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AMS, HISTORICAL, AND ARCHAEOLOGICAL DATING OF OPONICE CASTLE

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ABSTRACT. The fifth season of excavations of Oponice Castle in 2020 was located in the lower castle's courtyard. The research led to discovery of an original clay floor being heavily burned with charred plank and a rectangular stone-brick construction. The construction has collapsed upper part with a fallen low brick arch. The whole area was covered with numerous stove tiles and one clay mold for the production of stove tiles. The construction was identified as a pottery kiln dated to the second half of the 16th until the first half of the 17th century AD by the findings from excavated layer identified to the kiln destruction. Also, written sources mention a large fire in 1645 which destroyed the castle. The aim of this article is to use different methods of dating and refine the chronology of the context through microarchaeology and Bayesian modeling. For these purposes different types of samples were collected. The sampling focused on site formation process determination of pottery kiln use and the way of its destruction. Applying Bayesian analysis improved overall dating, through modeled time interval of the three individual sequences and helped recreated historical events during the period, when the calibration curve fluctuates.

KEYWORDS: AMS radiocarbon dating, Bayesian modeling, Early Modern Age, southwestern Slovakia, stratigraphic sequence.

INTRODUCTION

Oponice Castle (Figure 1A) is in the Topoľčany district on southwestern Slovakia (former Nitra County of Medieval Hungary). This castle is situated on a promotory of a Tribeč range main ridge (Figure 1B) as a part of the Fatra-Tatra Mountain complex and at 332–338 m above sea level (Bóna et al. 2017:6).

The castle was built sometimes by order of Csák gens around the 1290s. Its main purpose was protection of the border of Csák property and control of the nearby trade pathway from Topoľčany to the Nitra (Bóna et al. 2017:15). In 1321–1392, Oponice Castle became the property of Hungarian kings (from Charles I. Robert known as Charles Robert; reign 1308–1342 to Sigismund of Luxembourg; reign 1387–1437). Later, from 1395 (1406) Apponyi family became its only owner (Bóna et al. 2017:18–21).[1]

The castle was damaged and repaired several times, and it underwent extensive changes in appearance initiated by passing of the ownership. At the end, the castle area occupied around 3000 m^2 and can be divided into two parts—an originally gothic upper castle and a mainly renaissance lower castle, with 14 objects. During the 16th century the castle was abandoned by the Apponyi family, which moved to new-built manor house[2]. In this period the castle had several administrators and it was occasionally restored. Since the second half of 17th century

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[1]Peter of Stráže became the owner of the castle in 1395 and also the founder of the Apponyi family used from 1406. This family owned the castle until its extinction in the 17th century (Bóna et al. 2017:20–21).
[2]In 1512 they moved to the manor house situated under the castle's hill in Veľké Oponice village. According to historical building research this manor house was built at the beginning of the 16th century.

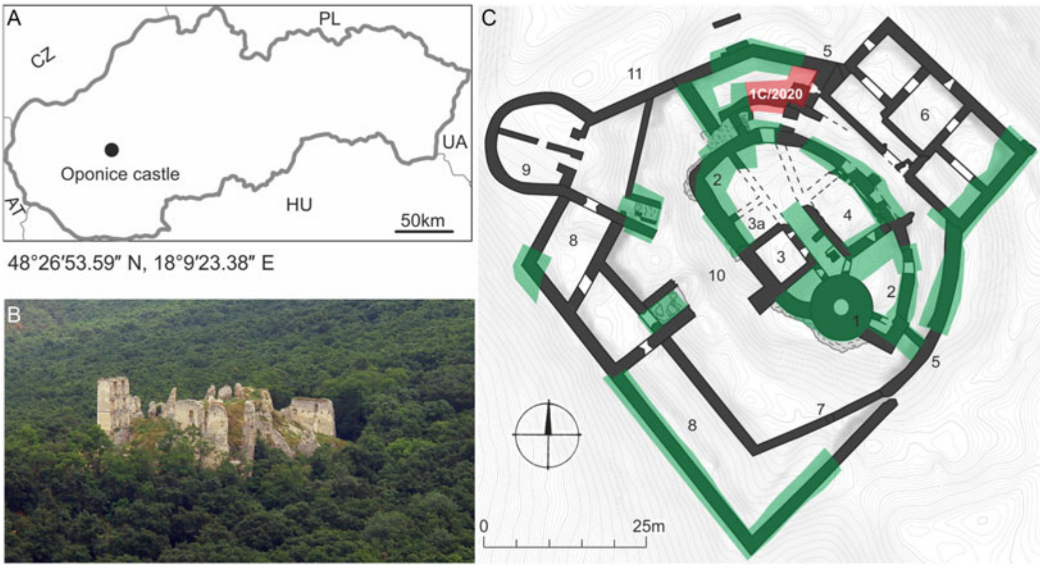

Figure 1 Oponice Castle: A. its location on southwestern Slovakia (central Europe); B. view from the west; and C. general plan with excavated trenches and marked trench 1C/2020. Legend, upper castle: 1—cylindrical keep; 2—circumferential defensive wall I; 3—palace I southwestern; 3a—its northwestern tract; 4—palace II northeastern. Legend, lower castle: 5—circumferential defensive wall II; 6—palace III northeastern; 7—a farm building; 8—palace IV southwestern; 9—cannon bastion called "Tereš"; 10—courtyard; 11—protective ditch.

only ruins from the castle remained (Bóna et al. 2017:14–38; Janura and Bóna 2022:489; Repka and Sater 2019:167–168).

Since 2015, systematic archaeological excavations of Oponice Castle have been carried out by the Department of Archaeology, Constantine the Philosopher University in Nitra, under supervisor D. Repka (Repka 2015, 2018; Repka and Styk 2016; Repka et al. 2017; Repka and Jančiová 2020). The excavations are related to the castle's monumental restoration by the Apponiana civic association. Six excavation seasons have already taken place and the area within 47 archaeological trenches was explored (around 24% of castle area; Figure 1C).

During the excavation in 2020, the eastern part of the courtyard of the lower castle (trench 1C/2020) was explored, with a unique and comprehensive archaeological context dated to the 17th century (Figure 2A)—destruction of stone-brick construction and wooden structure situated on the original clay floor heavily burned in some parts and with large pieces of charred wood. Because of the discovery of a clay mold (matrix) for the production of front heating walls of stove tiles and the large number of entire stove tiles it is interpreted as a pottery kiln (Repka and Jančiová 2020:42–43). Especially, the stove tiles are the most numerous findings at the castle after the kitchen ceramics. Detailed analysis of selected fragments of stove tiles indicates their production at the castle (Jančiová 2021).[3]

This unique and well-documented situation became the base for the radiocarbon (^{14}C) dating. The goal of the research was to place the original series of archaeological events in the context

[3]The analysis was a part of B. Stykova´s dissertation (Jančiová 2021), which focused on the stove tiles obtained during the excavation in 2015–2018.

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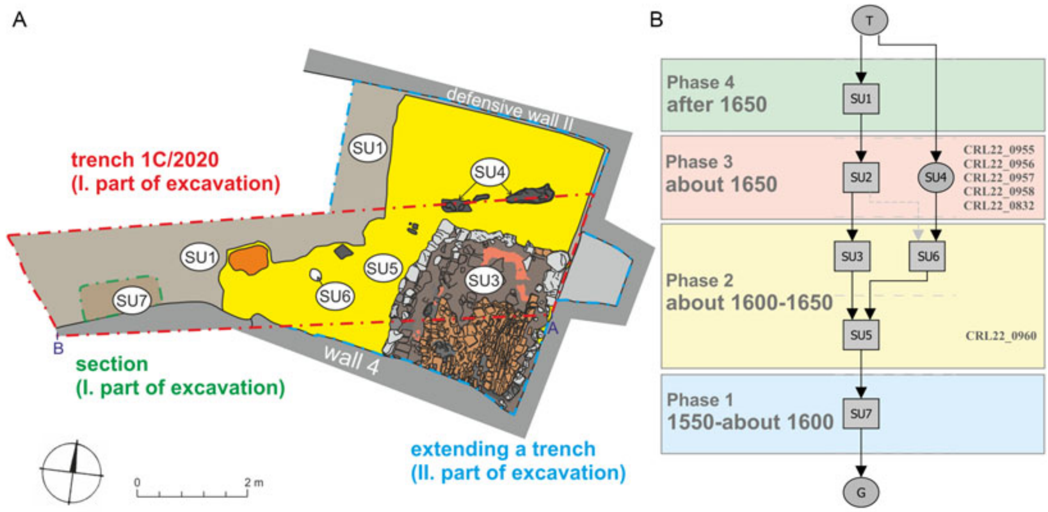

Figure 2 Trench 1C/2020: A. its general plan with defined stratigraphic units (SU1—destruction of castle's wall, SU2—layer with fragments and whole pieces of stove tiles, SU3—stone-brick construction of pottery kiln, SU4—large pieces of charred wood, SU5—clay floor, SU6—posthole, SU7—historical backfill). B. Harris matrix diagram with SU organized chronologically in four phases (phase 1—intentional filling, phase 2—creating a clay floor, construction of pottery kiln, wooden structure and their usage, phase 3—destructions of pottery kiln and wooden structure, phase 4—castle's wall destruction).

of trench 1C/2020 during the period of fluctuating calibration curve. The proposed strategy was to use the sequence of ^{14}C data in combination with integrating stratigraphy, as well as archaeological data and historical events. Finally, this paper presents the microarchaeology approach resulting to the refining the resolution period.

ARCHAEOLOGICAL DATA AND STRATIGRAPHY

In the examined archaeological context (trench 1C/2020), three relevant features were detected under the destruction layer of castle's wall (Figure 2: A): 1. clay floor, 2. pottery kiln (pyrotechnological device), and 3. wooden structure:

1. **Clay floor.** Original clay floor (SU5)[4] was created on the level of historical backfill (SU7) during the period from the second half of the 16th to the begin of 17th centuries. On its surface there was the pottery kiln, wooden structure as well as archaeological findings—e.g., animal bone and two coins (silver three-gross of Sigismund III Vasa from 1606 AD and silver denarius of Ferdinand II. from 1626 AD). These coins allow to date the use of clay floor to the 1st half of the 17th century (Repka and Jančiová 2020:42).
2. **Pottery kiln.** Rectangular stone-brick construction (SU3) about the size 2.45 × 3.05 m found on the clay floor in southeast corner of examined trench.[5] Originally, this was an exterior area between the circumferential walls from high gothic (wall 4) and late gothic period (defensive wall II). Its base was made of stones, bricks, ceramic tiles, and clay. Upper part consists of brick vault destruction *in situ*. On the west side fragments of a clay mold for the production of front heating walls of stove tiles were found. A stratigraphic layer (SU2),

[4]SU as stratigraphic unit.
[5]3D model is available online at https://skfb.ly/6VzOz; author M. Styk.

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which contains numerous fragments and whole pieces of stove tiles, was located above pottery kiln itself (SU3) and thus represents later destruction. Based on one stove tile with the calendar date 1586 AD and typical clay pipe from the half of 17th century, this unit was dated from second half of 16th to first half of 17th century. Sometime in the middle of the 17th century, a destruction of pottery kiln had occurred, probably together with workshop equipment (Repka and Jančiová 2020:42).

3. **Wooden structure.** Close to the pottery kiln, the clay floor was heavily burnt, and it contained large pieces of charred wood (SU4)—probably planks as an architectonical wooden component of wooden structure. One posthole (SU6) was found southwestern from the construction (pottery kiln). Originally, this posthole was probably related to the preserved remains of wooden planks, thus entire structure could represent shelter or the part of outdoor furniture (Repka and Jančiová 2020:42, 121–123).

The archaeological context contained three mentioned features recorded by several stratigraphic units because of individual events (Harris 1997). Their stratigraphic relationships are expressed in a Harris matrix diagram (Figure 2: B). This shows the relative time sequence of contextualized individual events. Relative dating of the archaeological findings from the stratigraphic units suggests the existence of four subsequent phases during 1550–1650 AD (Figure 2: B).

METHODS

Selection of Radiocarbon Samples

For the ^{14}C analysis 6 samples (4 charred woods, 1 soot, and 1 bone) were selected from the second (about 1600–1650 AD) and third phases (about 1650 AD) according to the Harris matrix diagram (Figure 2: B; Table 1). Even though these samples represent a contiguous time sequence based on stratigraphy, their ages should be related to different events due to different life span.

During the excavation, one larger charred wood from wooden structure was sampled. The wood plank had not been preserved in its entire width. In addition, the last growth ring (cambium) of the tree could not be identified. For this reason, a pair of samples with the known tree rings from two spots were taken—one from the edge and one from inner part of the wooden plank. This way the samples had known relative chronology (CRL22_0955 and CRL22_0956 with time gap of 10 yr, CRL22_0957 and CRL22_0958 with time gap of 17 yr). The age of the wood represents *terminus post quem* the wooden structure had been built. The tree species was identified by an archaeobotanist M. Hajnalová as a *Abies alba*.

In relation to a pottery kiln soot, sample (CRL22_0832) from the inner part of one stove tile was taken. We assumed that the soot represents traces of the burning, most likely, of the last tree rings and dating usage of pottery kiln.

Another sample (CRL22_0960) was an animal bone located above clay floor under the charred wood and it relates to the period of the end of the workshop activity. This bone was identified by an archaeozoologist K. Šimunková as a probable radius of O*vis*/*Capra* with estimated slaughter age 1–5 yr.

Table 1 Samples from Oponice Castle for ^{14}C dating and their interpretation.

CRL lab code	Material dated	Species	Stratigraphic unit (SU)	Stratigraphic phase	Archaeological event
CRL22_0955	Charcoal—plank	*Abies alba*	4	3	Destructions of wooden structure and pottery kiln.
CRL22_0956	Charcoal—plank	*Abies alba*	4	3	Destructions of wooden structure and pottery kiln.
CRL22_0957	Charcoal—plank	*Abies alba*	4	3	Destructions of wooden structure and pottery kiln.
CRL22_0958	Charcoal—plank	*Abies alba*	4	3	Destructions of wooden structure and pottery kiln.
CRL22_0960	Animal bone	Ovis/ Capra	5	2	Creating a clay floor. Construction of a pottery kiln, wooden structure and their usage.
CRL22_0832	Charcoal—stove tile soot	—	2	3	Destructions of wooden structure and pottery kiln.

Pretreatment of Samples

The samples were pretreated at Czech Radiocarbon Laboratory with international code "CRL". All samples were inspected and mechanically cleaned. The cleaned bone was grinded to a fraction of 0.5–1 mm. All samples were repeatedly washed with 0.5 M HCl followed by 0.1 M NaOH and finally 0.01 M HCl again with distilled-water wash steps in between (Gupta and Polach 1985; Jull et al. 2006).

The isolated collagen from the bone sample was gelatinized at 90ºC, filtered and dried at 60ºC to reach constant weight yielding the collagen of 128 mg/g.

Subsequently, all samples with a small amount of CuO were torch sealed under a dynamic vacuum into a quartz glass tube and combusted at 900ºC. The resulting carbon dioxide was purified and graphitized Rinyu et al. 2013; Molnár et al. 2013; Rinyu et al. 2015; Orsovszki and Rinyu 2015).

AMS Measurement

The samples were measured using the Multi-Isotope-Low-Energy AMS System (MILEA) at the Nuclear Research Institute of the Czech Academy of Sciences. The graphitized samples of oxalic acid NIST (NBS) HOX II SRM 4990-C and phthalic acid anhydride were used as standards and background (Schneider et al. 1995). The resulting ^{14}C activity and its combined uncertainty are given in yr BP (Before Present) as the conventional radiocarbon age (CRA) following Stuiver and Polach convention (Stuiver and Polach 1977). The free software OxCal v4.4 with the ^{14}C calibration curve IntCal20 was used for calibration (Bronk Ramsey 2009; Reimer et al. 2020).

Tree-Sequence and Bayesian Modeling

Fluctuating nature of the ^{14}C curve with several resulting time intervals of the similar probabilities can be detected in some period, e.g., 1640–1950 AD (Svetlik et al. 2019:1730). For improving the precision in our absolute calendar age intervals of wooden samples, we decided to perform a high-resolution ^{14}C wiggle-matching method (Pearson 1986; Bronk Ramsey et al. 2001). For a better understanding of the chronological development of the evaluated context, we have used Bayesian modeling (Bronk Ramsey 2009). ^{14}C samples of bone, wiggle-matching from charred woods as well as calendar data from coin set on the original floor was used for a contiguous sequence model. All used data were ordered in association with their depositional events and with use of archaeological contexts and stratigraphic information (according to Harris matrix).

RESULTS

We established three continuous sequences based on inverse transformation (Neustupný 2007:75) and archaeological events interpretation.

- Sequence no. 1 is represented by the tree rings removed from the wooden structure.
- Sequence no. 2 is captured archaeologically by debris on the floor: the animal bone and two coins. As a representant of the oldest period when both coins got here, silver denarius from 1626 AD was chosen for sequence.

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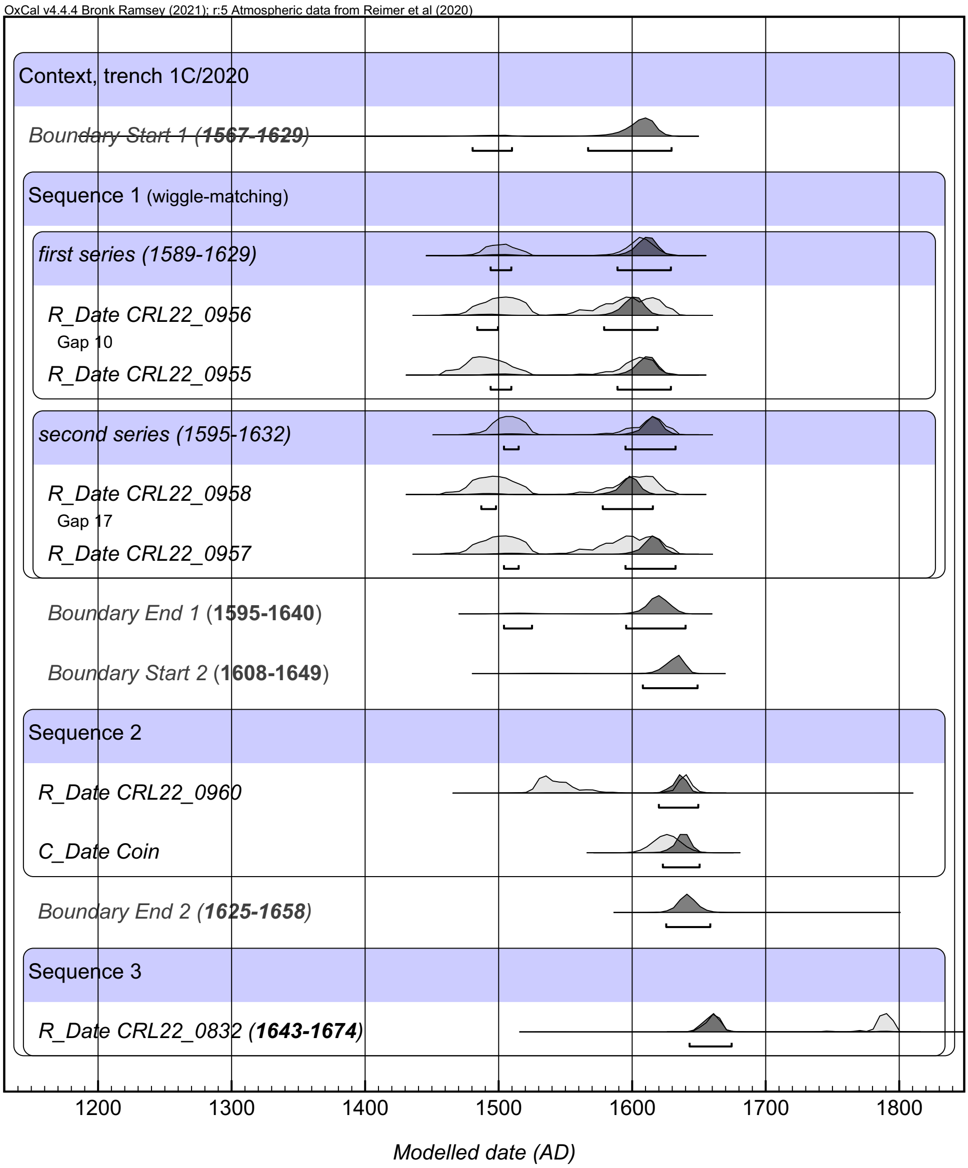

Figure 3 Final sequence of ^{14}C and calendar data as the results of a Bayesian stratigraphic analysis based on OxCal 4.4.4 (Bronk Ramsey 2009, 2017) using the IntCal20 calibration curve (Reimer et al. 2020).

- Sequence no. 3 represents proof of burning in the form of soot trapped in the chamber of the stove tile.

The first sequence is related to the stratigraphic phase 2 with historical dating to around 1600–1650 AD, when the pottery kiln and wooden structure was constructed and used. Based on the 91.9% probability, the boundary of event 1 started in the modeled interval between 1567–1629 AD (Figure 3). Wiggle-matching method determine time interval of two series of tree rings samples. First series (CRL22_0956 and CRL22_0955 with time gap 10 yr) shown modeled

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interval 1589–1629 AD with the 91.4% probability (Figure 3). The second series (CRL22_0958 and CRL22_0957 with time gap 17 year) showed a modeled interval between 1595-1632 AD with 92.4% probability (Figure 3). Both models give good agreement (A comb= 104.4 and 110.4). All samples of tree rings come from the same charred wood (same tree) and their wiggle match appears to be contemporaneous. They are associated to the same time ranges overlap in 35 yr (common range of both intervals). It indicates the close formation of these rings on the tree at the short period. We assume that the tree was cut down sometimes after this period (1595–1632 AD) and consequently, the wooden structure was built. This interval does not allow for an estimate of the time construction of a wooden structure. Considering, the later dating of the wooden structure seems justified. The boundary of event 1 ends in the modeled interval between 1595–1640 with 91.9% probability (Figure 3).

The second sequence starts in the modeled interval between 1608 and 1649 AD (Figure 3). The time of area usage is later than growth of tree used for wooden structure. It proves archaeological finds on the floor: animal bone (sample CRL22_0960) dating to the modeled interval between 1620 and 1649 AD (Table 2) and coin (C_Date Coin) modeled with 10 yr uncertainty to interval between 1623 and 1650 AD (Table 2). The uncertainty expressed the possible coin circulation, or it is usage in 0–10 yr. On the other side, the coin cannot extend to earlier than that date 1626, when the coin was created. Finally, time interval between 1626 and 1658 AD represents the usage of original floor in the period just before the destruction of the wooden structure (stratigraphic phase 3). We assume that the archaeological finds lay on the floor only for a very short time before its destruction and therefore the final modeled interval is related to the phase 3 with historical dating to around 1650 AD and characteristic with destruction of wooden structure and pottery kiln (Figure 2: B; Table 1). The boundary of this sequence end in the modeled interval between 1625 and 1658 AD (Figure 3). Due to the coin circulation interval must start later a few years later, after 1626 AD.

The last sequence is represented by a single soot sample (sample CRL22_0832). The individual dating of stove tile soot, which falls into the fluctuating parts of the calibration curve, appeared to be problematic (Table 2; Figure 4). Acquired date is related to the period of growth unknown tree rings range. Originally, we assumed the origin of the soot from the burn of wooden fuel used for heating in tile stove corresponding to stratigraphic phase 3 and greater probability of attachment of younger tree rings, which represent a larger volume of fuel. Due to the presence of soot samples in the sequence, it is modeled to interval between 1645–1674 AD (Table 2). It may be closely related to transition phase 3/4, after the destruction of wooden structure and pottery kiln and before destruction of castle walls. In this period, we can presume the end of the castle's occupation. For this reason, stove tile soot can point to secondary burning rather than the use of a pottery kiln.

DISCUSSION

From the view of chronometric hygiene, all examined samples fit to terrestrial carbonates and represents well-published data (Schmid et al. 2019:632). On the other hand, bulk sediments, such as tree rings, are problematic (CRL22_0955, CRL22_0956, CRL22_0957, CRL22_0958). They were determined as a long-lived fir tree (*Abies alba*). The observed growth rings are from an unknown position relative to the youngest tree rings. The average life span of *Abies alba* is *300–600* yr, therefore it could be strong bias in dating of archaeological events. For interpretation we used it as a supporting argument for determining the time length before the usage/construction of the wooden structure near the pottery kiln. Another problematic sample

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Table 2 ^{14}C data of samples from of Oponice Castle and modeled intervals.

CRL lab code	Conventional ^{14}C age ± (1σ), yr BP	Calibrated unmodeled interval (2σ), yr cal AD	Calibrated modeled interval (2σ), yr cal AD	Agreement index
CRL22_0956	351 ± 14	1476–1525 (41.5%)	1484–1499 (4%)	114.2%
		1556–1632 (54%)	1579–1619 (91.4%)	
CRL22_0955	366 ± 14	1458–1521 (57.2%)	1494–1509 (4.0%)	106.8%
		1580–1624 (38.3%)	1589–1629 (91.4%)	
CRL22_0958	359 ± 14	1465–1524 (49.6%)	1487–1498 (3.1%)	111.6%
		1571–1630 (45.9%)	1578–1615 (92.4%)	
CRL22_0957	352 ± 14	1475–1524 (42.3%)	1504–1515 (3.1%)	112.1%
		1558–1632 (53.1%)	1595–1632 (92.4%)	
CRL22_0960	291 ± 14	1522–1575 (63.8%)	1620–1649 (95.4%)	94.7%
		1625–1650 (31.6%)		
CRL22_0832	223 ± 14	1646–1674 (46.8%)	1645–1674 (92,4%)	91.6%
		1768–1800 (48.7%)	1784–1793 (3.0%)	

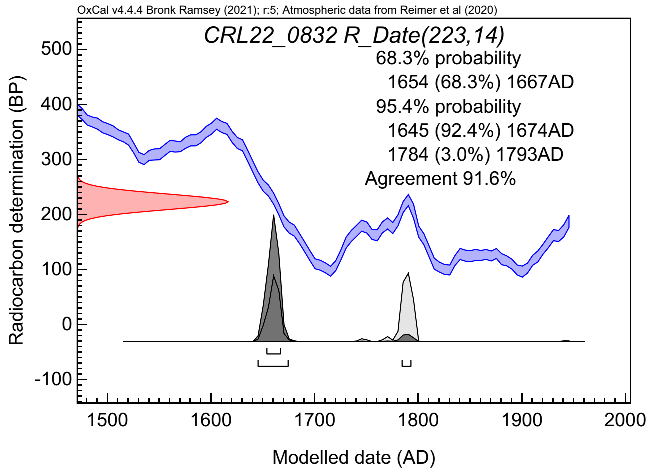

Figure 4 Probability of modeled data from ^{14}C sequence for stove tile soot sample shown against IntCal20 using OxCal 4.4.

is stove tile soot (CRL22_0832). This represents the worst usable ^{14}C data for archaeological interpretation. Assumptions for its interpretation was evidence of pottery kiln usage, the time of the kiln's demise or infiltrations from later periods. The stratigraphic boundary for the creation of such a sample is narrower, between the construction of the kiln and the destruction of the castle´s wall, which preserved the entire situation. We must consider the possibility that the destruction was exposed for some time, so there could be some contamination. Finally, the wooden sample represents bulk sediment, thus we cannot determine with certainty from which tree rings the carbon was captured on the chamber of the stove tile. Statistically, we can assume that there is a greater probability of releasing carbon from younger tree rings, purely from a wood volume. It is hard to prove and could be evaluated purely through stratigraphic relations.

The stratigraphic sequence submits an order of events, which we can only partially justify with ^{14}C dating. The main reason is insufficient sample hygiene. However, the model itself considers stratigraphic relations within the sequence, but that cannot be obligatory (Figure 2). It significantly depends on the archaeological interpretation of the contexts. Therefore, it differs in the order of sequences and at the same time represents the chronological development of the locality. The inverse transformation, as the archaeological method, allows us to sort the course of events through causal reconstruction. Regarding the selected samples, only one sample CRL22_0960 corresponds to its stratigraphic position, since it is a short-lived animal (O*vis*/*Capra*). The burned building, even if it is a later event, contains wood (sample CRL22_0955-58), which growth may have preceded the development of the context by several times and belongs earlier to Phase 1. On the other hand, the soot from the stove tile (CRL22_0832) arose only after the destruction of the pottery kiln and not due to its use, which indicates secondary deposition of the stove tile itself in phase 4. Such an order creates a framework for a model sequence that significantly refines the dating of individual samples. Even in the case of tree rings, it narrows the possible spread of cutting down trees before building the wooden structure.

Based on known historical sources, we can use single spatial and time events to interpretate and specify a Bayesian model (Figure 3). Because of the Turkish threat to Europe, which has popular expression as Turkish fear or the Turkish scare, Oponice Castle´s fortification was rebuilt and modernized short after the half of 16th century, maybe in 1566 AD (Bóna et al. 2017:24–27). The intentional filling of north part of lower courtyard (phase 1) may be related with this reconstruction of fortification, which was completed at the end of the 16th century.

The last and the most extensive late Renaissance reconstruction of Oponice Castle focused on increasing the representation of the Apponyi family and increasing the number of residential rooms was realized in first quarter of the 17th century (Bóna et al. 2017:28). New-built residential rooms had to be heated and therefore many stove tiles were needed to create stoves. It seems that the filled area of the lower courtyard was used to construct a stove tiles workshop just for this reason. It is questionable if the new-built rooms were permanently inhabited. Already in the first half of 16th century, the castle was abandoned by the Apponyi family, which resided in the new manor house situated under the castle in Oponice village (Repka and Sater 2019:168).

According to historian F. Tessedik (Tessedik 1827:54), the castle was finally destroyed by the fire in 1645 perhaps caused by lightning strike. Based on the preserved finds in the floor (entire stove tiles, clay mold, coins) we assume that this was a single event based on the examined context (trench 1C/2020). The castle's fire in 1645 would be suitable for an event like this, which could cause destruction of the pottery kiln and wooden structure. This calendar date corresponds to the second sequence and especially to its boundary end with modeled interval between 1625–1658 AD (Figure 3), and to the stratigraphical phase 3 with dating according to youngest finds about 1650 AD (Figure 2: B).

Sample of soot come from one stove tile placed with the front heating wall down and with the chamber up in examined archaeological context. We assume, that the soot was created later during a secondary activity. The time interval of this sample (Sequence 3) between 1645 and 1674 AD (Figure 3; Table 2) is representing *Terminus Post Quem* of the period of felling a tree. There is a possibility that the tree was felled and consequently used in examined archaeological context sometimes between two years (1643–1645 AD). Another option is later wood occurrence in this context. This can be related with the other opinions on the destruction of the castle: either the castle was destroyed by the Turks in the 17th century[6] (Hunfalvy 1860:137) or demolished at the beginning of the 18th century during the uprising of Francis II. Rákóczi (Ethey 1936:70). However, in 1667, there is a first mention of the castle as ruins (Janura and Bóna 2022:489).

CONCLUSIONS

The excavation of Oponice Castle brought large amounts of data connected with strong stratigraphic relations, which is unusual in a castle environment. A precise approach such as microarchaeology, allows us to identify chronological phases and samples background. Based on that, we can date with the ^{14}C data sequence single events even during the period when the calibration curve fluctuates. The resulting sequence uses data from different sources that are interrelated through archaeological context and stratigraphic phases. We modeled time intervals of the three individual sequences in a related to three stratigraphic phases (phase 2, 3 and transition phase 3/4 (Figure 3). Using the IntCal20 calibration curve, the modeled sequence of the 6 ^{14}C and 1 calendar dates gives an estimated time interval between 1567 and 1674 AD.

[6]On the other side, according to a historian M. Bel (1742:428–429), the castle was not conquered by Turks, and its demise was due to neglect.

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The earliest data, which precede the period of construction, are related to tree growth from 1567 to 1640 AD. The area usage is limited by finds on the floor in the range 1608–1658 AD. A problematic soot sample from the stove tile points to secondary burning rather than the use of a pottery kiln between years 1643–1674 AD. Results of individual samples (single plots) give an opportunity for more precisely dating the beginning and end of the main modeled sequence.

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REFERENCES

Bel M. 1742. Notitia Hungariae novae historicogeographica IV. Vienna (AUT): Tomvs Qvartvs.

Bóna M, Repka D, Sater P. 2017. Oponický hrad. Dejiny, výskum a obnova pamiatky. Nitra (SVK): Apponiana.

Bronk Ramsey C. 2009. Bayesian analysis of radiocarbon dates. Radiocarbon 51(1):337–360.

Bronk Ramsey C. 2017. Methods for summarizing radiocarbon datasets. Radiocarbon 59(2):1809–1833.

Bronk Ramsey C, van der Plicht J, Weninger B. 2001. "Wiggle matching" radiocarbon dates. Radiocarbon 43(2A):381–389.

Ethey G. 1936. A Zoborvidék multjából. Nyitra (SVK): Risnyovszky János Könyvnyomdája.

Gupta SK, Polach HA. 1985. Radiocarbon dating practises at ANU. Canberra: ANU.

Harris EC. 1997. Principles of archaeological stratigraphy. 2th ed. London (GBR): Academic Press.

Hunfalvy J. 1860. Magyarország és Érdely eredeti képekben. Pest.

Jančiová B. 2021. Stove tiles production. Study Possibilities of stove tiles on the example of collection from Oponice Castle [dissertation]. Nitra (SVK): Constantine the Philosopher University in Nitra.

Janura T, Bóna M. 2022. Oponice Castle in the modern era from the perspective of archival and architectural-historical research. Studia Historica Nitriensia 26(2):471–499.

Jull AJT, Burr GS, Beck JW, Hodgins GWL, Biddulph DL, Gann J, Hatheway AL, Lange TE, Lifton NA. 2006. Application of accelerator mass spectrometry to environmental and paleoclimate studies at the University of Arizona. Radioactivity in the Environment 8:3–23.

Molnár M, Janovics R, Major I, Orsovszki J, Gönczi R, Veres M, Leonard AG, Castle SM, Langy TE, Wacker L, Hajdas I, Jull AJT. 2013. Status report of the new AMS ^{14}C sample preparation lab of the Hertelendi Laboratory of Environmental Studies (Debrecen, Hungary). Radiocarbon 55(2–3):665–676.

Neustupný E. 2007. Theory of archaeology. Plzen (CZE): Aleš Čeněk.

Orsovszki G, Rinyu L. 2015. Flame-sealed tube graphitization using zinc as the sole reduction agent: precision improvement of Environ MICADAS ^{14}C measurements on graphite targets. Radiocarbon 57(5):979–990.

Pearson GW. 1986. Precise calendrical dating of known growth-period samples using a "curve-fitting" technique. Radiocarbon 28(2A):292–299.

Reimer P, Austin W, Bard E, Bayliss A, Blackwell P, Bronk Ramsey C, Butzin M, Cheng H, Edwards R, Friedrich M, et al. 2020. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). Radiocarbon 62(4):725–757.

Repka D. 2015. Oponice, okres Topoľčany, Oponický hrad. Výskumná dokummentácia z archeologického výskumu. Nitra (SVK): Constantine the Philosopher University in Nitra.

Repka D. 2018. Oponický hrad. Výskumná dokumentácia z archeologického výskumu. Nitra (SVK): Constantine the Philosopher University in Nitra.

Repka D, Jančiová B. 2020. Oponice, okres Topoľčany, Oponický hrad. Výskumná dokumentácia z archeologického výskumu. Nitra (SVK): Constantine the Philosopher University in Nitra.

Repka D, Sater P. 2019. Coat of arms on a stone segment from Oponice Castle—the activity of the

Horváth family in the Aponi family residence. Studia Historica Nitriensia 23(1):158–170.
Repka D, Styk M. 2016. Oponice, okres Topoľčany, Oponický hrad. Výskumná dokumentácia z archeologického výskumu. Nitra (SVK): Constantine the Philosopher University in Nitra.
Repka D, Styk M, Šimunková K. 2017. Oponický hrad. Výskumná dokumentácia z archeologického výskumu. Nitra (SVK): Constantine the Philosopher University in Nitra.
Rinyu L, Molnár M, Major I, Nagy T, Veres M, Kimák Á, Wacker L, Synal H-A. 2013. Optimization of sealed tube graphitization method for environmental ^{14}C studies using MICADAS. Nuclear Instruments and Methods in Physics Research B 294:270–275.
Rinyu L, Orsovszki G, Futó I, Veres M, Molnár M. 2015. Application of zinc sealed tube graphitization on sub-milligram samples using Environ MICADAS. Nuclear Instruments and Methods in Physics Research Section B 361:406–413.
Schmid MME, Wood R, Newton AJ. Vésteinsson O, Dugmore AJ. 2019. Enhancing radiocarbon chronologies of colonization: chronometric hygiene revisited. Radiocarbon 61(2):629–647.
Schneider RJ, McNichol AP, Nadeau MJ, Reden KF. 1995. Measurements of the Oxalic Acid II/Oxalic Acid I ratio as a quality control parameter at NOSAMS. Radiocarbon 37(2):693–696.
Stuiver M, Polach H. 1977. Reporting of ^{14}C data. Radiocarbon 19(3):355–363.
Svetlik I, Jull AJT, Molnar M, Povinec P, Kolar T, Demjan O, Pachnerova Brabcova K, Brychova V, Dreslerova D, Rybnicek M, Simek P. 2019. The best possible time resolution: How precise could a radiocarbon dating be? Radiocarbon 62(5):1–12.
Tessedik F. 1827. Die Burgen—Appony. In: Hormayr J, Mednyánszky A, editors. Taschenbuch für die vaterländische Geschichte VII. Wien. p. 28–54.

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