events. The dates of the events are known from chronicles, archaeological materials, and dendrochronological data for several assemblages. We have taken a large series of ¹⁴C samples from the same assemblages, dated them in 2 different laboratories, and compared the data. The accuracy of the ¹⁴C dates proved to be compatible with dates found via the archaeological material. The article shows the potential for ¹⁴C dating of archaeological assemblages connected with known historical events. The results of the research conducted by the authors serve as an additional argument for the broader use of the ¹⁴C dating method in studies of archaeological sites related to the Middle Ages in Russia.

INTRODUCTION

The literature on Medieval Russian history is limited, with chronicles mentioning only portions of the most important historical events. Thus, dating through archaeological means is very important for identifying historical events. However, the classical archaeological methods (typological, stratigraphic) provide a rather wide age range. Archaeological finds (pottery and artifacts) can also be used for dating. Depending on the object of study, artifacts and assemblages can be dated to within 100 to 500 yr, whereas dating to within a decade is possible only in exceptional cases. Of course, dendrochronology can give a much more precise calendar date than any of the above methods, but unfortunately, wooden buildings only survive at sites that have a so-called "wet" occupation layer. Consequently, dendrochronology cannot be used to date most Medieval sites.

Some Medieval sites may have little archaeological material or none at all (e.g. settlements, towns with a poor occupation layer, burials without grave goods, etc.). In such cases, it would be logical to complement archaeological dating methods with radiocarbon dating. Unfortunately, ¹⁴C dating is still not widely used in Russia for the chronology of Medieval sites. The reason lies in the assumption that the method gives very imprecise results within a space of several centuries. To better understand the potential for ¹⁴C dating of Medieval sites, we have used it to date certain events that are known from written sources and have reliable dendrochronological and archaeological dates.

To enhance the credibility of the experiment, we took several samples from each assemblage and had them dated at laboratories in St. Petersburg (Le) and Kiev (Ki). Both laboratories use the conventional technique based on measuring the activity of ¹⁴C in benzene. To remove the different contaminants, we used the standard methods described in the literature (Polach and Golson 1966; Waterbolk 1971; Arslanov 1987; Renfrew and Bahn 2000). The visible inorganic admixtures (roots, sand, small stones, and others) were removed first. Next, organic contaminants such as carbonates and humic acids were removed using the alkali-acid treatment method. First, the carbonates are removed by boiling the sample in 3% HCl, washing and boiling in 3% NaOH for 1 hr. The samples

¹Institute of Archaeology of the Russian Academy of Sciences, Moscow, Russia.

²Corresponding author. Email: engov@mail.ru.

³Institute for the History of Material Culture of the Russian Academy of Sciences, St. Petersburg, Russia.

are then washed, dried, and burned to obtain pure charcoal. To convert the ^{14}C age to calibrated age, the OxCal v 4 program was used (Bronk Ramsey 2009) with the IntCal09 calibration data. It is very important to compare the results obtained by different laboratories to be sure of the reliability of a ^{14}C age.

LOCATION

We took as an example the results of archaeological investigations in the Yaroslavl Kremlin (central Russia). Yaroslavl is 280 km north of Moscow and situated on the banks of the Volga River (Figure 1). The investigations conducted by the Institute of Archaeology of the Russian Academy of Sciences (IARAS) in 2004–2010 (Leont'yev and Yakovlev 2005; Osipov 2006; Osipov and Faradzheva 2007; Faradzheva and Osipov 2007; Engovatova 2008, 2009; Engovatova and Yaganov 2008) revealed archaeological remains connected with 2 well-known historical events, namely:

- The founding of the town by Prince Yaroslav the Wise in AD 1010.
- The devastation of the town by Batu Khan's army in AD 1238.

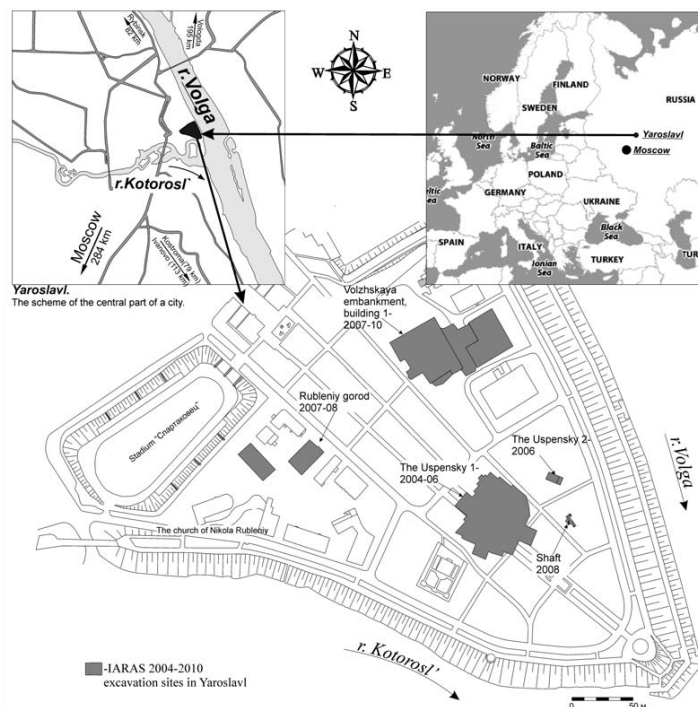


Figure 1 Scheme of IARAS 2004–2010 excavation sites in the Yaroslavl Kremlin

ARCHAEOLOGICAL MATERIALS

Period of the Town's Foundation

Excavations revealed the remains of strong fortifications: ruined walls (earthwork and timber) and a ditch. Judging by the stratigraphy (Figure 2), the walls were built over a surface that had no urban occupation layer. The surface under the rampart revealed traces of plowing, which are probably connected with the settlement that preceded the town. The layer yielded several fragments of handmade pottery that can be dated broadly to the 9th to early 11th centuries.

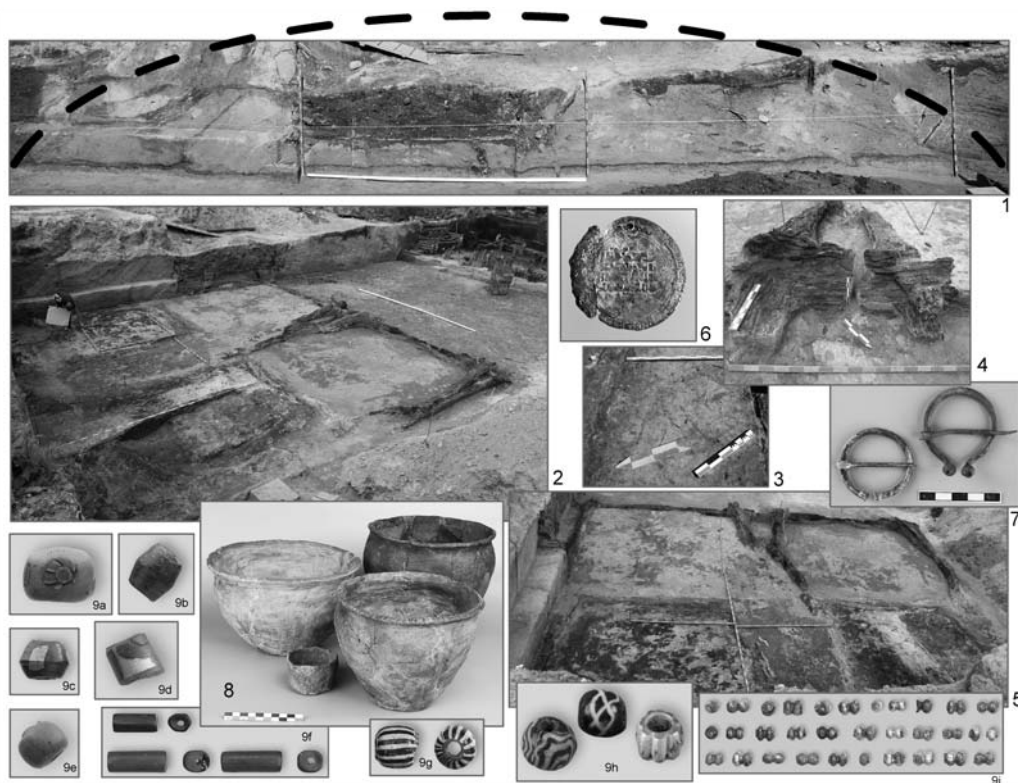


Figure 2 Archaeological objects and finds from the 11th century: 1) cross-section of rampart; 2, 5) structures inside the rampart over the decomposed layer; 3) plowed layer under the rampart; 4) structures in the rampart; 6–8) archaeological finds dated to the 11th century (6–dirham, 7–fibulae, 8–ceramic vessels); 9) beads: a–eyed yellow bead; b–bi-trapezoidal dark blue bead; c–dark blue bead with white rhombic décor; d–silver-glass bead; e–lemon-shaped yellow bead; f–*pronizki* of blue-green glass; g–lemon-shaped striped bead; h–black bead with white décor, ribbed silver-glass bead; i–drawn beads of gold- and silver-glass).

Inside, the fortified wall consisted of 3 rows of wooden frames (*gorodni*). The outer *gorodni* are larger than the inner ones (5.6 × 5.6 m, 4.8 × 4.8 m, and 4.1 × 4.1 m, respectively). Figure 2 shows the remains of the wooden constructions. All the constructions were built at the same time and their lower parts were filled with sand. The overall width of the fortifications reached 16 m, and the height must have been greater (only the lower 2 m have been preserved at the excavation site). This type of wall structure (large open *gorodni*) has analogies at Old Russian sites from the 9th to 10th and early 11th centuries. The same Yaroslav the Wise built a similar construction in Kiev in 1037. However, since Kiev was the capital of Old Rus, the fortifications there were much larger (36 m wide). The fact that wide (16 m) fortifications were built in Yaroslavl is extremely important: the scale of the construction work indirectly indicates the fortifications were intended to protect the important Yaroslav the Wise.

The chronicles give the date of the town's foundation as AD 1010. To ascertain the date, we selected a series of ¹⁴C samples (>20) from the wooden constructions inside the rampart and the buried soil. The dotted line on the chart (Figures 4, 5) shows the date when the fortifications were built according to the chronicles (AD 1010).

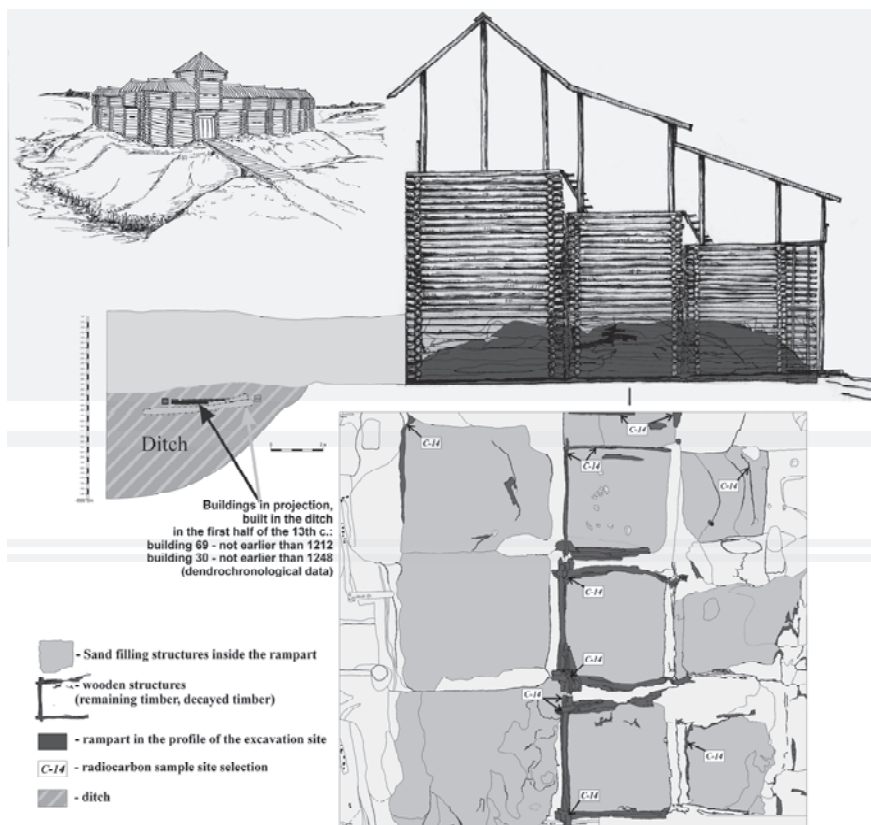


Figure 3 Remains of the 11th-century town's fortifications in the layout of the excavation site, town wall (reconstruction).

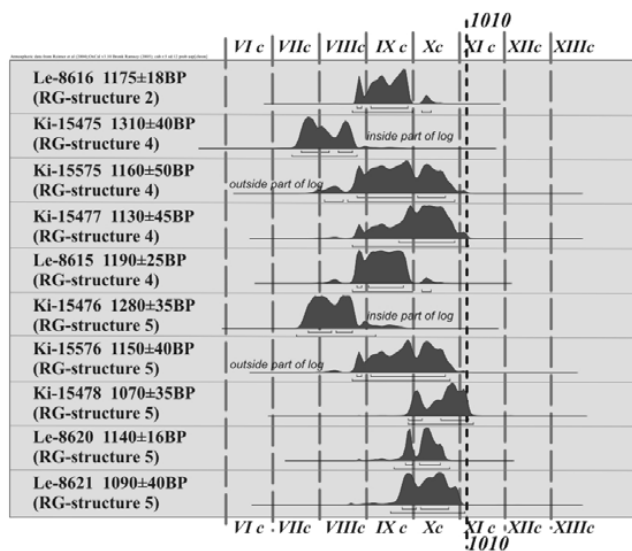


Figure 4 ¹⁴C dating results for wooden structures inside the rampart (inside and outside parts of tree trunk), Rubleniy Gorod excavation site.

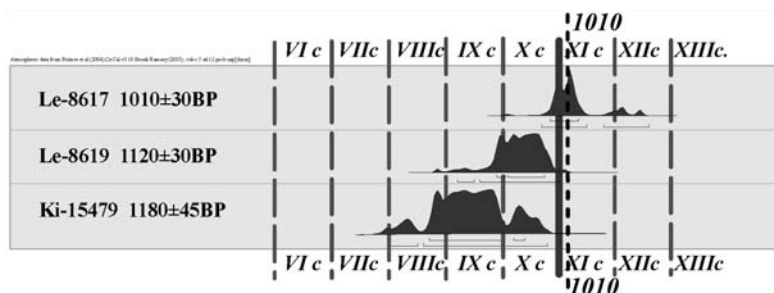


Figure 5 Results for ¹⁴C dating of buried soil, Rubleniy Gorod excavation site

The calibrated dates fall into the interval between the 9th and the beginning of the 11th centuries AD. Since the wooden constructions are made of large trees possibly over 100 yr old, we took samples from the inside and outside parts of the tree trunk. Figure 4 shows 2 samples from the inside part of the tree trunk. They are older than the outer parts. Thus, the slightly older age of the construction as indicated by the ¹⁴C dates could be explained by the age of the trees that were used as building material.

We can say that according to the ¹⁴C data, the first fortifications in the town of Yaroslavl and the founding of the town itself date to the interval between the 9th and the 11th centuries AD. Thus, the degree of accuracy of the ¹⁴C data is compatible with the accuracy of dating obtained through analysis of the archaeological material and the typology of the wooden constructions.

The plowed layer at the settlement that preceded the town dates to an earlier period. The analysis of 3 ¹⁴C samples indicates an interval between the 9th and 10th centuries AD (Figure 5). The accuracy of the dates is also compatible with pottery analysis. Comparison of the date given in the chronicles as the year of the town’s founding (AD 1010) and the ¹⁴C dates (Figures 4, 5) shows that it falls within the probability range.

Devastation of the Town by the Tatar Mongols

Archaeological evidence of the devastation of Yaroslavl in 1238 comprises the following: 1) a thick burnt layer that includes burnt-down buildings; and 2) 9 sanitary mass burials (containing remains of men, women, and children).

The inhabitants were killed when the city was taken. Over 2 months had passed before the bodies were buried (according to data from forensic medical examination by S A Nikitin). The semi-decayed corpses were hastily buried in cellars under the burnt-down buildings, in pits, and even in a well. Anthropological examination (Buzhilova et al. 2008; Buzhilova and Goncharova 2009; Nikitin 2009) revealed that all the people were killed with sabers, arrows, and spears. It is likely that the attackers were on horseback since the majority of the killed were stricken from above. It appears that most of the town’s defenders wore no helmets, as many of the skulls show fatal injuries (Figure 6). A total of 9 mass burials have been discovered in different areas within the kremlin. All the burials date to the same time. How can that be proven? First, all the burials are of the same type. Sanitary mass burials in burnt-down buildings and pits are seldom encountered in towns. All the skeletons from all 9 burials show evidence of death by violence and had lain unburied for a certain length of time. Animal remains (horses, cows, dogs, etc.) are also found in the sanitary burials. The backfilling of the burials yielded datable artifacts and pottery (Figure 7). Their typological analysis showed that all the burials date to no later than the first third to middle of the 13th century AD.



Figure 6 Archaeological evidence of the destruction of Yaroslavl at the beginning of the 13th century: 1–3) mass burials investigated; 4, 5) evidence of contact with heavy weapons on skulls from the mass graves; 6, 7) evidence of saber cuts on skulls from the mass graves; 8, 9) reconstructed portraits of early 13th-century Yaroslavl inhabitants.

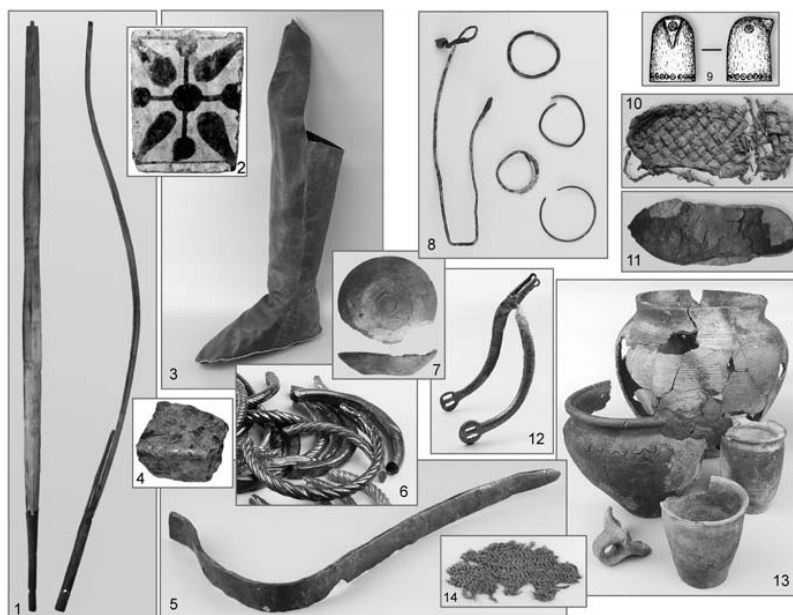
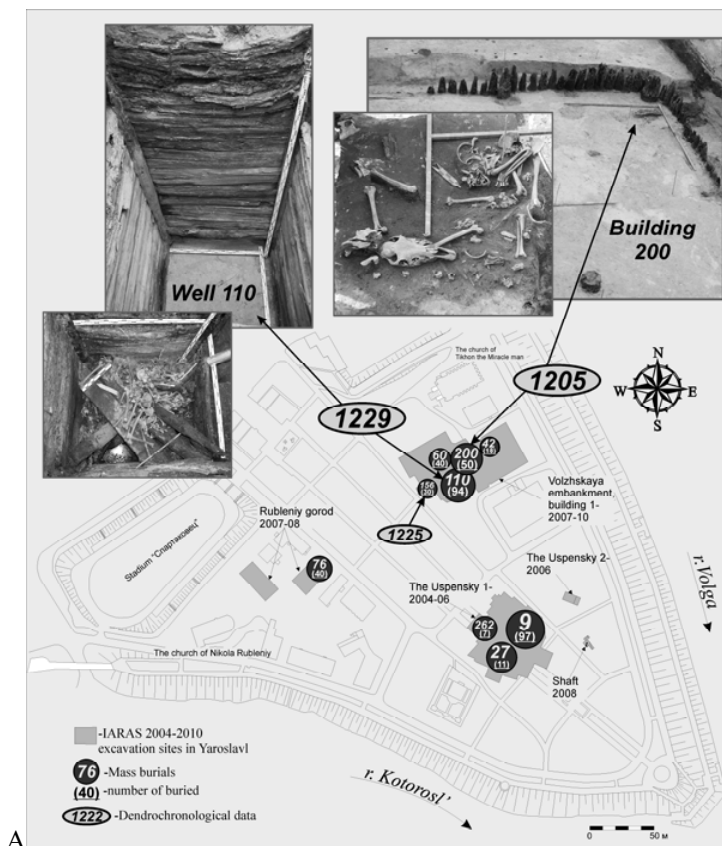


Figure 7 Artifacts from the early 13th-century mass burials in Yaroslavl: 1) wooden bow; 2) stained glass; 3) leather boot (reconstruction); 4) fragment of plinth; 5) broad sword; 6) glass bracelets; 7) clay saucer, stamped; 8) temple rings; 9) bone chess piece; 10) bast shoe; 11) felt insole with leather sole plate; 12) spur; 13) clay vessels; 14) fragments of clothing.

We also have dendrochronological data for the burnt-down buildings and the well. According to dendrochronological investigations (Karpukhin 2009; Karpukhin et al. 2011), the structures were built no later than the 1230s: well nr 110: AD 1229; building nr 200: AD 1205; building nr 56: AD 1225; building nr 80: AD 1209; building nr 69: AD 1212 (Figure 8).



Site	Detail of construction	Date
№ 110	Eastern corner post	1226
	Eastern corner post	1226
	Southern corner post	1227
	SE timber set 1	1219
	SW timber set 4	1220
	NE timber set 6	1221
	SW timber set 5	1221
	NE timber set 9	1221
	NE	1221
	NE timber set 8	1221
	SE timber set 3	1221
	SW timber set 1	1228
		1207
		1208
	1220	
	1225	
	1225	
	1220	
	1228	
	1229	
Site	Detail of construction	Date
№ 180		1197
		1209
№ 156	1 st timber set, NW wall	1223
	1 st timber set, SW wall	1223
	2 nd timber set, SW wall	1225
	2 nd timber set, NW wall	1225
№ 200	Pole from SW wall	1205
	Rod pole from SE wall	1205

№ 69 (connected with burial №76)	Rod pole from SE wall	1204
	NE wall, remains	1193
	Log near NW wall	1193
	NE wall, remains	1194
	Upper timber set, SE wall	1194
	NE wall, loss	1197
	Lower timber set, SE wall	1200
	SW of floor beam	1204
	Lower timber set, NE wall	1210
	Upper timber set, SW wall	1211
	2 nd timber set, SW wall	1211
Upper timber set, NE wall	1212	

Figure 8 A) Scheme of mass burial locations. B) Dendrochronological data for some of the pits and constructions used for mass burials or connected with them (burnt down).

When analyzing dendrochronological data, we should remember that the lifespan of wooden buildings in Medieval Rus was usually brief. According to data from the Novgorod archaeological expedition, the average lifespan of a wooden building was 30 yr. In rare cases, a wooden house could survive for 50 yr without undergoing serious repairs. Consequently, the devastation of the town must have occurred in the interval between the 1230s and the end of the 1240s. The only testimony of such a catastrophe in the chronicles is the story of the invasion by the army of Batu Khan and the devastation of many Russian towns. The chronicles state that Yaroslavl was taken in February 1238. It is noteworthy that the mass burials have yielded remains of fur caps and double-layer woolen clothing, which would indicate that the battle took place in winter. We selected several samples for ¹⁴C dating from each of the burials. Both human and animal bones were analyzed (Figure 9).

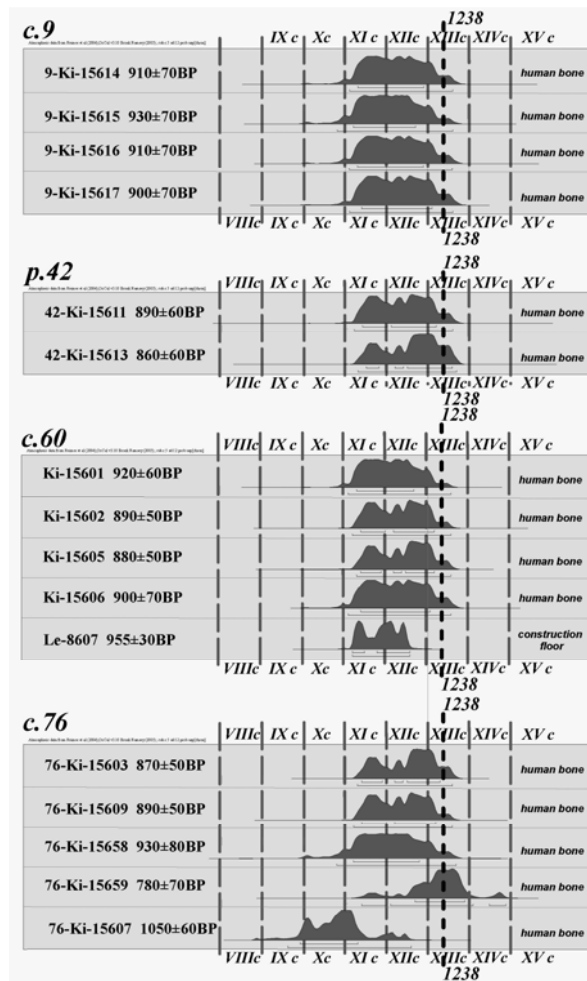


Figure 9 Results of ¹⁴C dating for samples from mass burials

¹⁴C analysis showed that all the burials date to the same time period. The chart (Figure 10) shows that the ¹⁴C dates correlate with the dendrochronological dates for the same buildings and with the date mentioned in the chronicles of AD 1238 (see Figure 11).

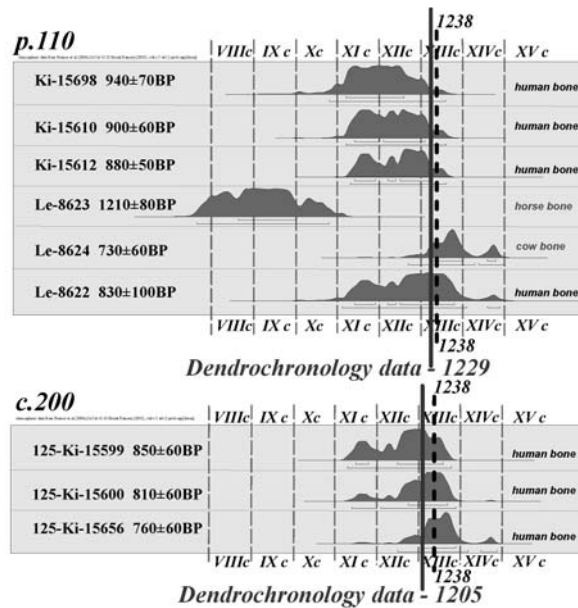


Figure 10 Comparison of ¹⁴C and dendrochronological dates for the mass burials.



Figure 11 Seal of Vsevolod (Ioann) Konstantinovich, first prince of the Yaroslavl *udel* (AD 1210–1238), with images of St. John the Baptist and St. Constantine. Prince Vsevolod ruled starting from 1218 and was killed on 4 March 1238 in the battle with the Tatars on the River Sit’.

CONCLUSIONS

On the whole, the results of ¹⁴C analysis yielded a similar sequence and do not contradict the data obtained through stratigraphy and typological analysis of the archaeological artifacts. ¹⁴C dating provided an additional independent source of information about the time when the fortifications were built and the time when the town of Yaroslavl was devastated. The data obtained in 2 independent laboratories concur in all the cases. Over 40 different samples were cross-analyzed. This study proves the reliability and objectivity of the methods employed.

In general, the results correlate well with the historical dates of the events determined archaeologically where we excavated. The degree of accuracy of the ¹⁴C dates proved to be close to the accuracy of pottery- and artifact-based dating. This once again shows that ¹⁴C dating can be used for Medi-

eval sites and is a reliable and adequate method. Thus, if more precise methods (dendrochronology, etc.) cannot be applied, the ^{14}C method can be used for dating burials that contain no grave goods, settlements that have a poor occupation layer, and other archaeological sites.

REFERENCES

- Arslanov KhA. 1987. *Radiocarbon: Geochemistry and Geochronology*. Leningrad: Leningrad University Press. p 112–45. In Russian.
- Bronk Ramsey C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51(1):337–60.
- Buzhilova A, Goncharova N. 2009. A mass grave from a Medieval Russian town: the anthropological evidence of a social catastrophe. In: *Vers une anthropologie des catastrophes. Actes des 9e journées d'antropologie de Valbonne*. p 286.
- Buzhilova A, Goncharova NA, Engovatova A. 2008. Mass graves from a Medieval Russian town: bio-cultural context of remains. In: Abstracts of 17th Paleopathological Association Meeting "Diseases in the Past." Copenhagen, 25–27 August 2008. p 27.
- Engovatova AV. 2008. Report on the 2007 rescue archaeological excavations in the town of Yaroslavl at Volzhskaya embankment, building 1. Moscow: IARAS. p 1–308. In Russian.
- Engovatova AV. 2009. Report on the 2008 rescue archaeological excavations in the town of Yaroslavl at Volzhskaya embankment, building 1. Moscow: IARAS. p 1–408. In Russian.
- Engovatova AV, Yaganov AV. 2008. To the topography of the Rublenny gorod in Yaroslavl (based on the materials of the 2007 archaeological investigations). In: *Moscow Rus': Archaeology and the History of Architecture. On the 60th Anniversary of Leonid Andreevich Beliaev*. Moscow: IARAS. p 90–7. In Russian.
- Faradzheva NN, Osipov DO. 2007. Archaeological investigations in the historical center of the town of Yaroslavl (Uspenskiy excavation site 2004–2006). Moscow: IARAS. In Russian.
- Karpukhin AA. 2009. Preliminary results. Tree-ring chronology from excavations in Yaroslavl in 2008. Appendix 6 to the "Report on the conservation of archaeological excavations in Yaroslavl by address: the area limited the Chelyuskin's square and Kotorosl embankment, building 1 (on the construction site) (Rublenny gorod II - 2008)." Volume 5. Moscow: Archive IARAS. p 30–2.
- Karpukhin AA, Soloveva LN, Engovatova AV. 2011. Dendrochronological dating of the structures of XIII century from excavations in Yaroslavl. Analytical Research Laboratory of Natural Science. Moscow: IARAS. p 92–115.
- Leont'yev AE, Yakovlev AV. 2005. Report on the 2004 excavations in the town of Yaroslavl on the site scheduled for reconstruction of the Cathedral of the Dormition. Uspenskiy-I excavation site. Moscow: IARAS. In Russian.
- Nikitin SA. 2009. Act of the medico-forensic and portrait investigations N 31-66/09. Appendix 7 to the "Report on the conservation of archaeological excavations in Yaroslavl by address: the area limited the Chelyuskin's square and Kotorosl embankment, building 1 (on the construction site) (Rublenny gorod II - 2008)." Volume 5. Moscow: Archive IARAS. p 33–59.
- Osipov DO. 2006. Rescue architectural and archaeological investigations on the site scheduled for reconstruction of the Cathedral of the Dormition in Yaroslavl, 2005 [report]. Moscow: IARAS. In Russian.
- Osipov DO, Faradzheva NN. 2007. Rescue architectural and archaeological investigations on the site scheduled for reconstruction of the Cathedral of the Dormition in Yaroslavl, 2006 [report]. Moscow: IARAS. In Russian.
- Polach HA, Golson J. 1966. Collection of specimens for radiocarbon dating and interpretation of results. In: *Australian Institute of Aboriginal Studies Manual No. 2*. Canberra: Australian National University.
- Reimer PJ, Baillie MGL, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck CE, Burr GS, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Hajdas I, Heaton TJ, Hogg AG, Hughen KA, Kaiser KF, Kromer B, McCormac FG, Manning SW, Reimer RW, Richards DA, Southon JR, Talamo S, Turney CSM, van der Plicht J, Weyhenmeyer CE. 2009. IntCal09 and Marine09 radiocarbon age calibration curves, 0–50,000 years cal BP. *Radiocarbon* 51(4): 1111–50.
- Renfrew C, Bahn P. 2000. *Archaeology: Theories, Methods, and Practices*. 3rd edition. London: Thames & Hudson.
- Waterbolck HT. 1971. Working with radiocarbon dates. *Proceedings of the Prehistoric Society* 37:15–33.