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RESEARCH ARTICLE

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A Late Medieval motte-and-bailey settlement in a lowland river valley landscape of Central Poland

Piotr Kittel[1] | Jerzy Sikora[2] | Piotr Wroniecki[3]

[1]Department of Geomorphology and Palaeogeography, Faculty of Geographical Sciences, University of Lodz, Łódź, Poland

[2]Department of Historical Archaeology and Weapon Studies, Institute of Archaeology, University of Lodz, Łódź, Poland

[3]Independent Researcher, Warsaw, Poland

Correspondence
Piotr Kittel, Department of Geomorphology and Palaeogeography, Faculty of Geographical Sciences, University of Lodz, ul. Narutowicza 88, PL 90–139 Lodz, Poland.
Email: piotr.kittel@geo.uni.lodz.pl

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Abstract

The Rozprza motte-and-bailey residence in Central Poland was inhabited from the third decade of the 14th century up to the 15th century A.D. and functioned as a seat of a noble family. It was situated in the place occupied previously by an Early Medieval open settlement and a later ring-fort. The motte was constructed on the river terrace remnant adjoining a strongly expanding flood plain in the central part of the mid-Luciąża River valley. The immediate surroundings of the stronghold were studied by means of archaeological excavations, detailed geological mapping (hand-auger transects and trenching), and large-scale aerial photography, as well as geochemical and geophysical (magnetic gradiometry and soil electrical resistance) prospection. All the results have been integrated within a GIS and supported by a set of ^{14}C dates that allow for a detailed geomorphological reconstruction of the stronghold situation, including former river patterns, the local flood plain development, and the history of the Medieval fortress site with its moats. Our research provides insights into the late Holocene evolution of a small river valley and confirms the favorable conditions for the location of the motte on a terrace remnant protected by the system of moats and surrounding paleochannels and swampy areas within the valley floor.

KEYWORDS
alluviation, Little Ice Age, moat fill, motte-and-bailey, valley floor

1 | INTRODUCTION

The remains of the stronghold at Rozprza are situated on the valley floor of the Luciąża River within the larger Vistula River basin. The reconstruction of changing flood plain morphology is important to establish the paleoenvironmental setting of the fortress location. The positioning of Medieval (particularly Early Medieval) settlements in lower parts of river valleys has been recognized as typical for the Polish Lowlands (e.g., Bartkowski, 1978; Dunin-Wąsowicz, 1974; Florek, Florek, & Kaczmarzyk, 1998; Kurnatowski, 1963, 1968, 1975). However, in Central Poland, only a few Medieval sites have been subjected to detailed geoarchaeological studies—including Łęczyca-Tum (Forysiak, Czubla, & Marosik, 2015; Krzemiński, 1987); Burzenin-Witów (Krzemiński, 1970); Ląd (Bartkowski, 1978); Rozprza (Goździk, 1982); Strońsko (Kittel, Forysiak, & Twardy, 2009); Czerchów (Krzemiński & Krysiak, 2012); and Lutomiersk-Koziówki (Kittel, 2012, 2012a).

Our studies are focused on the detailed reconstruction of the depositional history and changes of the local flood plain and the Medieval fortress site formation, with special attention to the development of its moat system. The main aim of the study is the reconstruction of the topographical, geomorphological, geological, and hydrological situation related to the location of the motte-and-bailey, which was a private, wooden residence typical for the European Lowlands in the Late Medieval Period. The research was based on modern methods of environmental archaeology with an initial (in 2013–2014) focus on geoarchaeological studies with the use of noninvasive techniques. Part of the results (aerial photography, geophysics, hand-auger transects, preliminary radiocarbon data sets) have already been published by Kittel, Sikora, and Wroniecki (2015) and Sikora, Kittel, and Wroniecki (2015a). The current paper focuses on the results of the detailed trenching work conducted in 2015–2016 with new radiocarbon (^{14}C) and dendrochronological dating. All of the data—both archaeological and geoarchaeological—were integrated for the reconstruction of the motte-and-bailey site location on the local hilltop, in relation to flood plain and river channel dynamics.

The ongoing study in Rozprza is one of the first archaeological and geoarchaeological research projects on the remnants of the Late Medieval and the Early Modern motte-and-bailey complex along with its environmental context. Geoarchaeological research into the paleoenvironmental conditions of Medieval defensive and residential sites is essential for a more in-depth understanding of

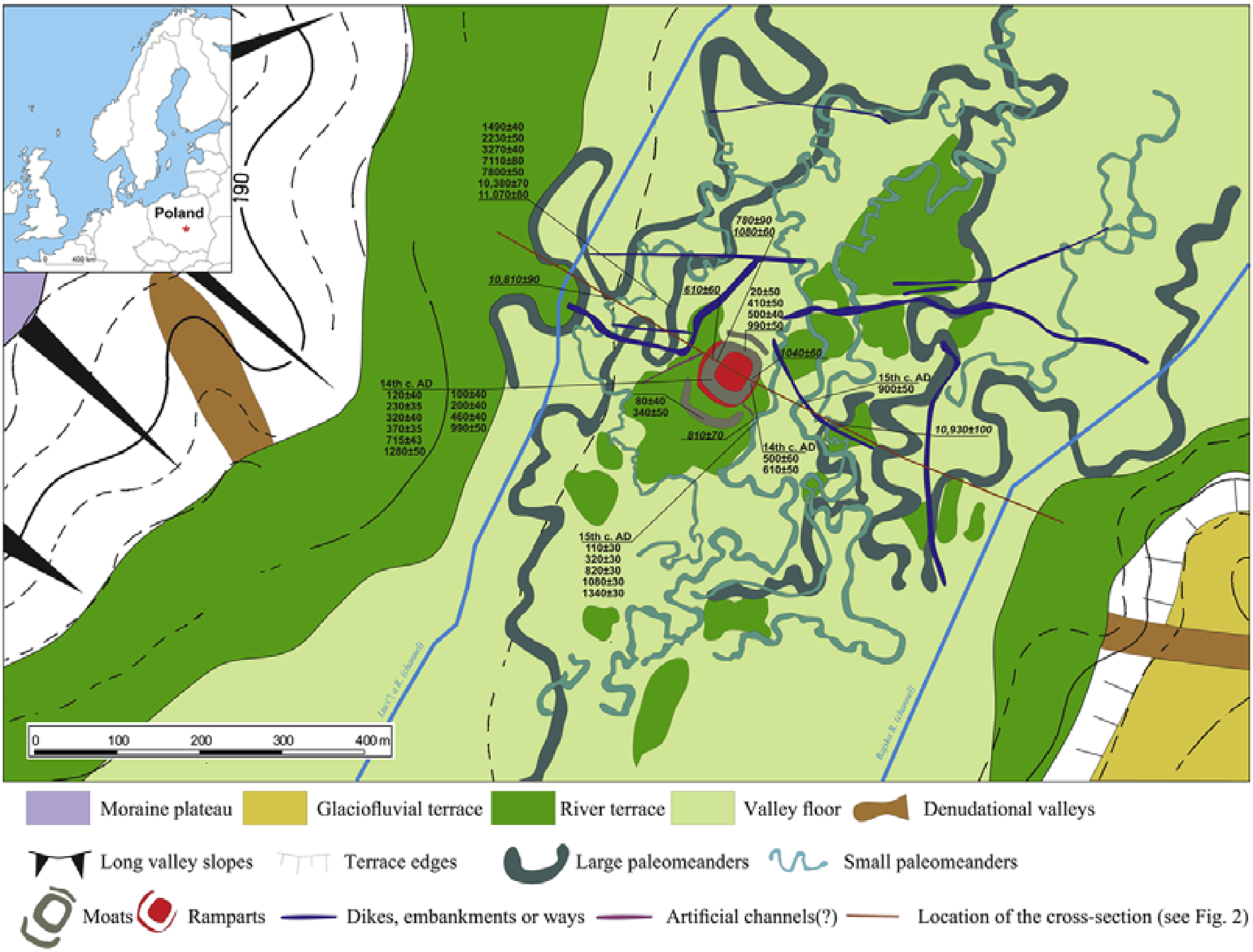


FIGURE 1 Geomorphological map of the Rozprza stronghold vicinity. Radiocarbon ages are uncalibrated with one sigma errors (^{14}C yr B.P.) and based on organic deposits; those in italics are from drillings (see Table I). Ages presented as centuries are based on dendrochronological and archaeological data from moat fills [Color figure can be viewed at wileyonlinelibrary.com]

their location and also in the context of site development in relation to natural history (Gebhardt & Langohr, 1999; Kurnatowski, 1963; Legg & Taylor, 2006; Lewin, 2010). A detailed study of flood plain evolution at the beginning of the Little Ice Age is also a key aim of this research.

2 | STUDY AREA

The site (51°18′07″ N; 19°40′04″ E; 182–183 m asl) is situated in Central Poland, ca. 60 km south of Łódź, in the middle sector of the Luciąża River valley. This is a 53 km long, third-order tributary of the Pilica River in the mid-Vistula River basin. The average discharge of the Luciąża River is 1.9 m^3/s, and its basin area covers 765 km^2. A regulated channel of the Luciąża River is today situated approximately 250 m to the west of the stronghold remnants and the Rajska River canal is ~350 m to the east (Figures 1 and 2). Relics of the defensive system (i.e., ramparts and moats) of the Medieval stronghold are poorly preserved but still clearly visible in the relief. Currently, the site occupies an area covered by meadows and fallow fields, in some places located between the main channel of the Luciąża River and the Rajska River (the secondary channel of the Luciąża River system).

Geomorphological research of the Luciąża River valley area was previously conducted by Goździk (1982) and Wachecka-Kotkowska, (2004a, 2004b). These studies enhanced our general knowledge of the geological structure of the Luciąża River valley and the major late Quaternary stages of the valley evolution, but they did not include a detailed survey of the valley floor. In the Luciąża River valley close to Rozprza, one (highest) Wartanian (corresponding to Warthe—see Marks, 2011) glaciofluvial terrace and two Vistulian (Weichselian) river terraces (a high terrace and a low terrace) were recognized. The Wartanian terrace is elevated ca. 6–7 m above modern river level, the Plenivstulian terrace—ca. 2 m and the Late Vistulian Terrace—ca. 1 m. The western morainic upland is formed in tills, and the eastern upland by glaciofluvial sands and gravels (Wachecka-Kotkowska, 2004a). While the valley floor is widening in the Rozprza area, the studied fortress was established on the Plenivistulian residual terrace surrounded by the Holocene flood plain, in the central part of the Luciąża River valley (Goździk, 1982). The morphology of the valley floor has been obliterated by the deposition of modern overbank alluvium (Wachecka-Kotkowska, 2004a, 2004b).

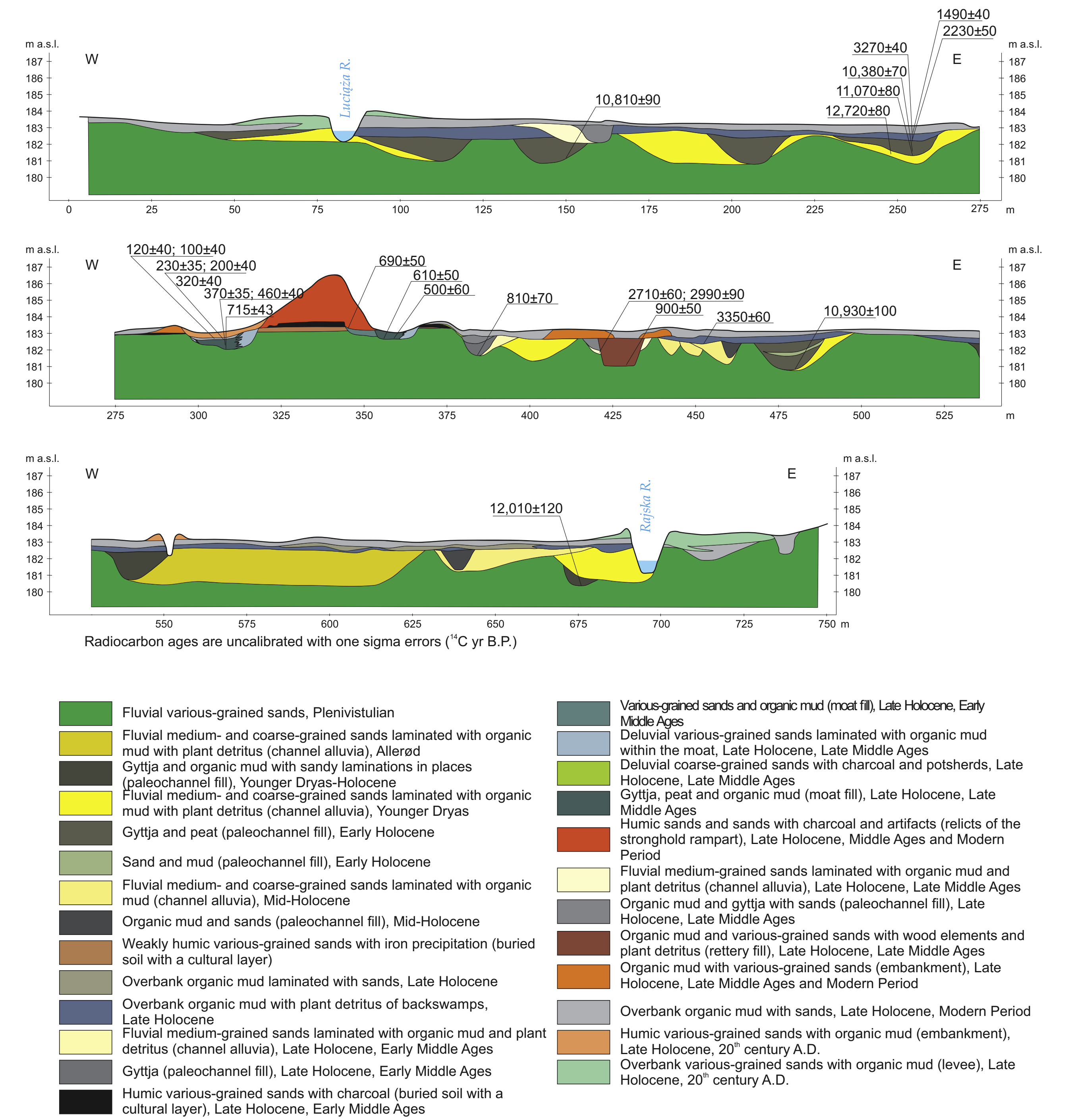


FIGURE 2 Geological cross-section of the Luciąża River valley floor in the Rozprza stronghold vicinity (for the location of the cross-section, see Figure 1) [Color figure can be viewed at wileyonlinelibrary.com]

3 | PREVIOUS ALLUVIAL RESEARCH IN CENTRAL POLAND

In Central Poland, only a few detailed paleoenvironmental studies of river valleys, especially concerning the Middle Ages, have been conducted (Twardy, Forysiak, & Kittel, 2014). The mid-Ner River valley was one of the most extensively inhabited areas in the Middle Ages. However, intense geomorphological and geoarchaeological research revealed no geological record of the Medieval human impact on valley evolution (Kittel, 2012, 2012a, 2014). The sandy/silty overbank deposits at the Kolonia Bechcice site in the Ner River valley accumulated in modern times, most likely over the last 250–300 years (Płóciennik et al., 2016). Also, the coarse-grained sands recorded at the Lutomiersk–Koziówki site (the Ner River valley as well) accumulated between the mid-17th and the beginning of the 19th century A.D. (Kittel et al., 2014). Clear geological evidence of Medieval flooding under human impact, dated to the 11th–12th centuries A.D., is described in the Dobrzynka

River valley. The existence of those floods is supported by a set of radiocarbon dates for organic mud and peats underlying overbank deposits (dated to between 1210 and 810 yr B.P.). Those processes were combined with increased human activity at the turn of the 11th and 12th centuries A.D. (Kittel, 2011). The present-day valley floor in the Rawka River in Rawa Mazowiecka is formed by a thick (up to 1.5 m) overbank cover, containing Late Medieval and modern artifacts. Initially, the river inundations led to silt accumulation, and subsequently sands were deposited. Those processes could have been a response to catchment deforestation, occurring probably after the 13th century A.D., that is, in the period of urban settlement development (Kittel, 2013; Kittel & Skowron, 2007).

In Central Poland, evidence of water-logging of valley floors resulting from human occupation in historical times was found in the Bzura River valley near Łęczyca (Forysiak et al., 2015; Krzemiński, 1987), the Warta valley in Ląd (Bartkowski, 1978), and in the lower Moszczenica valley (Kamiński, 1993). The accumulation of sandy loams in the historical period has been described in the Luciąża River in Rozprza (Goździk, 1982; Wachecka-Kotkowska, 2004b), the lower Moszczenica River (Kamiński, 1993), the Linda River near Ozorków (Marosik, 2003), the Dobrzynka River (Kittel, 2011), the Ner River near Lutomiersk (Kittel et al., 2014, Kittel, 2011), and in the Grabia River (Pawłowski, Milecka, Kittel, Woszczyk, & Spychalski, 2015).

The well-documented flood phases from the Late Middle Ages are the result of catchment deforestation and agricultural development leading to increases in surface runoff, denudation, and overbank deposition (Brázdil et al., 1999; Brown, 1997; Hoffmann et al., 2010; Kaiser et al., 2012; Kurnatowski, 1968, 1975; Lewin, 2010; Olaczek, 2000; Starkel, 1983, 2002; Strzemski, 1964). The frequency and intensity of floods increased in response to the progressive woodland clearance and increasing agriculture (Dotterweich, 2008, 2013). As a result, settlements moved from valley floors to higher parts of valleys, as well as uplands. Such processes were recognized for the Polish Lowlands as early as in the 13th–14th centuries A.D. (Dunin-Wąsowicz, 1974). Since the Middle Ages direct human impact on valley floors in Central Poland was linked to the establishment of water mills, fullers (Kamiński, 1993; Olaczek, 2000), and retteries (Olaczek, 2000).

Evidence of flooding from the Middle Ages and the Modern Period in Central Poland are referred to in records from Southern Poland collected by Starkel et al. (2013) and also from Central Europe after Kalicki (2006 and references within). Starkel et al. (2013) defined a very distinct phase of floods that started from 1000 yr cal. B.P. with two main Medieval phases in the 10th–12th and the 14th–16th centuries A.D. (Gębica, Starkel, Jacyšyn, & Krąpiec, 2013). The intense accumulation of overbank deposits has been dated in that area to ca. 550–450 yr cal. B.P. (Alexandrowicz, 1996) and the felling of trees by flooding to the 13th–14th centuries A.D. in the Vistula valley near Cracow (Kalicki & Krąpiec, 1991).

4 | ARCHAEOLOGICAL BACKGROUND

According to written sources from the 11th to 13th centuries, Rozprza was one of the most important Medieval strongholds in Central Poland, next to Łęczyca, Sieradz, and Spycimierz (Chmielowska, 1975; Kajzer, 2007; Kamińska, 1953, 1971; Sikora, 2007, 2009). It is mentioned for the first time in the so-called Mogilno Falsification from A.D. 1065, then in the Bull of Gniezno from A.D. 1136—in the group of important princely forts paying tribute to the Archbishops of Gniezno. In the 13th century A.D., it became a seat of castellan—a local officer, and in the next century it is mentioned as a private property of the Nagodzice-Jelitczycy noble family (Zajączkowski, 1961).

The site at Rozprza was the subject of archaeological research in 1963–1966 under the direction of A. Chmielowska of the Museum of Archaeology and Ethnography in Łódź. A series of excavations and test trenches were made, aiming to identify the stratigraphy of the stronghold and the adjacent area. As a result, Chmielowska (1966, 1982) distinguished four phases of the fortress's development, starting from the ninth to the 14th century A.D. The last phase dated to the 13th and 14th centuries, when the site was understood to be a noble family's private residence, probably of the motte type. It was built on the base of an earlier, Early Medieval ring-fort. Four small open settlements located on small hillocks around the fortress were also identified.

Based on recent studies, the stronghold in Rozprza consists of a Late Medieval motte with poorly preserved remains of an earlier ring-fort. The motte was a pan-European type of fortified residence, known throughout many areas—from Ireland to Poland and from southern Scandinavia to Italy. It is understood to be a typically artificial conical mound, in circular, oval, or rectangular shape, often protected by an outer moat and a more-or-less complicated system of additional fortifications (ramparts or walls). Sometimes one or more enclosed courtyards or baileys with additional domestic, residential, and other building (even churches) were attached to the mound. In this configuration, such complex is usually called a "motte-and-bailey" (Higham, 2003; Hingham & Barker, 2004; Kenyon, 1990) On the mound top stood a tower made of timber, stone, or bricks, constituting a residential manor building or just a further part of a defensive system.

Such features appeared first in Northern France and the western part of Germany around A.D. 1000 (Hinz, 1981; Mesqui, 1991; Müller-Wille, 1966). During the 11th century, motte castles appeared in Flanders and the Netherlands, as well as in England (Aarts, 2007; Kenyon, 1990). In the 12th century, they became one of the most popular types of feudal residence in German-speaking areas (Heine, 2004). In Southern Italy, motte-type fortresses were erected by the Normans in the 11th and 12th centuries (Cirelli & Noyé, 2013). In the 13th–14th centuries in Western Europe, motte castles were abandoned or turned into masonry features. In the same period, they became a popular defensive residence in Southern Scandinavia, Eastern Germany countries, Poland, and Czechia (Heine, 2004; Kajzer, 1993, 2004; Marciniak-Kajzer, 2011; Unger, 1988). In the Czech territory, they are called "tvrz"—that is, small size medieval fortification (Durdík, 2001). Analogous motte-type castles were also recorded in the Western Ukraine (Volyn), where they might have occurred as a result of Hungarian and Polish influences (Panyshko, 2014).

The study of the history of private Medieval knighthood residences in Poland was discussed by Marciniak-Kajzer (2011), while G. Leńczyk was a pioneer of the study of such features in the 1930s

(Horbacz, 1997). The first fully modern research on the motte-type residences was conducted by Kamińska (1968) at Siedlątków in the Warta River valley. Her work "shaped the research attitudes of archaeologists until today" (Marciniak-Kajzer, 2011, p. 26). Substantial progress in these studies resulted from the studies of Kajzer (1972, 1980, 1993, 2004), who dealt with the genesis of this feature in the Polish territory, but also conducted archaeological verification of numerous objects and drew attention to the fact that the chronology of this type of residence goes significantly beyond the period of the Middle Ages. Previous studies indicate that the motte type of defensive residence was introduced in Poland in the 13th century, replacing in some cases older timber and earth ring-work-type defensive features. The advocates of such a model were probably the Piast dynasty princes (Kajzer, 1993), who used it as residences of minor importance, the so-called "transitional type castles" or "colonization castles," associated with administrative reforms and colonization movements, especially in previously unpopulated, forested areas. The term "transitional type castles" was introduced by Durdík (2001), and in Poland by Boguszewicz (1998). In the 13th and 14th centuries, they became a typical model of knightly residence in the Polish territory. In the Polish Lowlands, it was the dominant model of a noble seat until modern times.

Kamińska proposed a basic approach for surveys of Medieval mansions that included: (1) topography of the site, (2) the shape of the stronghold, (3) the internal structure of the mound/embankment, (4) the age of the object, (5) additional facilities, (6) sources regarding the historical owners (cf. Marciniak-Kajzer, 2011). In practice, this research program was not often realized. These guidelines only slightly address the environmental contexts of strongholds, narrowing it in most cases to a discussion of topography, understood as general characteristics of the relief in the immediate vicinity, referring present conditions directly to the past. The issue of the spatial context related to economic and settlement features was also poorly outlined. Noninvasive, especially geophysical research methods, have so far been used only to a limited extent (Brejcha & Wroniecki, 2010; Ordutowski, 2011).

Although the motte-type castles have been the subject of numerous archaeological investigations across Europe and in Poland—and are one of the popular subjects of castellology and more general medievalists' discourse—they have only very rarely been the subject of geoarchaeological and paleoenvironmental surveys (e.g., Fischer, Glos, & Nakoinz, 2003). In the present study we have attempted to fill this gap in knowledge.

5 | METHODS

In 2013–2015, a non-destructive survey of the selected fortresses' surroundings was carried out in Central Poland (Andrzejewski & Sikora, 2017). The project included field walking, aerial photography, geochemical and geophysical (magnetic gradiometry and soil electrical resistance or "earth electrical resistance" after Schmidt, 2013) prospection along with detailed geological mapping. The combined results provided new data at Rozprza for the reconstruction of the river pattern of a small (ca. 7 ha) area and of an artificial moat system of the motte situated within the valley floor (Figure 3). Our results shed new light on the shape and chronology of the complex by not only revealing new details of archaeological features but also by showing previously unknown geomorphological structures on the valley floor (see Kittel et al., 2015; Sikora et al., 2015a).

Both natural structures and anthropogenic features recorded with geophysical methods were verified by geological sounding. A detailed geological survey was carried out in order to recognize the surficial geology of the stronghold's surroundings and the geological structures recorded by aerial photographs and geophysical surveys. In total, 234 cores were taken using an Eijkelkamp hand auger at the depths of 1.0–3.5 m. Detailed geological cross-sections of the fortress's immediate surroundings were created based on their results (Kittel et al., 2015).

In 2015–2016, intensive fieldwork was undertaken with the use of archaeological trenches and geological outcrops (Figures 4 and 5). The trenches allowed the recording of archaeological structures and cultural layers of preserved rampart features and moats' fills, as well as the identification of paleochannel fills and subsurface overbank deposits. Successive 10-cm layers of deposits were removed from the trench exposures. Within such 10-cm arbitrary layers, stratigraphic units were distinguished. All the excavated deposits were sifted and floated by stratum with the use of a 4×4 mm sieve. All the discovered artifacts and ecofacts were collected with relation to "natural" stratigraphic units, as well as to arbitrary layers. The exploration of the lowest, waterlogged layers within the moats and the paleochannels was possible with the use of a motorized water pump. The uncovered layers and features were documented with three-dimensional photogrammetric methods and described with digital methods.

Trench 1 had dimensions of 2.5×12 m and crossed the moat and the outer rampart surrounding the stronghold from the east. The purpose of this trench was to identify the stratigraphy of the moat and the inner slope of the outer rampart.

Trench 2 (2×12 m), located within the paleochannel visible on aerial photographs, was recorded in the geophysical survey and confirmed during geological mapping. The aim of this excavation was to identify the paleochannel fill and obtain data for the paleoenvironmental reconstruction.

Trench 3 (1.5×25 m), situated SW of the stronghold, was dug to obtain a full cross-section through the very well-preserved moat, the adjoining outer rampart, and the motte mound (Figure 5). Its purpose was also to collect a core of organic deposits of the moat fill for paleoecological analyses, as well as samples and ecofacts for both radiocarbon and dendrochronological dating.

Trench 4 (2×10 m), located west of the stronghold, on a large paleochannel, was identified in magnetic gradiometry results and hand-auger soundings. The purpose of this trench was to allow study of the paleochannel fill and overbank alluvium cover and also to obtain data for paleoenvironmental research (i.e., cores of organic deposits for paleoecological analyses and samples for radiocarbon and dendrochronological dating).

Trench 5 (2×15 m), located within the paleochannel visible in the terrain, was recorded on aerial photographs and confirmed

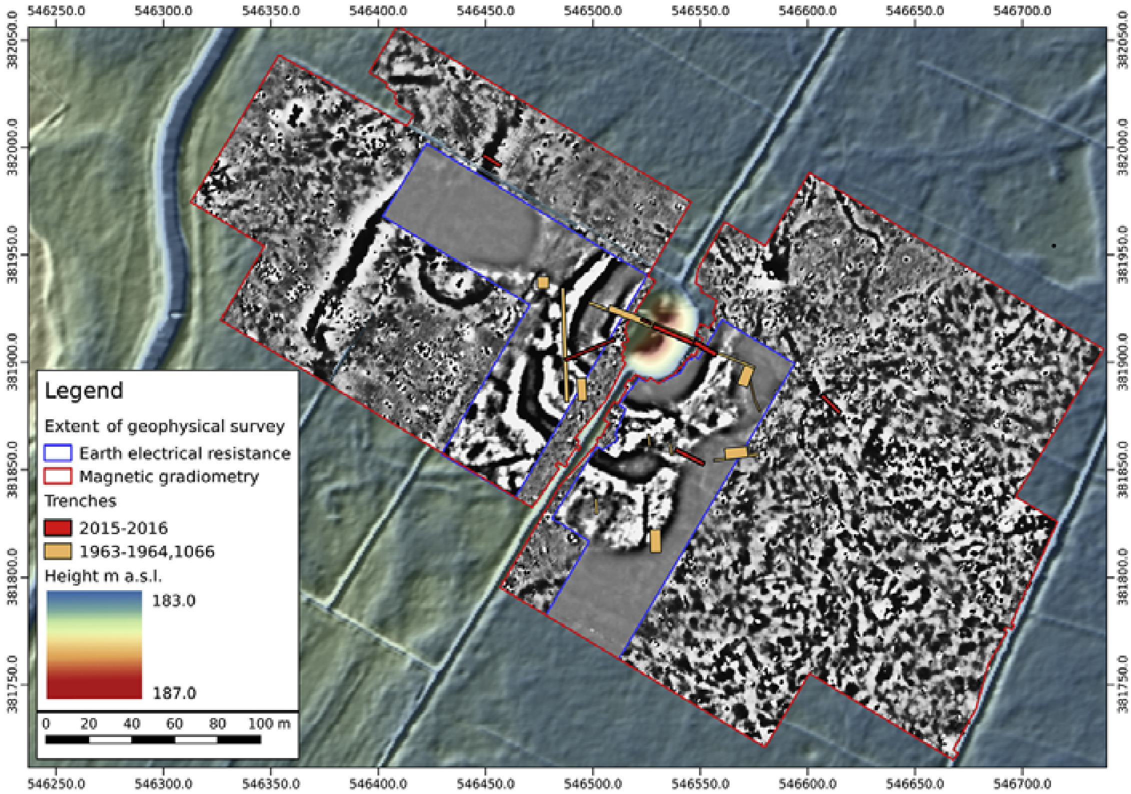


FIGURE 3 Geophysical survey visualization presented against the shaded relief digital elevation model from airborne laser scanning in the framework of the ISOK program. Magnetic gradiometry: –1 to 1 nT, black and white scale; earth electrical resistance: 90–160 ohm-m black and white scale (ed. by Sikora) [Color figure can be viewed at wileyonlinelibrary.com]

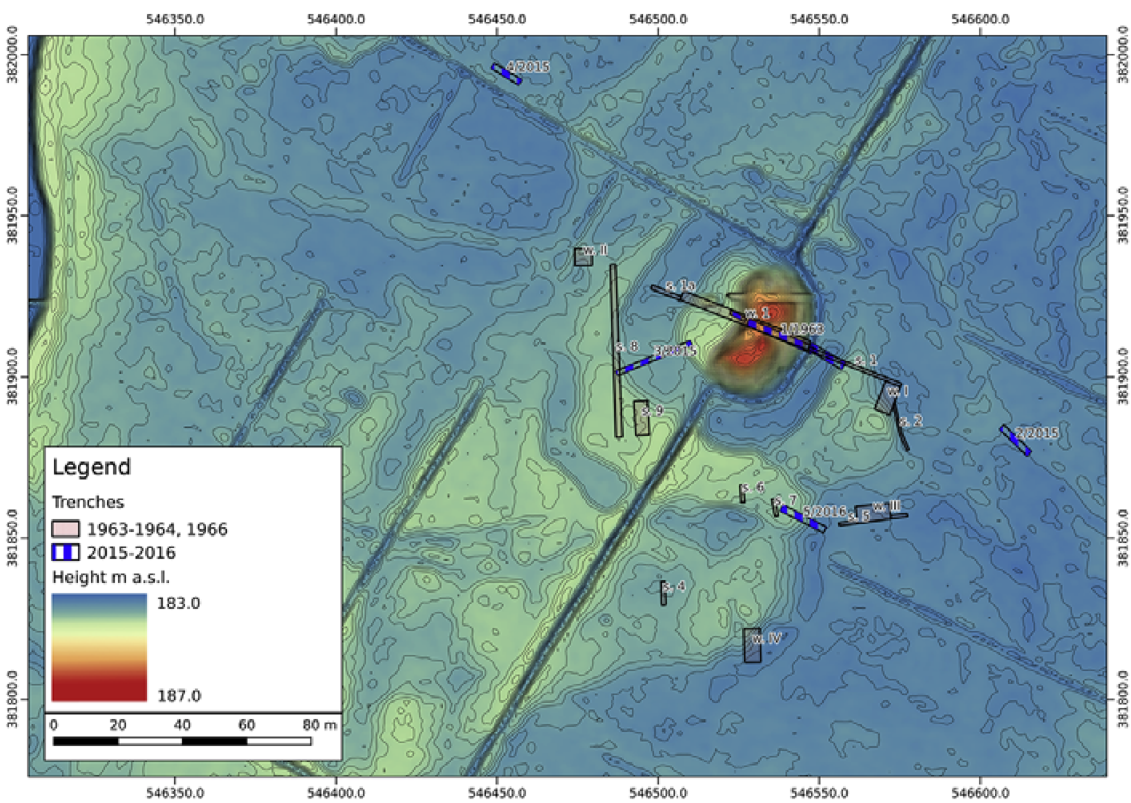


FIGURE 4 Hypsometric plan with trenches highlighted presented against the shaded relief digital elevation model from airborne laser scanning in the framework of the ISOK program [Color figure can be viewed at wileyonlinelibrary.com]

FIGURE 5 An aerial photo taken during excavations in 2015. The ramparts, the moats, and the terrace remnant (the area of the baileys) visible as crop marks (photo by Wroniecki, 2015) [Color figure can be viewed at wileyonlinelibrary.com]

during geological mapping. The aim of the excavation was to identify the paleochannel fill and obtain data for the paleoenvironmental reconstruction.

Additionally, Trench 1/1963 (3×27 m), crossing the preserved part of the stronghold's earthwork, was reopened during the study. This was to allow its redocumentation with modern, digital tools (such as photogrammetry), to reanalyze the stratigraphy of the remnants of the earthwork, and to collect findings and samples for establishing the chronology of subsequent phases of the stronghold's development. First the northern wall of the trench was analyzed and documented, and then the stratigraphic units preserved in the "steps" left in 1963 (to maintain the stability of the sandy sections) were explored. At the same time, thanks to an efficient water pump and to the extremely dry excavation season in 2015, it was possible to complete the exploration of the bottom layers of the earthwork and of the moat left by the previous research team.

At the same time, the wall of the drainage ditch was cleaned and documented in order to better understand the stratigraphy of the entire terrace remnant on which the settlement was developed. It allowed us to obtain almost a full cross-section through the fortress on the NE-SW axis. The ditch was divided into two parts, a northern one (25 m long) and a southern one (85 m long).

All the data recovered by these methods were spatially located with the use of GPS RTK equipment or Total Station and integrated within a Geographic Information System (GIS). A program of geological hand augering in the valley floor, the stronghold's surroundings, and within the moat was continued in 2015–2016. In total, 341 cores were recovered.

Selected samples of bulk organic deposits from the moat—as well as the paleochannel fills and the overbank materials collected from the hand-auger cores and from the walls of the archaeological trenches and the geological outcrops—were dated by radiocarbon (^{14}C) using the liquid scintillation technique (LST). The ^{14}C results from cores presented in Kittel et al. (2015) are combined with the new ^{14}C data set from the trenches to provide a more robust alluvial chronology for the mid-Luciąża River flood plain. Accelerator mass spectrometry (AMS) ^{14}C dating was conducted on plant macrofossils selected from the very bottom of the moat fill (Table I). ^{14}C data calibration was carried out with the use of the OxCal 4.2.4 software (Bronk Ramsey, 2009) and the atmospheric data from IntCal13 (Reimer et al., 2013). All calibrated ages are presented in the paper at ± 1 sigma (± 1 and ± 2 sigma ranges are in Table I). The OxCal P_Sequence model was used to calculate the age/depth model for the moat fill in trench 3 and for the paleochannel fill and the overbank deposits in trench 4. Selected wooden elements were dendrochronologically dated (M. Krąpiec, pers. commun.). Both radiocarbon and dendrochronological determinations were done in the Laboratory of Absolute Dating in Skała, Poland.

6 | RESULTS

6.1 | Paleochannel fills and overbank alluvium

The aerial photographs and geophysical prospection enabled the discovery of subfossil paleomeanders of different sizes, as well as relicts of archaeological features, that is, a system of ramparts and moats of

TABLE I Results of radiocarbon dating from Rozprza motte and surroundings

Dated Deposits or Material	Location of the Sample	Depth b.g.l. [cm]	Age 14C yr B.P.	Laboratory No.	Age cal ^{14}C Prob. 68.2%	Age cal ^{14}C Prob. 95.4%	References	Remarks
Top of sandy organic mud (top of MF)	N drainage ditch	20–25	20 ± 50 PB	MKL-2965	A.D. 1697–1917	A.D. 1684–1929	This paper	
Top of peat (MO2)	S drainage ditch	38–43	80 ± 40	MKL-2966	A.D. 1696–1917	A.D. 1682–1937	This paper	
Top of organic mud (top of OA)	Trench 3	38–43	100 ± 40	MKL-2958	A.D. 1694–1918	A.D. 1680–1939	This paper	
Bottom of weakly sandy organic mud (OA)	Trench 5	25–30	110 ± 30	MKL-3157	A.D. 1693–1919	A.D. 1681–1938	This paper	
Top of organic mud (top of OA)	Trench 3	42–47	120 ± 40	MKL-2839	A.D. 1684–1928	A.D. 1675–1942	This paper	
Top of peat (top of MF)	Trench 3	50–55	200 ± 40	MKL-2957	A.D. 1655–1950	A.D. 1642–1950	This paper	
Top of peat (top of MF)	Trench 3	55–60	230 ± 35	MKL-2840	A.D. 1643–1950	A.D. 1526–1950	This paper	
Bottom of peat (MF)	Trench 3	75–80	320 ± 40	MKL-2841	A.D. 1514–1641	A.D. 1468–1649	This paper	
Bottom of organic mud (PF)	Trench 5	45–50	320 ± 30	MKL-3158	A.D. 1518–1640	A.D. 1483–1646	This paper	Fill of the Late Medieval overbank flow channel
Bottom of peat (bottom of MO2)	S drainage ditch	60–65	340 ± 50	MKL-2967	A.D. 1485–1634	A.D. 1453–1645	This paper	
Wood fragment	Trench 2	50–100	360 ± 40	MKL-3391	A.D. 1465–1628	A.D. 1450–1636	This paper	Element of rettery construction
Top of coarse-detritus gyttja (MF)	Trench 3	85–90	370 ± 35	MKL-2842	A.D. 1453–1620	A.D. 1446–1635	This paper	
Bottom of sandy organic mud (MF)	N drainage ditch	40–45	410 ± 50	MKL-2964	A.D. 1435–1618	A.D. 1420–1635	This paper	
Top of coarse-detritus gyttja (MF)	Trench 3	60–65	460 ± 40	MKL-2956	A.D. 1417–1455	A.D. 1401–1616	This paper	
Top of organic mud (top of MF)	N drainage ditch	45–50	500 ± 40	MKL-2963	A.D. 1408–1442	A.D. 1319–1455	This paper	
Bottom of organic mud (bottom of MF)	Trench 1	60	500 ± 60	MKL-2608	A.D. 1326–1451	A.D. 1297–1615	This paper	
Top of gyttja (top of PF)	Drilling	80–90	540 ± 60	MKL-2409	A.D. 1318–1435	A.D. 1296–1448	Kittel et al. (2015)	Late Medieval rettery relicts fill (?)
Bottom of organic mud (MO2)	N drainage ditch	60–65	550 ± 50	MKL-2972	A.D. 1318–1428	A.D. 1299–1441	This paper	
Peat (MF)	Drilling	35–45	610 ± 60	MKL-2412	A.D. 1299–1399	A.D. 1281–1421	Kittel et al. (2015)	
Bottom of organic mud (bottom of MF)	Trench 1	40–45	610 ± 50	MKL-2609	A.D. 1299–1399	A.D. 1285–1414	This paper	
Wood fragment	Trench 5	100–130	700 ± 40	MKL-3394	A.D. 1267–1381	A.D. 1249–1392	This paper	Element of rettery construction
Bottom of clayey organic mud (bottom of MF)	Trench 3	134–136	715 ± 43	D-AMS 016324	A.D. 1259–1380	A.D. 1221–1389	This paper	AMS data of selected plant macroremains
Top of peat (top of MF)	Drilling	40–50	780 ± 90	MKL-2404	A.D. 1155–1297	A.D. 1035–1390	Kittel et al. (2015)	
Bottom of gyttja (bottom of PF)	Drilling	120–130	810 ± 70	MKL-2610	A.D. 1162–1275	A.D. 1040–1291	This paper	
Organic mud(PF)	Trench 5	70–75	820 ± 30	MKL-3159	A.D. 1193–1259	A.D. 1165–1265	This paper	Late Medieval rettery relicts fill, redeposited organic matter

(Continues)

TABLE I (Continued)

Dated Deposits or Material	Location of the Sample	Depth b.g.l. [cm]	Age 14C yr B.P.	Laboratory No.	Age cal ^{14}C Prob. 68.2%	Age cal ^{14}C Prob. 95.4%	References	Remarks
Wood fragment (bottom of MF)	Trench 3	90–100	870 ± 50	MKL-2970	A.D. 1049–1223	A.D. 1040–1257	This paper	
Organic mud (PF)	Trench 2	160–165	900 ± 50	MKL-2611	A.D. 1044–1189	A.D. 1024–1224	This paper	Late Medieval rettery relicts fill, redeposited organic matter
Bottom of organic mud (bottom of MF)	N drainage ditch	75–80	990 ± 50	MKL-2962	A.D. 992–1150	A.D. 904–1165	This paper	Redeposited organic matter
Bottom of organic mud (bottom of MF)	Drilling	35–45	1040 ± 60	MKL-2411	A.D. 897–1038	A.D. 783–1158	Kittel et al. (2015)	Redeposited organic matter
Bottom of peat (MF)	Drilling	75–85	1080 ± 60	MKL-2405	A.D. 895–1017	A.D. 774–1115	Kittel et al. (2015)	Redeposited organic matter
Gyttja(PF)	Trench 5	70–75	1080 ± 30	MKL-3160	A.D. 901–996	A.D. 894–1018	This paper	Late Medieval rettery relicts fill, redeposited organic matter
Bottom of clayey organic mud (bottom of MF)	Trench 3	75–80	1190 ± 60	MKL-2955	A.D. 726–941	A.D. 687–974	This paper	Redeposited organic matter
Bottom of clayey organic mud (bottom of MF)	Trench 3	130–135	1280 ± 50	MKL-2843	A.D. 671–770	A.D. 655–875	This paper	Redeposited organic matter
Bottom of gyttja(bottom of PF)	Trench 5	125–130	1340 ± 30	MKL-3161	A.D. 650–688	A.D. 645–765	This paper	Late Medieval rettery relicts fill, redeposited organic matter
Bottom of weakly sandy organic mud (OA)	Trench 4	55–60	1490 ± 40	MKL-2813	A.D. 541–622	A.D. 430–648	This paper	
Bottom of clayey organic mud (bottom of OA)	Trench 4	85–90	2230 ± 50	MKL-2814	372–209 B.C.	396–186 B.C.	This paper	
Lamination of organic mud (CH)	Trench 2	60–65	2710 ± 60	MKL-2612	906–810 B.C.	996–797 B.C.	This paper	CH with Late Medieval potsherds
Lamination of organic mud (CH)	Trench 2	128–132	2990 ± 90	MKL-2613	1386–1088 B.C.	1433–976 B.C.	This paper	CH with Late Medieval potsherds
Top of coarse-detritus gyttja (top of PF)	Trench 4	90–95	3270 ± 40	MKL-2815	1610–1504 B.C.	1632–1449 B.C.	This paper	
Organic mud (bottom of OA—see remarks)	Drilling	65–73	5780 ± 80	MKL-2406	4721–4538 B.C.	4826–4457 B.C.	Kittel et al. (2015)	Top of PF
Bottom of gyttja (bottom of PF)	Drilling	110–120	5790 ± 90	MKL-2410	4766–4532 B.C.	4876–4450 B.C.	Kittel et al. (2015)	Late Medieval rettery relicts fill (?)
Top of gyttja (PF)	Drilling	83–90	6760 ± 80	MKL-2407	5732–5576 B.C.	5834–5527 B.C.	Kittel et al. (2015)	
Bottom of coarse-detritus gyttja (PF)	Trench 4	155–160	7110 ± 80	MKL-2816	6059–5903 B.C.	6207–5806 B.C.	This paper	
Top of clayey gyttja (PF)	Trench 4	160–165	7800 ± 50	MKL-2817	6688–6573 B.C.	6767–6496 B.C.	This paper	
Bottom of gyttja (bottom of PF)	Drilling	180–190	10,200 ± 120	MKL-2408	10,180–9667 B.C.	10,441–9445 B.C.	Kittel et al. (2015)	

(Continues)

TABLE I (Continued)

Dated Deposits or Material	Location of the Sample	Depth b.g.l. [cm]	Age 14C yr B.P.	Laboratory No.	Age cal ^{14}C Prob. 68.2%	Age cal ^{14}C Prob. 95.4%	References	Remarks
Bottom of clayey gyttja (PF)	Trench 4	175–180	10,380 ± 70	MKL-2818	10,446–10,175 B.C.	10,578–10,048 B.C.	This paper	
Bottom of gyttja (bottom of PF)	Drilling	205–215	10,810 ± 90	MKL-2959	10,836–10,710 B.C.	10,952–10,616 B.C.	This paper	
Bottom of gyttja (bottom of PF)	Drilling	235–245	10,930 ± 100	MKL-2960	10,960–10,767 B.C.	11,082–10,744 B.C.	This paper	
Bottom of clayey organic mud (bottom of PF)	Trench 4	205–210	11,070 ± 80	MKL-2819	11,082–10,890 B.C.	11,131–10,805 B.C.	This paper	
Bottom of clayey organic mud (bottom of PF)	Drilling	265–275	12,010 ± 120	MKL-2961	12,079–11,791 B.C.	12,200–11,618 B.C.	This paper	
Lamination of organic mud (CH)	Trench 4	190	12,720 ± 80	MKL-2820	13,337–13,083 B.C.	13,460–12,830 B.C.	This paper	

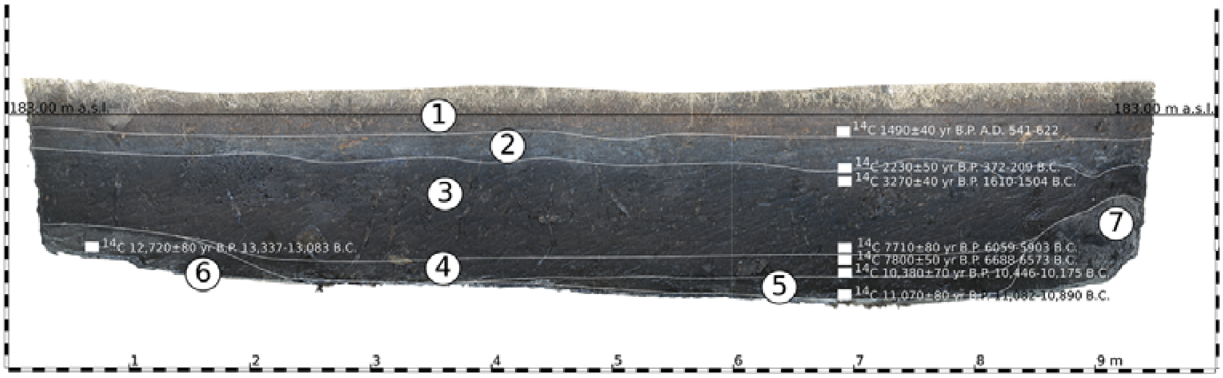
MF: fill main moat; MO2: fill moat no. 2; OA: overbank alluvia; PF: paleochannel fill; CH: channel alluvia; b.g.l.: below ground level.

the medieval fortress. Geophysical prospection revealed the presence of a strong curvilinear magnetic anomaly with a double arc shape in the western part of the stronghold. It was recognized as the trace of a large paleomeander of the Luciąża River. This is supported by the existence of a small depression periodically inundated, as recorded on the aerial photographs. In the eastern part of the survey area, narrow, linear, partly wavy, positive anomalies, and zones of positive point and point dipolar magnetic anomalies were documented. These were interpreted as a system of multiple, small paleomeanders (Kittel et al., 2015).

The fill of the large paleochannel (its width was about 10 m and the radius ca. 15 m) was studied within trench 4 (Figure 6). It consisted of organic mud in the lower part overlain by coarse-detritus gyttja and peat with well-preserved fragments of wood and other plant macrofossils. The thickness of the paleochannel fill reached up to 1.3 m (from ca. 0.9 to 2.1 m below the ground level) (Table I). It is underlain by channel alluvium of sands and gravels with plant detritus admixtures and laminations of organic mud (one of them dated to 12,720 ± 80 yr B.P.; that is, 13,337–13,083 B.C.; Table I) and overlain by overbank deposits of organic mud with sandy admixtures. The radiocarbon dates from the very bottom of the paleochannel (11,070 ± 80 yr B.P.; that is, 11,082–10,890 B.C.) and from the bottom of the coarse-detritus gyttja (10,380 ± 70 yr B.P.; that is, 10,446–10,175 B.C.) indicate a cutoff of the channel around 13,000–12,500 cal. yr B.P., that is, during the Allerød. The oxbow lake basin existed at least up to 3270 ± 40 yr B.P., that is, 1610–1504 B.C., as shown by the ^{14}C date from the top of coarse-detritus gyttja of the paleochannel fill. Since 2230 ± 50 yr B.P. (372–209 B.C.) or later—the date may be too old because of organic matter redeposition—in this case an overbank accumulation of organic mud with plant detritus that started within a periodically existing back swamp. The results of hand augering (Figure 2) show that organic mud covers a subfossil flood plain and it has a greater thickness within the paleochannels. Its deposition ended before the Middle Ages. It was followed by the deposition of sandy-silty overbank sediments and this took place after 1490 ± 40 yr B.P. (i.e., after A.D. 541–622), most probably in the Late Middle Ages or even in Modern Times. This is demonstrated in trenches 2 and 5, where the sandy-silty overbank deposits cover the remains of a Late Medieval rettery. The modern age of the accumulation of sandy-silty overbank deposits is confirmed by the ^{14}C date in the trench 5 of 110 ± 30 B.P., that is, A.D. 1693–1919. These deposits also cover layers with the Late Medieval artifacts and features in trench 5 (Figure 7).

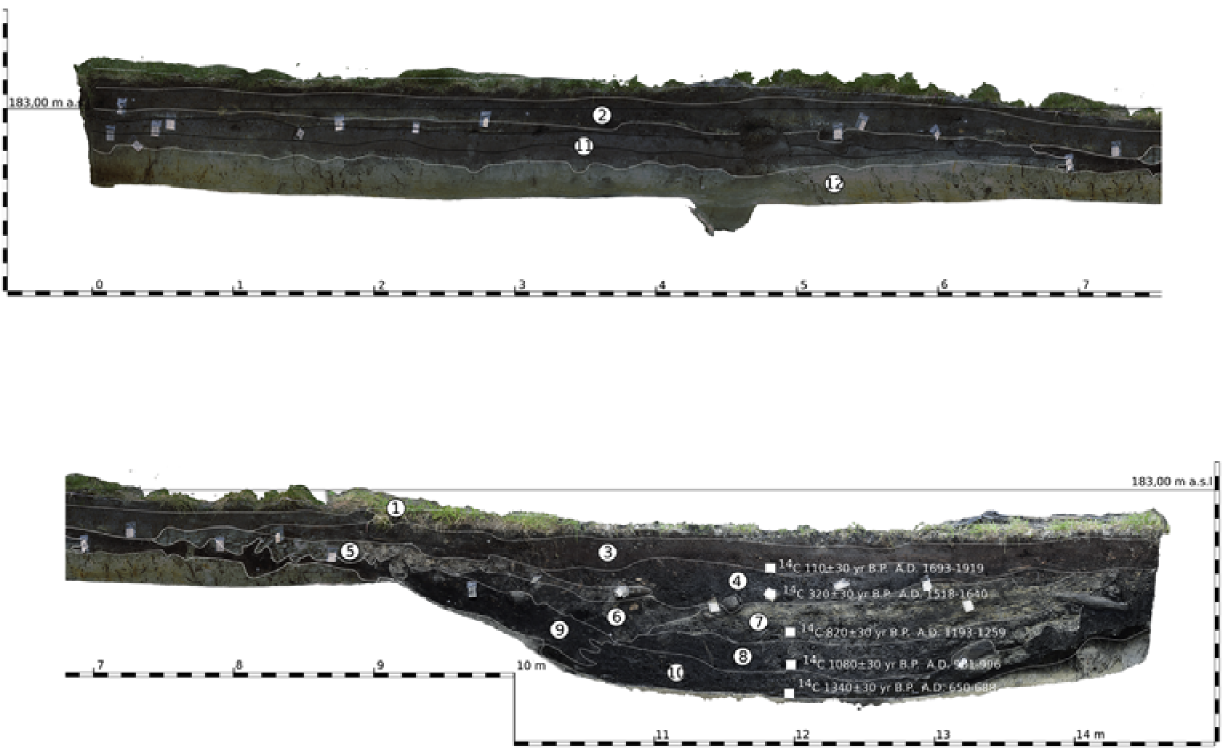
East of the stronghold, a complex of small paleomeanders was recognized from geophysical prospection and aerial photo analysis. Their occurrence was also confirmed from geological mapping, which documented the existence of channel alluvium with a depth of up to 2 m, and covered with overbank deposits of partly sandy organic mud. In places, small paleochannels exist with a depth of up to 1–1.5 m, filled with organic deposits, mostly peats and gyttja (Kittel et al., 2015).

One of these small paleochannels was excavated in trench 2. It was dated previously to the middle and late Holocene based on ^{14}C dates from bulk samples from the hand-augered core (Kittel et al., 2015). However, during the trench excavations, numerous wooden construction elements were recorded, such as horizontal trunks and vertical poles and rods. The oak poles were most probably related to the course



LEGEND:
1 – overbank sandy organic mud; 2 – overbank clayey organic mud; 3 – coarse-detritus gyttja and peat; 4 – clayey coarse-detritus gyttja; 5 – clayey organic mud; 6 – sands laminated with organic mud of point bars; 7 – Weichselian fluvial sands

FIGURE 6 The wall S of trench 4/2015—a cross-section of the paleochannel (photo and ed. by Sikora, 2015) [Color figure can be viewed at wileyonlinelibrary.com]



LEGEND:
1 – humic sands; 2 – overbank sandy organic mud; 3 – overbank organic mud; 4 - peaty organic mud, palaeochannel fill; 5 – sands laminated with organic mud, deluvium with numerous Late Medieval artifacts; 6 – sands with organic mud, palaeochannel fill with Late Medieval artifacts; 7 – sands with organic mud laminations, point bars with Late Medieval artifacts; 8 – organic mud with sandy laminations, palaeochannel fill with Late Medieval artifacts; 9 – organic mud; 10 – gyttja, rettery fill with Late Medieval artifacts; 11 – humic sands with charcoal, cultural layer with Late Medieval artifacts; 12 – sands of the Weichselian terrace remnant

FIGURE 7 The wall NE of trench 5/2016—a cross-section of the paleochannel (photo and ed. by Sikora, 2016). Stratigraphic units were marked in the field in the trenches with white patches with unit numbers visible on the sections [Color figure can be viewed at wileyonlinelibrary.com]

of a bridge or a platform from the 14th century (dendrochronological dates: from A.D. 1324 −7/+8 to A.D. 1366 −6/+8; M. Krąpiec, pers. commun.) and the rods to construction elements of an artificial water reservoir. The banks of that basin were probably reinforced with vertical stakes supporting the construction of braided, horizontal branches. The purpose of this reservoir is not yet clear—the limited extend of the trench allowed only partial recognition of this feature. It was unclear in the previous geophysical survey. It could be related to a mill sited nearby or may have performed other functions connected with linen and/or hemp production associated with the rettery, as confirmed by the preliminary plant macrofossils analysis of R. Stachowicz Rybka (pers. commun.). The reservoir was established within the river channel or the oxbow lake.

In the lower part of the trench, the channel alluvium was recorded, as point-bar deposits. They were partly excavated during the earthwork connected with the later erection of the tank. Numerous Late

Medieval artifacts were found within the point-bar deposits, which document the functioning of a river channel in this site in the Late Middle Ages. It must be stressed that the ^{14}C dates from organic mud laminations of channel alluvium were overestimated—they gave ages of 2710 ± 60 yr B.P. and 2990 ± 90 yr B.P. The transformed river channel or oxbow lake was adopted at the end of Late Middle Ages or the beginning of the Modern Period (ca. 360 ± 40 yr B.P., 1465–1628 A.D.) for a reservoir of mill and/or a rettery or for other purposes. In a later period (most probably in the 16th century AD) the artificial tank was filled with earthworks rich in medieval and modern artifacts and ecofacts.

The results obtained in trench 2 also confirm the accumulation of silty-sandy overbank deposits—with a thickness of up to 0.6 m over a wide area of the valley floor, as documented in geological mapping (Figure 2)—no earlier than in the 16th century AD.

One more paleomeander documented in the immediate vicinity of the stronghold was a very important element of the medieval landscape of the Luciąża River valley floor in the Rozprza motte surroundings. It closes from the east the terrace remnant occupied by the fortress complex. The geological structure and stratigraphy of the paleochannel were recognized previously by hand-auger boring and later confirmed in trench 5. The cover of overbank deposits reaches 0.5 m at this feature and it consists of sandy organic mud. Sandy slope deposits with medieval potsherds were revealed on the western bank of the paleomeander, which documents intense runoff in the immediate motte area. The organic fill of the paleochannel reaches up to 0.9 m in thickness and it was ^{14}C dated at its lower part to 1340 ± 30 yr B.P., that is, A.D. 650–688 (Figure 7). Based on those data, we assumed that the paleomeander, clearly visible on aerial photos as well as in the results of geophysical survey, and confirmed also in geological survey, was an oxbow lake in the Middle Ages, partly filled with slope deposits in the Late Middle Ages. In trench 5, numerous wooden construction elements, primarily vertical poles and rods, were recorded. The oxbow lake was used as a rettery in the Late Middle Ages, as confirmed by both radiocarbon dating of a wooden construction element (700 ± 40 yr B.P., that is, A.D. 1267–1381) and the artifacts found. The basin was later (after 110 ± 30 yr B.P., A.D. 1693–1919) filled with overbank deposits.

6.2 | The moat fill

Soil electrical resistance prospection revealed a relative decrease in soil resistance around the fortress's earthwork and the structure was recognized as traces of moat features. High resistance connected with an unknown exterior defensive feature of the stronghold was also recorded. In the western part of the study area, a very narrow, linear anomaly intersecting the large paleochannel was registered. It was also clearly visible as a crop mark on aerial images (Kittel et al., 2015, Sikora, Kittel, & Wroniecki, 2015b). Based on geological hand-auger coring and the spatial orientation toward the fortress, it was interpreted as a possible bridge or a causeway or dike. Based on the geophysical data, we estimate that the inner bailey was surrounded by two concentric ramparts and a main ambient moat (moat no. 1); the second, additional bailey surrounded by another rampart and the second, trapezoidal moat (no. 2) were located to the south. Both are partly visible in the relief, on aerial photographs, and in the earth resistance survey results, and were also confirmed by geological mapping (Kittel et al., 2015). A partial northern moat most likely also existed.

The geological survey with hand augering documented the existence of moats filled with organic (gyttja and peat) and partially inorganic deposits containing rich remains of wood and other plant detritus. The results correspond to various geophysical anomalies and also to the features documented by the previous archaeological research (Chmielowska, 1966, 1982). The medieval age of the documented features was evidenced previously by ^{14}C data of bulk samples collected from the bottom of moat fill with the use of a hand auger: 1080 ± 60 yr B.P., that is, A.D. 895–1017 and 1040 ± 60 yr B.P.; that is, A.D. 897–1038 (Kittel et al., 2015).

The fill of the moats was analyzed in detail in the archaeological trenches. Trench 1 revealed layers consisting of organic mud and peat, and a thin bottom unit of sand laminated with organic mud and wooden fragments. In the eastern part of the trench, poorly preserved wooden vertical posts were excavated. In the bottom part of the moat fill, numerous fragments of wood, mainly scrap and discarded pieces of destroyed timber constructions, as well as branches, were recorded. The fragments of wooden elements discovered at the very bottom of the moat in trench 1 were dendrochronologically dated to "after A.D. 1298" (M. Krąpiec, pers. commun.), while other elements found within organic deposits of the moat fill were dated to the 14th century.

Within trench 3 (Figure 8), the upper silty-sandy layers contained Early Medieval finds (mostly potsherds from the 11th to 13th centuries A.D.) and they covered the moat fill with organic mud, peat, and gyttja containing younger, 14th century artifacts. This situation must be understood as evidence of destruction of the western part of the stronghold mound in the 1940s, in this way the early medieval materials were redeposited.

In the trench 3, the main moat had a width of almost 21 m and a trapezoidal cross-section with a depth of more than 0.5 m, up to more than 1.1 m in its inner part (the greatest thickness of organic mud, peat, and gyttja). In trenches 1 and 1/1963, the moat was narrower, with a width of about 17 m. In this area (in trench 1), the presence of wooden constructions was recorded near the outer edge of the ditch in the form of poorly preserved, vertical timber poles. Such structures were not detected in trench 3. In both areas (in trenches 3 and 1/1963), two rows of vertical, sharpened wooden poles of a palisade, and horizontal beams lying behind them were excavated near the inner moat's slope. They formed a stockade-like structure, which was the very outer part of the earthen mound of the motte. These constructions, dated dendrochronologically to the 14th century (Figure 9), were covered in trench 3 with thick layers of slope deposits (various sized sands laminated with organic mud) from the rampart's earthwork. The presence of slope wash deposits was documented between the beams and below them, suggesting that originally the structure was only partially built with sand. It was covered later in the course of rapid depositional processes resulted from the intense surface runoff appearing on highly inclined slopes of the rampart and the moat. In addition, a large number of stones, pieces of burned clay, and pottery shards, redeposited from the earthwork by the slope processes, were detected in the vicinity of the constructions and within the slope deposits

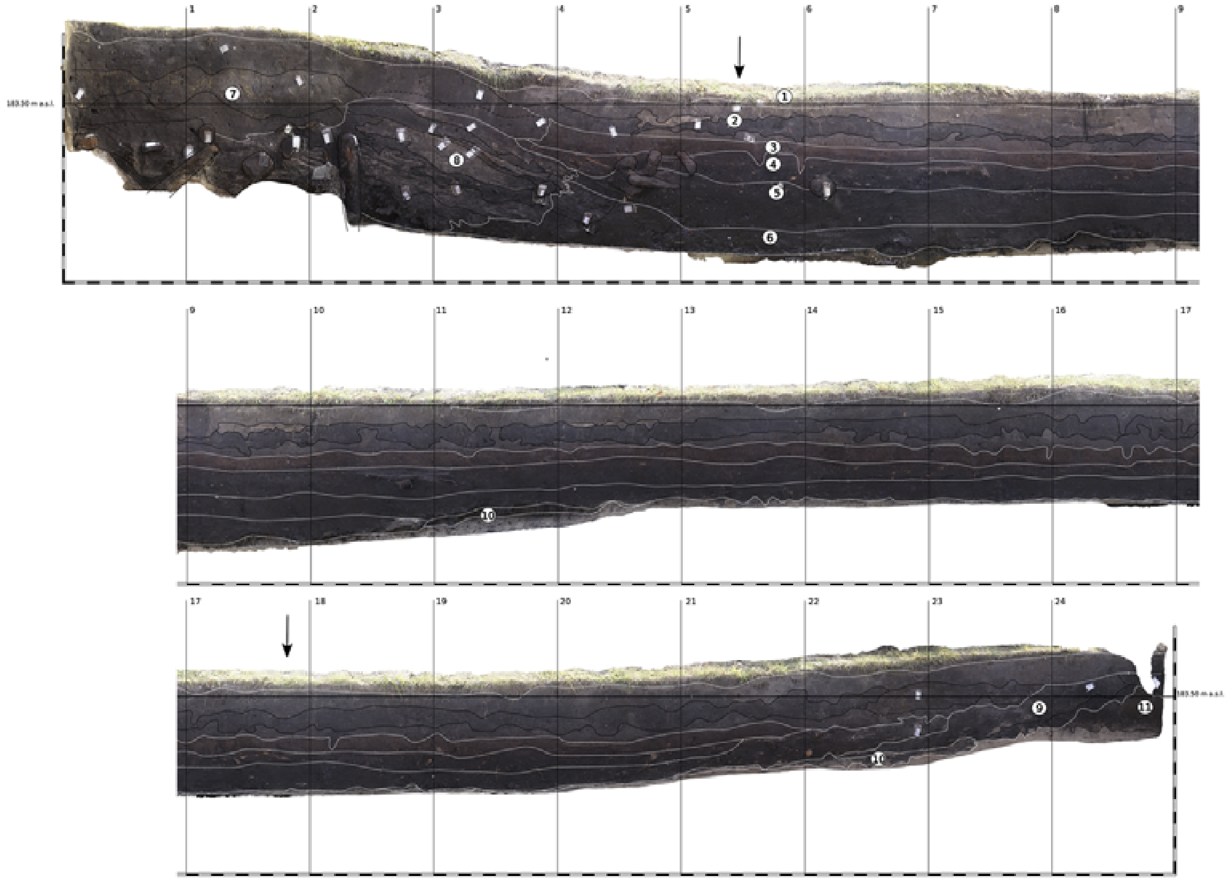


FIGURE 8 The wall SE of trench 3/2015—a cross-section of the main moat (photo and ed. by Sikora, 2015). Stratigraphic units were marked in the trenches with white patches with unit numbers visible on the sections [Color figure can be viewed at wileyonlinelibrary.com]

At the moat bottom, numerous secondarily discarded pieces of wood and other organic materials were recorded—one of them was dendrochronologically dated to A.D. 1329 (M. Krąpiec, pers. commun.). They were covered with gyttja containing a small number of artifacts. Numerous large chunks of wood, especially branches and boughs, in the upper unit of the moat fill (organic mud and peat) were typical for the area near to its inner slope. The fill of the main moat consists in trench 3 of organic mud with sandy admixtures and with numerous fragments of wood and roots as well (at a depth from ca. 30/35 to 55/60 cm below the ground level), peat with wood fragments (55/60–85/90 cm b.g.l.), coarse-detritus gyttja (85/90–120/125 cm b.g.l.), and clayey coarse-detritus gyttja with sandy admixtures (120/125–130/135 cm b.g.l.). The LST ^{14}C data obtained from the very bottom of the moat fill (1190 ± 60 yr B.P. and 1280 ± 50 yr B.P.) was too early when compared with the dendrochronological data set and the age of artifacts. AMS ^{14}C results on selected plant macrofossils provide more credible ages for the fill (715 ± 43 yr B.P., that is, A.D. 1259–1380; Table I, Figure 10). The artifacts found within the moat fill are not older than from the 14th century A.D. The overestimation of the ^{14}C dating of bulk material from bottom samples is explained as a result of the redeposition of organic matter and carbonates from older humic horizons and a cultural layer in the surroundings and slopes of the ditch. It also explains why dates that are too early were obtained previously for samples of organic deposits from the hand-auger cores. It must be stressed that correct interpretation was possible only during later excavation works.

Based on a set of radiocarbon dates and on an age/depth model, as well as dendrochronological dating and an analysis of pottery and other finds, we can estimate the creation of the moat to the second or rather third decade of the 14th century A.D. Changes in the type of deposition basin—from (partly) open water with gyttja to a swamp with peat accumulation took place most probably around A.D. 1500. These distinct changes in the depositional environment resulted in the accumulation of overbank organic mud and later sandy organic mud within the system of the moat ditches. This was initiated in the 18th or even 19th century A.D.—it could also be due to the degradation of the outer motte rampart, which allowed flood inflows into the moat. These results are also confirmed by paleoecological analyses (paper in preparation).

The second trapezoidal moat (no. 2) was recorded within an outcrop of the drainage ditch (Figure 11). This feature had a width of about 11 m and a depth of approximately 0.5 m. In the trapezoid cross-section it has a flat bottom. Wooden structures, similar to those observed in the main moat, were not found. The moat fill consisted of sandy organic

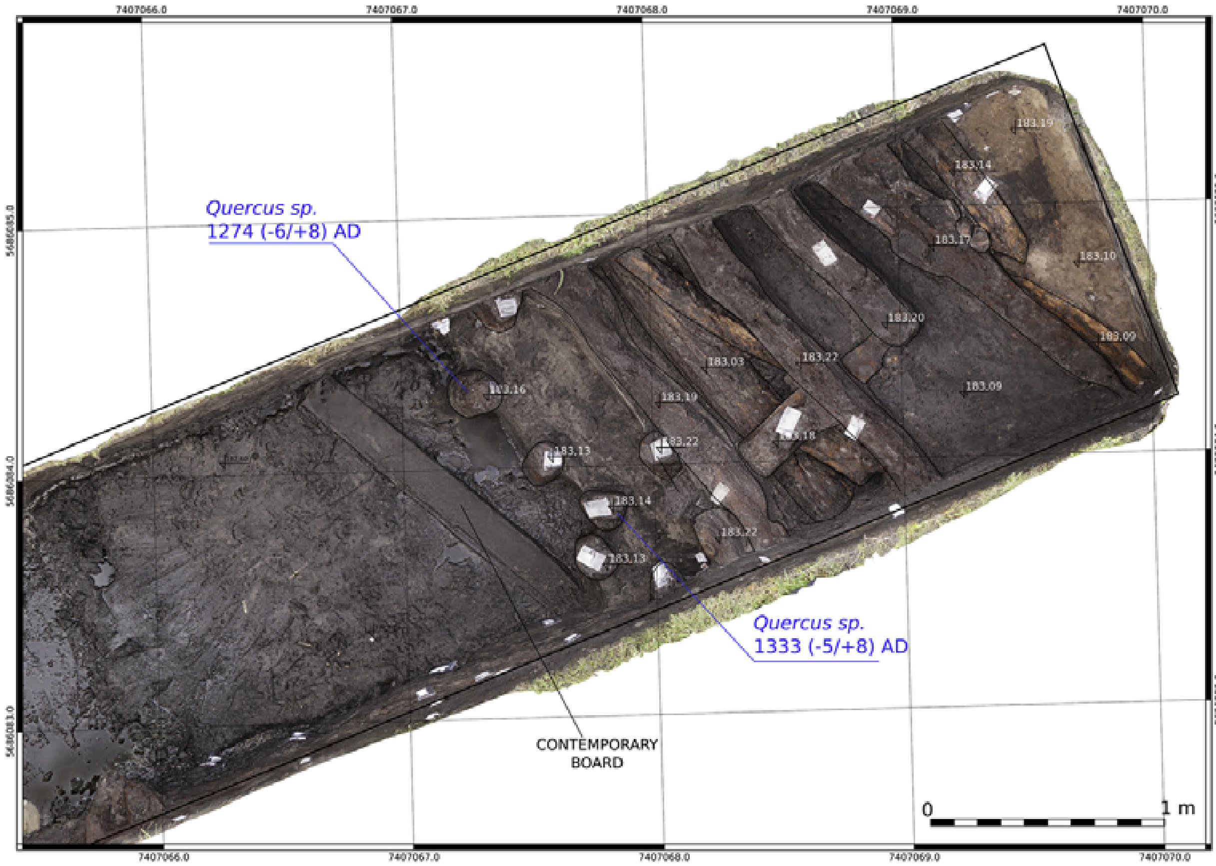


FIGURE 9 The eastern part of trench 3/2015 with traces of timber construction (photo and ed. by Sikora, 2015). Stratigraphic units were marked in the trenches with white patches with unit numbers visible on the sections [Color figure can be viewed at wileyonlinelibrary.com]

mud, clayey peat, and sand with organic mud at the very bottom and slope wash deposits on the moat sides. The age of the feature based on the ^{14}C data is 340 ± 50 yr B.P., that is, A.D. 1485–1634. The radiocarbon age indicates that moat no. 2 might have been built in the 15th or even the 16th century. The deposition of sandy organic mud was connected with flooding in the 18th–19th centuries A.D., based on the ^{14}C data from the top of the peat (80 ± 40 yr B.P., that is, A.D. 1696–1917).

6.3 | The reconstruction of the fort

The context of the mound studied in the reexcavated trench 1/1963 was not especially clear. Its western part was totally destroyed during intense earthworks in the 1940s. The preserved mound is multiphased: constructed with remains of the Early Medieval earthen ramparts, with traces of later enlargements and rebuilding in the 14th century, most probably in the shape of the conical mound of the motte. Several strata can be interpreted as the Late Medieval earthwork overwhelming the inner courtyard of the earlier ring-fort. They were recognized along with a pit filled with a set of stones and clay layers, as well as traces of burnt wood. This stratigraphical complex must be interpreted as the remains of timber building foundations, which were set on the top of the motte mound. The exact reconstruction of this building is not possible, but on the basis of analogies, we can assume that it was a timber tower.

The research carried out so far has permitted us to propose a reconstruction of the 14th–15th century A.D. fort situated in the valley floor of a small-sized lowland river. It was a large and complex structure of a motte-and-bailey type. Its central part was a conical mound with an oval base of about 33 × 39 m dimensions, based (partly) on an older ring-fort rampart, with a height of approx. 3.6 m above the level of the surrounding area. A solid wooden structure was built at the top of the mound, perhaps in timber-frame or log construction, set on a "foundation" of clay and stones. It is not clear whether it was the only structure at the top of the earthwork. It is also not clear whether it was related to any additional fortifications that might have protected the mound platform. Without a doubt, at its base the wooden-earth structure was composed of double vertical lines of timber poles and related horizontal beams. They strengthened the inner slope of the moat that was 17–21 m wide and up to ca. 1.1 m in depth. The moat was an open water basin (in the 14th–15th centuries A.D.), fed by groundwater, and also by surface runoff. The fortress was situated on the river terrace remnant that was elevated no more than about 1 m above the surrounding valley floor and covered by organic mud and with numerous abandoned channels. The moat was surrounded by a rather small circular rampart. At least in the eastern part of the moat, its outer slope was reinforced with vertical, wooden poles.

The complex was surrounded both from the north and the south by other moats—most probably from the 15th century A.D. The southern moat is better recognized: it is 17.5 m wide and up to 0.5 m deep.

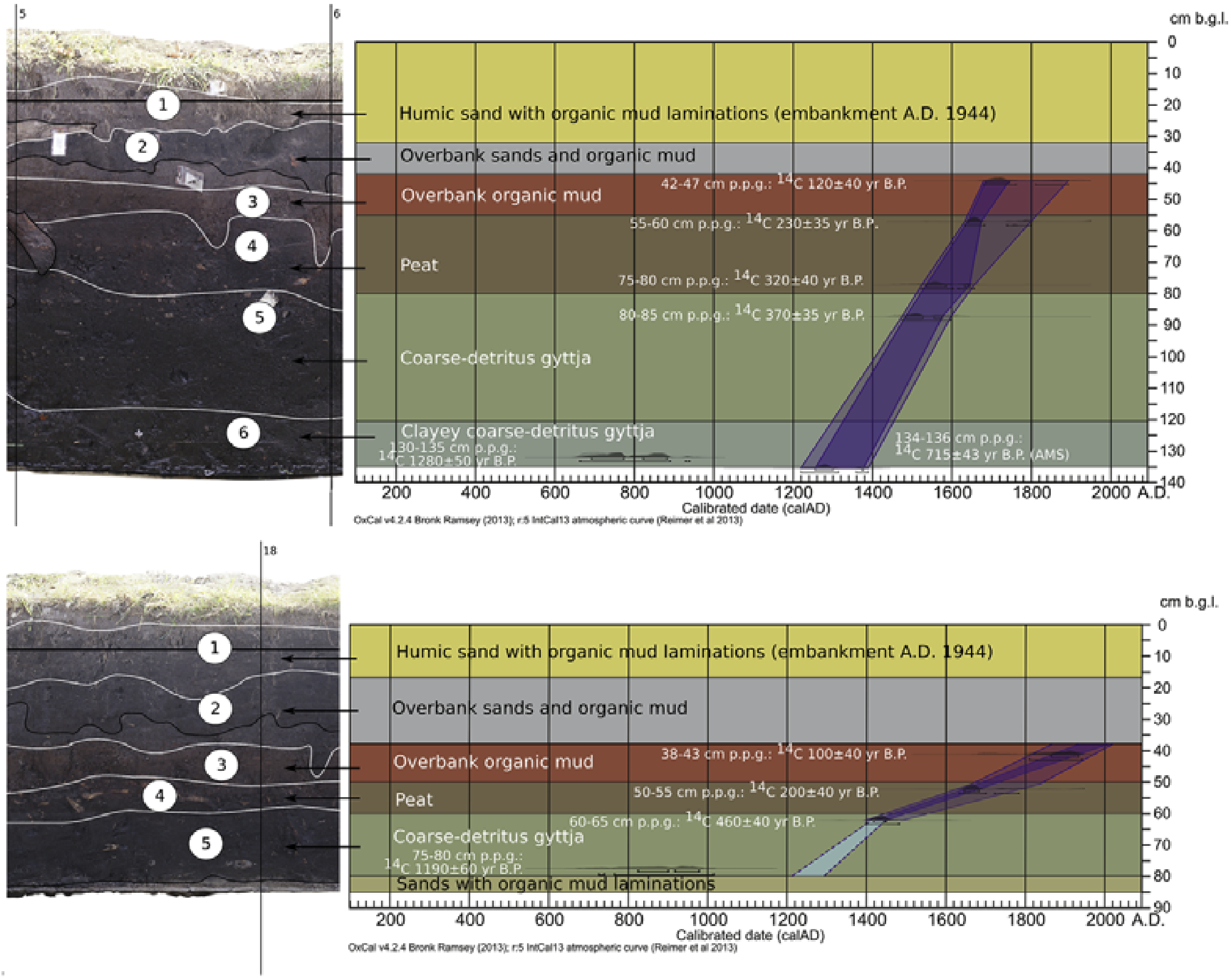


FIGURE 10 The depth/age model for the main moat fill (see Figure 8) [Color figure can be viewed at wileyonlinelibrary.com]

It delimited a kind of trapezoidal platform of 1052 m^2, of which the longer side (approx. 64 m long) is attached to the rampart. The platform was probably occupied by numerous features accompanying the motte, constituting a kind of bailey. It is not clear whether the platform was enclosed with a rampart from the south. In an electrical resistance survey, a zone of higher resistance, similar in characteristics to the anomalies representing the previously described circular rampart, was observed here. This may suggest that there was also a similar defensive construction. From the east, another smaller and semicircular platform adjacent to the rampart was recognized. It was partially excavated during the research in the 1960s. Relics of wooden buildings and the type of wooden fencing consisting of vertical poles and horizontal beams running along the edge of the platform were recognized.

To the south of moat no. 2, along its edge, another rampart might have been raised. It was also recognized in the form of higher anomalies during the earth resistance survey. Behind it, another, most probably an open bailey, occupied a semicircular terrace. From the west of the fortress, a long linear embankment, possibly a causeway or dike, was recognized in aerial photos and in the geophysical survey. It is also still visible in the field. In place of its connection to an external, circular rampart, a rectangular anomaly was observed in soil electrical resistance and GPR surveys. It is probably a relict of a wooden structure of a gate. We can suppose that a similar feature might have been situated on the eastern side of the fortress, leading in the direction of the bridge across river channel or oxbow or artificial reservoirs, possibly related to a mill or a rettery. A number of large vertical poles excavated in this place indicate that a bridge might have been constructed here in the second part of 14th century A.D., helping to cross the swampy Luciąża River valley floor (Figure 12).

7 | DISCUSSION

This reconstruction shows that the stronghold occupied an area of 1.3 ha, and was a feature of a significant scale, surpassing most of similar private residences from the Late Middle Ages in the Polish Lowland. The scale of this fortress exceeds the average size of motte-type residences belonging to the medieval nobility in Central Poland. For example, the recently excavated motte in Gieczno seems to be similar to the one in Rozprza in many respects—with a central mound, a circular moat, an outer rampart, and an additional bailey, and an area of about 0.42 ha. In many cases, these residential complexes were limited to a mound of a diameter usually between 30 m and

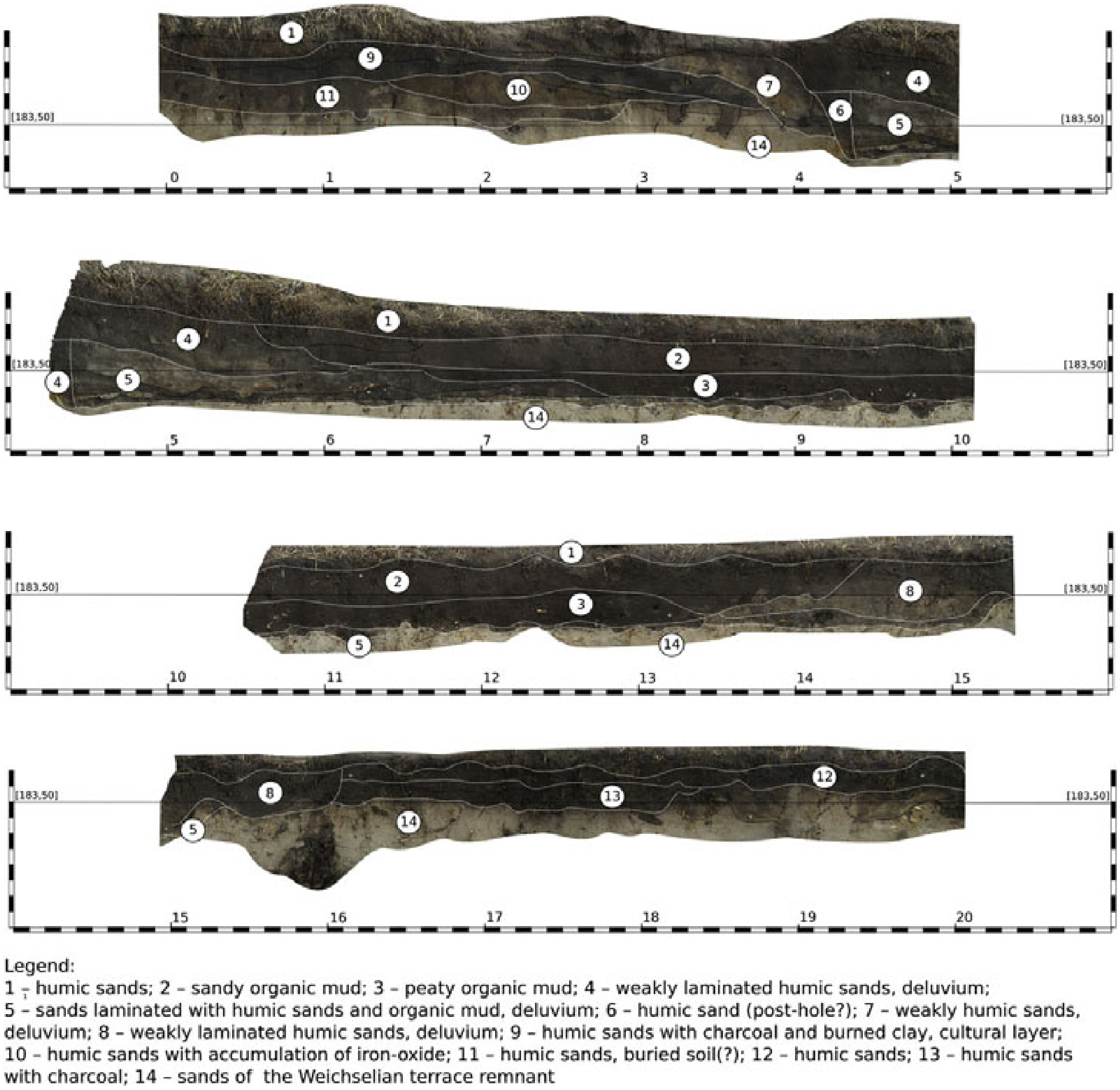


FIGURE 11 The wall of the drainage ditch, sections from 1 to 4 (see Figure 4). A cross-section of moat 2 (photo and ed. by Sikora, 2015) [Color figure can be viewed at wileyonlinelibrary.com]

60 m, with a timber tower or a manor on top, often without additional moats or ramparts, so their habitable areas were even smaller (e.g., Marciniak-Kajzer, 2011). Such a large area and a complex layout were usually restricted to residences constructed by a small group of the elites. In many cases, they were older strongholds of the ring-fort type rebuilt in the Late Middle Ages by modifying the mound to the shape of the motte.

The feature in Spicymierz was built in the form of an ovaloid ring-fort, of an area of 1.3 ha, inside which a motte mound was developed in the 14th century, with a diameter of about 64 m (Poklewski, 1975). It is very likely that the construction could have been an initiative of Paweł Ogon, the capintaneus (starosta), later the castellan, and subsequently the governor of the Łęczyca Province, and also one of the most influential magnates in the reign of the king of Poland Władysław I the Elbow-high (Bieniak & Szymczakowa, 1985). It cannot be excluded that the Spicymierz motte was the foundation of Jarosław Bogoria Skotnicki, Archbishop of Gniezno, who received a village with a stronghold from king Kazimierz the Great in A.D. 1348. The older fortress in Błonie-Rokitno, containing a mound with a diameter of about 35 m, built on the outer rampart in the 13th century, was also similar. The area of that motte-and-bailey complex was also 1.3 ha (Kiersnowska, 1971).

The stronghold in Błonie was a residence of prince Konrad I of Masovia who died in A.D. 1247. Konrad himself could be recognized as one of promoters of motte-type residences in medieval Poland, as he was a founder of several such fortresses in the first half of the 13th century A.D. The construction of the defensive residence in Rozprza was a result of the status of its owners—representatives of one of the major noble families in Central Poland from the 13th to 16th centuries A.D.—Nagodzice-Jelitczycy (Potkański, 1924; Zajączkowski, 1961).

The geological and geomorphological survey of the Rozprza stronghold area confirms the conclusions of Goździk (1982) about the very favorable location of the defensive structure on the surface of the sandy Plenivistulian terrace remnant protected by the surrounding swampy areas. However, our research allows more detailed

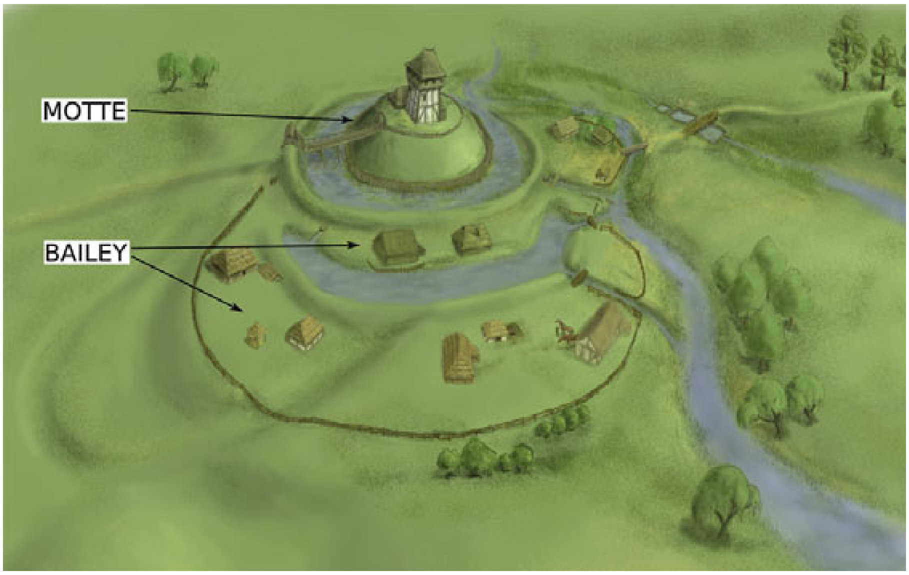


FIGURE 12 The reconstruction of the motte in Rozprza within the paleolandscape in the14th–15th century A.D. (drawn by Sikora) [Color figure can be viewed at wileyonlinelibrary.com]

recognition of the morphology of the immediate vicinity of the Late Medieval motte. Our results evidence a different paleoenvironment in Rozprza in the Early and Late Middle Ages compared to the previous research in this area (Goździk, 1982) and in other strongholds in Central Poland (Dunin-Wąsowicz, 1974; Forysiak et al., 2015; Krzemiński, 1970, 1987; Kurnatowski, 1963, 1968, 1975). The previous studies usually document the necessity of removal of early medieval settlements from valley floors, as a result of paleohydrological changes, and the location of new Late Medieval colonies in upper, elevated parts of valleys and also on plateaus. In the 14th–15th centuries A.D., the motte in Rozprza occupied a very low hillock of the terrace remnant in the central part of an extensive valley floor. As confirmed by the latest dendrochronological data, the site was redeveloped, probably temporarily, after a period of withdrawal, in the 16th century. Clear traces of intense earthworks in the valley floor, which are still visible in the relief, (partly) dated to the Late Middle Ages were recognized. The Luciąża River flood plain represented the inactive meandering channel style after Lewin (2010), with a rather stable channel or two to three channels and with a number of hillocks of the Plenivistulian terrace remnants. Those dry sandy terraces were suitable for crossing the Luciąża River flood plain (Figure 1).

The paleoecological study of the moat fill shows the presence of shallow stagnant water in the first period of existence of a ditch but evidence of small brief floods (or rinsing of the moat) was also recorded. The transformation of the limnetic environment of the moat into the telmatic habitat took place abruptly at the beginning of the 16th century A.D. Evidence of drier conditions was documented for the 16th century A.D. Geological evidence of overbank deposition in the moats is recorded as late as in the 18th century. There is no record of alluviation in the Luciąża River flood plain in Rozprza from the beginning of the Little Ice Age, as confirmed in numerous river valleys in Poland (Alexandrowicz, 1996; Dunin-Wąsowicz, 1974; Florek et al., 1998; Gębica et al., 2013; Goździk, 1982; Kalicki, 1996, 2006; Kamiński, 1993; Kittel, 2013; Klimek, 2002; Klimek & Latocha, 2007; Krzemiński, 1987; Latocha, 2009; Pawłowski et al., 2015; Starkel, 2002; Starkel et al., 2013; Wachecka-Kotkowska, 2004b), Central Europe (Gębica et al., 2013; Hoffmann, Lang, & Dikau, 2008; Kalicki, 2006; Notebaert & Verstraeten, 2010), and also Western Europe (Hoffmann et al., 2008, 2010; Kaiser et al., 2012; Lewin, 2010; Macklin et al., 2006, 2010; Notebaert & Verstraeten, 2010; Robinson, 1992; Rumsby & Macklin, 1996—older references within).

Historical records from the 11th to 15th century A.D. about floods in Poland (see Rojecki, 1965) and the whole of Central Europe are very rare, but they are more commonly encountered since the 16th century A.D. (Kaiser et al., 2012). Glaser et al. (2010) identified four periods of increased flood frequency of Central European rivers dated to: A.D. 1540–1600, 1640–1700, 1730–1790, 1790–1840, which correlated with climatic fluctuations during the Little Ice Age. The second and fourth period with peaks in the 1660s and 1830s are present very clearly in the Vistula River system. The 18th century alluviation of the Luciąża River valley can be correlated with the third (between A.D. 1730s and 1790s) or fourth (from A.D. 1790 to A.D. 1840) period of increased flood frequency after Glaser et al. (2010). Simultaneously, we recorded a rather dry phase in the 16th century, while evidence of numerous floods was noted mainly in the second half of that century and attributed to higher precipitation (Brázdil et al., 1999; Mudelsee, Börngen, Tetzlaff, & Grünewald, 2003), including in the Vistula River basin (Glaser et al., 2010). The earliest historical information about floods in the Rozprza area is from A.D. 1677, but for Rozprza as late as from 1843/1844 A.D. (Żerek-Kleszcz, 1989).

8 | CONCLUSION

The total area occupied by the fortification system of the motte in Rozprza spanned about 1.3 ha. It was one of the largest forts of this type in Central Poland and it functioned as a residence of one of the major noble families in the medieval Polish Kingdom. The Rozprza motte was situated in a defensive location on a sandy terrace remnant in the central part of a (partly) swampy valley floor. It was developed from the 20s to 30s of the 14th to probably the 15th century, with a short-term episode of redevelopment in the 16th century A.D. No distinct paleoenvironmental changes in the valley floor were recorded for that time that might have caused the deterioration of conditions for the motte complex development at the beginning of the Little Ice Age. For the Luciąża River valley in Rozprza, an intensification of overbank deposition has been recognized in our study for the period after the 15th century, and most probably not earlier than from the 18th century A.D. Therefore, the Luciąża River valley floor might have been intensely occupied during the whole of the Middle Ages and Early Modern Times. More stable conditions in the early phase of the Little Ice Age must be related to local conditions of paleoenvironmental evolution of the mid-Luciąża River valley in that time.

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ORCID

Piotr Kittel http://orcid.org/0000-0001-6987-7968

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