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Piotr Wroniecki*, Roman Brejcha**,
Jerzy Sikora***

Knowing Without Digging? Non-invasive Research of the Krzczonów Earthwork and its Surroundings

ABSTRACT

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The topic of this paper is a non-invasive research case study of a protected monument mound in Krzczonów, Świętokrzyskie voivodeship in Lesser Poland. It explores the possibilities of non-invasive methodological approaches in the recognition of archaeological sources by asking whether it is possible to procure relevant information without conducting excavations. A new interpretation of the mound's function and chronology is based on data derived from multi-method field surveys including remote sensing (satellite imagery, UAV, light aircraft, ALS), geophysical (magnetic gradiometry, earth resistance), total station measurements and analytical field walking prospection along with comparison of archival field-walking data. We would like to hypothesize that, contrary to the protected monument list, the Krzczonów earthwork is not a prehistoric feature but could be related to the end of 14th up to the beginning of the 16th century. In this case it could be understood as a remnant of a motte-type castle.

Key words: Krzczonów, non-destructive archaeology, motte-type castle, Late Medieval Period, Early Modern Period

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Introduction

The topic of this paper is research focused on a protected monument and archaeological site in Krzczonów, Świętokrzyskie voivodeship (fig. 1). The area is situated in the eastern tip of Proszowice Plateau which is a coherent part of the Lesser Poland Loess Upland. It is a fertile area covered by chernozem. The most prominent feature of the Krzczonów site, and the only one preserved in topography, is an earthwork mound in the middle of an arable field. It is situated on the southern terrace of the Dobrula small river valley. The earthwork itself is poorly preserved,

* Institut of Archaeology, University of Wrocław, Szewska 48 Street, 50-139 Wrocław, Poland; piotr.wroniecki@gmail.com
** Institute of Archaeology of the Czech Academy of Sciences Letenská 4 Street, 118 01 Praha 1, Czech Republic; brejcha@arup.cas.cz
*** Institute of Archaeology, University of Łódź, G. Narutowicza 65 Street, 90-131 Łodź, Poland; jerzy.sikora@uni.lodz.pl

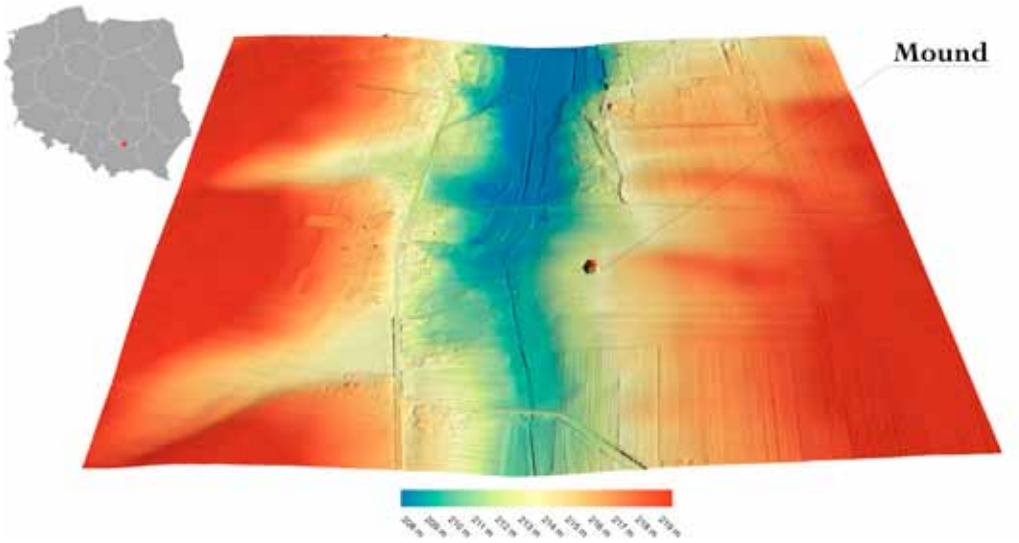

Fig. 1. General three-dimensional view of the Krzczonów landscape based on ALS (ISOK) data. View from the West

approximately 20×20 m in area and 7.5 in height, with very visible signs of natural and anthropogenic erosion.

The mound was added to the national protected cultural heritage monument list in 1986 as a prehistoric barrow (INSPIRE ID: PL.1.9.ZIPOZ.NID_A_26_AR.21851)[1] In Poland this register represents the highest form of legal protection of heritage monuments. The Polish Archaeological Record (Konopka 1981) program (polish: "Archeologiczne Zdjęcie Polski", henceforth abbreviated to AZP), functions in parallel with the register and includes data collected with the prominent use of field-walking. The AZP field survey for Krzczonów (site nr 146, grid 97–63) was carried out in 2004. The acquired AZP data revealed pottery finds in its vicinity dated to Early Medieval (4 sherds)[2] and Early Modern (51 sherds) periods, which is somewhat contradictory with the register.

[1] The register is accessible at the web address: https://danepubliczne.gov.pl/dataset/rejestr-zabytkow-archeologicznych/resource/e50443ee-a891-4a92-9b11-a67ac8667173 [access: 9.11.2017].

[2] However, Early Medieval dating of these four sherds could raise doubts, because according to AZP card dating has been based on surface decoration which is in form of stamp (1x) and engraved wavelet line (3x). Both ornamental elements are known from Late Medieval period as well and as far as wavelet line is concerned, it was found on Late Medieval ceramic material e.g. in nearby site of Łysokanie (Sztyber

This confusing situation regarding the chronology and past function of the mound provides a good example of the shortcomings of field-walking data and hence poses a valid research question: exactly what type of monument is being protected? The answer is important in regard to the archaeological understanding of the area and has impact on heritage management requirements. Barrows and Late Medieval/Early Modern mounds are places that may for instance require different protections schemes.

It was thought that this problem may be solved through the recognition of archaeological features in its immediate vicinity. In other words, to find out if this anthropogenic structure with topographic relief is a part of some broader archaeological component, which could reveal information about its former function and purpose. To facilitate these aims (and at the same time not cause further destruction of the archaeological site through large-scale excavation) research has been based entirely on non-invasive approaches. The theoretical and methodological framework of this approach has been described in earlier papers (Brejcha, Wroniecki 2010; Wroniecki 2016). Survey work has been taking place intermittently since 2008. Initially on a voluntary basis and also as part of larger field-walking surveys of the University of Warsaw (see Brejcha, Wroniecki 2010; Dulęba *et al.* 2015) and subsequent aerial surveys were undertaken between 2010–2014 as part of the *Prospekcja Małopolska* project (Wroniecki, Maksymowicz 2014). Since 2015 research is taking place as part of The *Hidden Cultural Landscapes of the Western Lesser Poland Upland Non-destructive methods applied to settlement studies* project funded by a National Science Centre research grant (Wroniecki 2016, Wroniecki 2017).

Methods

Since the beginning the research methodology has been fully based on the acquisition of data through non-invasive techniques, including remote sensing (freely available satellite imagery and airborne laser scanning), aerial prospection from a light-aircraft and unmanned aerial vehicle (UAV), geophysical methods (earth resistance and magnetic gradiometry), precise geodetic-topographical measurement

2014, 282) and also during our field survey here in Krzczonów (see below, fig. 8:8). Furthermore, none of our 569 sherds is of Early Medieval dating.

and finally analytical surface artefact collection and a small metal detector survey. These methods have been applied progressively, considering their availability, in order to maximize their effectiveness and mutual complementarity. As has been emphasized many times, integrated approaches to archaeological prospection are necessary to generate reliable information for understanding and management of archaeological sources (cf. Gojda 2004; Cowley 2011; Rączkowski 2011).

Remote sensing techniques were initially used to carry out a preliminary assessment of the study area, its topography and environmental conditions and to document the state of preservation of the mound. The initial phase of research in 2008 consisted of analyzing freely accessible satellite images from Google Earth (http://earth.google.com). This provided basic information about the site and its surroundings, such as the shape and the extent of area and the earthwork itself, the presence of potential crop marks and contemporary land-use of the site and its accessibility. Airborne laser scanning (ALS), as another remote sensing technique, was applied at a later stage. In 2008 ALS data for Poland was not available and the technique itself mostly unknown. Nowadays this method is being employed among the first prospection tools in landscape research mainly due to its general availability. At the beginning of our field research, in 2009, we created a Digital Terrain Model (DTM) through precise total station height measurements tied to national reference points (fig. 4) in order to document the state of preservation of the mound, which has been liable to destruction owing to both anthropological (ploughing, soil extraction) and natural (erosion, bioturbation) factors. From 2015 we have used a DTM (fig. 3) that was interpolated from a point cloud (in the form of LAS-format files)[3] and visualized using the Relief Visualization Toolbox (Kokalj *et al.* 2013). We used the multi-hillshade, hillshade, slope and Sky View Factor visualization techniques.

Aerial prospection from a light, two seater, and high-wing aircraft has been carried out systematically with at least one survey annually since 2010. Most flights were carried out in late June or early July with 58 flight hours having been completed up to 2017. A DSLR camera synchronized with a handheld GPS unit was used to take oblique and near vertical photographs.

[3] ALS data were obtained from the Polish Geodetic and Cartographic Documentation Centre. More information is available at the website: http://www.codgik.gov.pl/index.php/zasob/numeryczne-dane-wysokosciowe.html [access: 9.11.2017].

The first geophysical survey over an area of approximately 0.32 ha was carried out in 2009 using the earth resistance technique in a 1 m spacing twin-probe configuration with a spatial resolution of 1×1 m. Another 0.72 ha survey was carried out in 2016 with the use of a 0.5 m spacing Wenner array. Magnetic gradiometry prospection over a 5 ha area took place in 2015–2017 with a 1×0.12 m sampling interval. The survey will be continued. Tests were also carried out with the use of total-field magnetic intensity measurements with an Overhauser instrument. The geophysical survey is aimed at large-scale prospection and recognition of archaeological sources and has been the most successful method in understanding the intensity and type of archaeological features hidden within the Krzczonów landscape.

Detailed surface artefact collection was conducted to complement the geophysical survey. Surface collection for prospection purposes was not carried out at the beginning of the research and is included in the workflow of methodical approaches. Establishing an appropriate overall chronology of the site was not the only aim of surface collection. We also wanted this method to contribute to the understanding of structure, characteristic and spatial extent in particular temporal and cultural levels of the site. These aims would be impossible to carry out using the traditional – so called synthetic – field walking approach ("site search") that is why we chose an analytical approach. It is conducted along artificial, regularly spaced units, being considerably smaller that the estimated structure. This resulted in quantitative data being collected that are mutually comparable. The collection takes place in a standardized form and intensity, maintaining a fixed spacing and direction. All finds are collected, not just a subjective selection. Data obtained this way facilitates a proper independent evaluation of the archaeological finds compared to the original model (see Kuna 2001, 28–30; Kuna 2004, 324–333). From the spectrum of systematic field walking methods we have chosen collection on a square grid, which allows a detailed analysis on the distribution and density of surface finds in a chosen area (Kuna 2004, 330–331). In Krzczonów, an area of 3.78 ha around the earthwork mound was divided into 42 square grids, each 30×30 m in size. Survey was undertaken on freshly ploughed soil without any crops, at quite high intensity with 10 field workers. Survey lines were 3m apart.

It is important to note that this research approach is in direct contrast to the established AZP procedures, which included either, more (non-

analytical) field-walking, without the possibilities for quantitative and spatial analyses or some form of archaeological excavations. The latter are of course deemed the definitive approach to recognition and protection of archaeological sites – despite their invasive nature. Hence our applied research approach challenges established modes of practice in the recognition of archaeological sites in Poland.

Data assessment

Despite annual aerial prospection surveys, no crop or soil marks were ever registered in the vicinity of the mound (fig. 2). This was caused by a mix of high soil moisture and unfavorable crops such as sugar beets. Satellite imagery was successful in capturing crop growth differences interpreted as remnants of a past road system (see Brejcha,

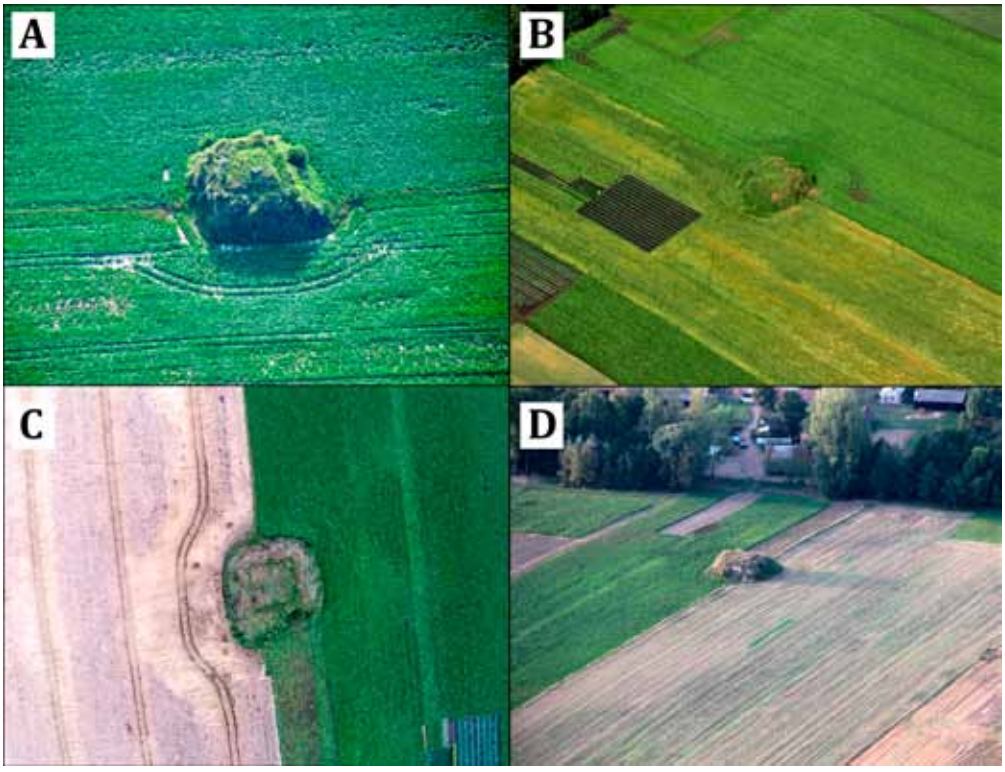

Fig. 2. Krzczonów. Selected results of aerial prospection surveys. Top left: Airplane, 09.07.2012. Top right: Airplane, 06.07.2016. Bottom left: UAV, 25.07.2015. Bottom right: Airplane, 25.09.2015

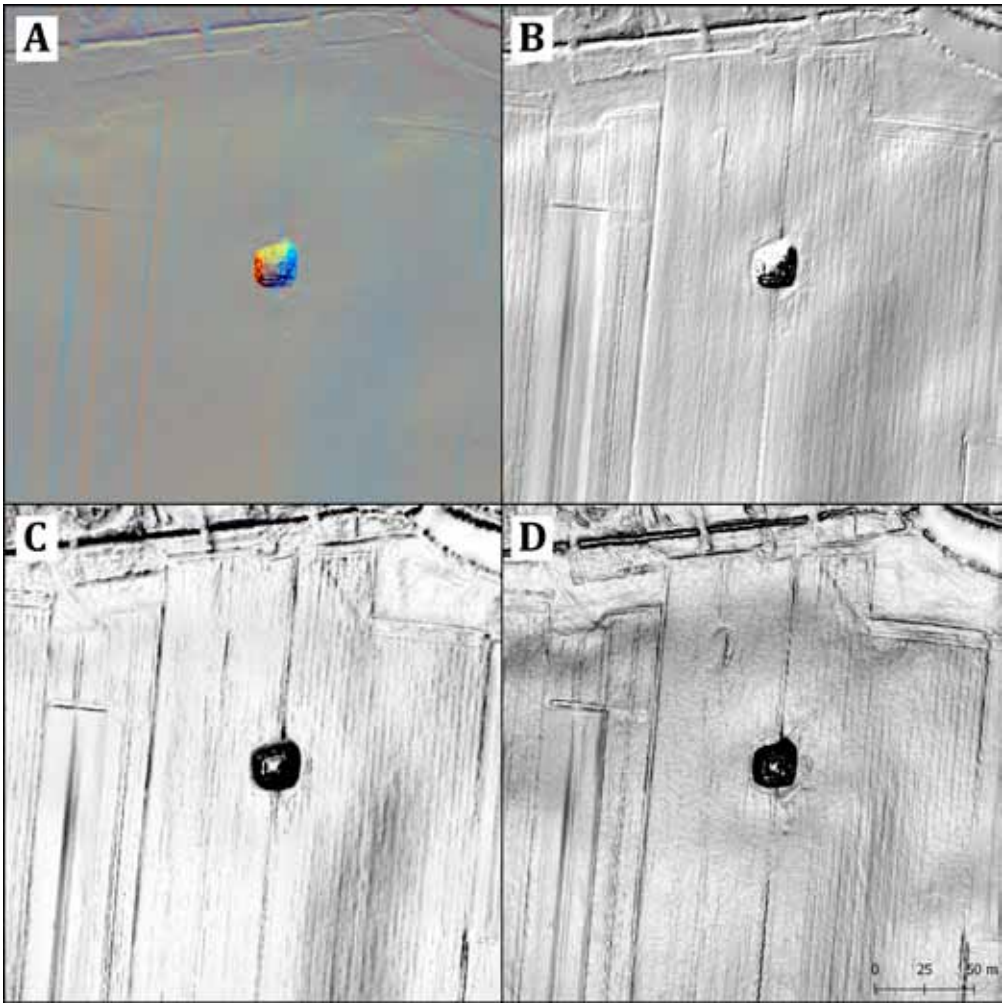

Fig. 3. Krzczonów. Visualizations of reclassified ALS (ISOK) data. A) Multi-directional hillshade B) Hillshade C) Sky view factor D) Slope. North at the top

Wroniecki 2010, 374–376 and Brejcha 2010, 66–67). Aerial imagery, geodetic measurements (fig. 4) and airborne laser scanning (fig. 3) has been an effective way of documenting the mound's rather low state of preservation and visible rectangular structure on its summit. This feature may be indicative of the possible remains of a masonry (?) foundation of the tower structure that were either dismantled for other use or destroyed by WW2 activities in the area.

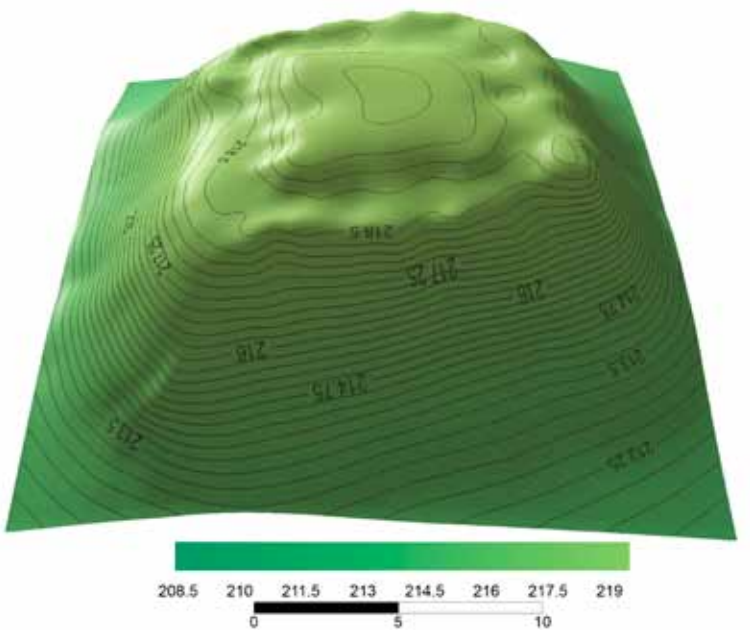

Fig. 4. Krzczonów. Visualization of 2009 total station survey. View from the south. Contour line step is 0,25 m. Altitude scale is in meters a.s.l. Size scale is in meters

The small-scale 2009 twin-probe earth resistance survey revealed a low resistance area in the immediate vicinity of the mound which was interpreted as a remnant of a possible moat (fig. 5). The 2016 survey unfortunately did not reveal any archaeologically significant anomalies. Earth resistance results are strongly influenced by soil moisture indexes, in the same manner as the appearance of crop mark. Another explanation is that the only variable that was changed was the electrode configuration to a 0.5 m Wenner array giving a shallower depth of investigation compared to a 1 m array. A slow rate of data acquisition compared to other techniques, soil moisture dependence and field availability (uncontrollable variables) are direct factors in our conclusion that earth resistance surveys should not be regarded as a prime geophysical method for the recognition of features in the Krzczonów landscape.

The results of the magnetic gradiometry survey resulted in the most significant data spatially and qualitatively (fig. 6). Numerous anomalies were registered in most of the area, including natural closed depressions, local soil changes, contemporary field manuring (as dipolar

Fig. 5. Krzczonów. Location and visualization of 2009 Twin-probe (1m spacing) earth resistance survey. North at the top

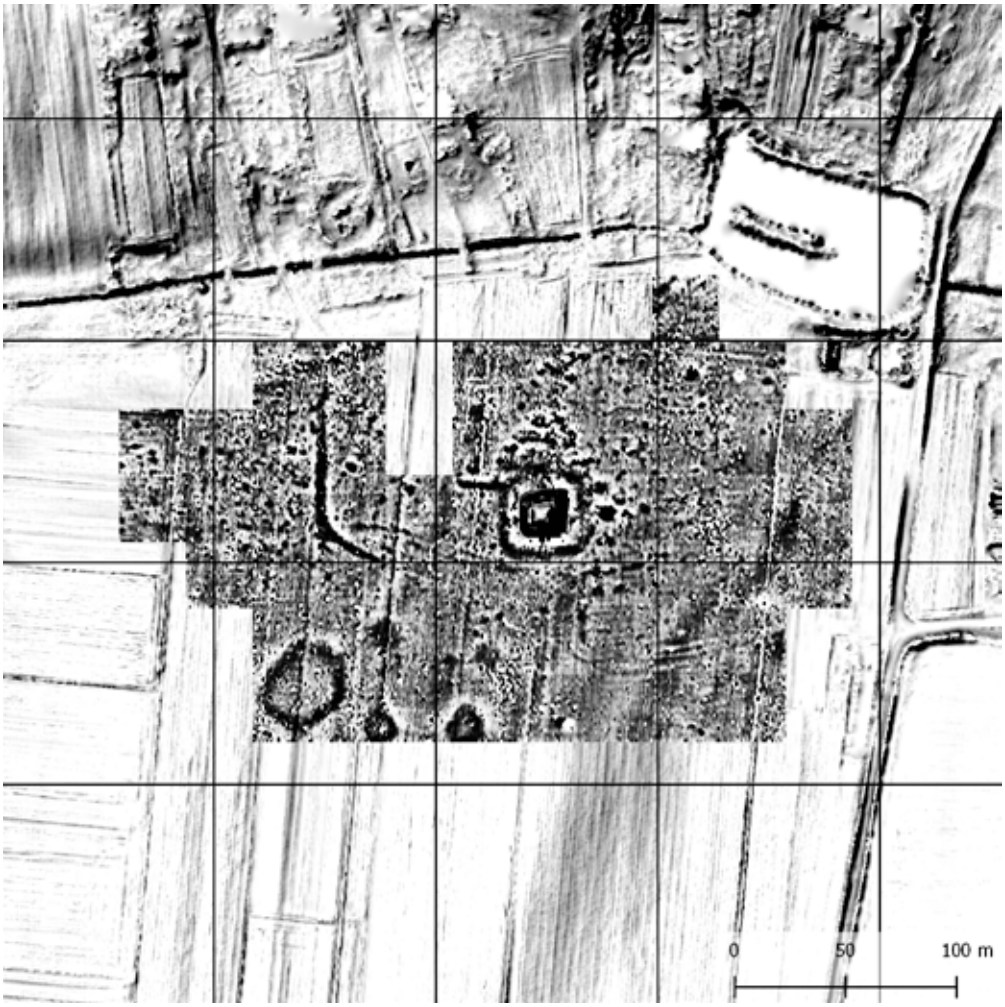

Fig. 6. Krzczonów. Location and visualization (± 1nT, light to dark) of 2015–2017 magnetic gradiometry data. North at the top

anomalies) as well as a multitude of curvilinear and point magnetic anomalies linked with past human activities. Remains of possible man-made structures surround the mound, the most prominent includes a low amplitude rectangular anomaly about 36×36 m in extent and on average about 5m in width wide (fig. 9: A). Immediately adjacent to the mound are a multitude of square and rectangular-shaped, higher amplitude anomalies with average dimensions about 5×5 m dimensions (fig. 9: C). These were registered in high convergence to the north and

east of the mound. Similar anomalies further to the north and west of the mound were lower in intensity and could relate to archaeological features. A relatively highly magnetized curvilinear anomaly, oriented approximate N-S is visible almost 100m to the west of the mound. The source of the anomaly could be the artificial leveling/fill of a gully road. Other possible continuations of this road can be recognized in similar responses in the magnetic data. They are located on higher ground, perpendicular to the slope direction and hence were less liable to slope erosion and therefore generate narrower and lower amplitude magnetic anomalies (fig. 9: B).

The analytical field walking survey was carried out in 2016. The collection of artefacts obtained in Krzczonów resulted in 569 potsherds (fig. 7: A) whose total weight was nearly 5 kg. In this group 23 small fragments are dated to 18th–19th centuries (fig. 7: D). These fragments were spread randomly with no specific concentrations and represent typical Late Modern waste scattered in the field. The remaining finds are related to the Late Medieval period (14th–15th centuries; 421 artefacts; fig. 7: B) and the Early Modern Period (16th century; 125 artefacts; fig. 7: C). In this group two raw materials associated with the type of clay used are recognized. Firstly there is ferruginous material, mostly of brick red, brown or grey colors, forming two thirds of assemblage, and the so-called white-type, which differs from white or various shades of creamy to pink colors – if burnt in oxidation atmosphere. If the burning atmosphere was reductive, the pottery surface has dark grey color. There is a (mostly inner) surface finish in form of color glazing (green, olive, honey and yellow) on many fragments of white-type material (fig. 8: 7, 15, 19). The most common form of decoration is multiple horizontal engraved lines (fig. 8: 9), sometimes accompanied by a wavelet line (fig. 8: 8) or vertical notches (fig. 8: 1, 11). Tracing wheel was used as well (fig. 8: 10). Among the white-type material there are two pieces with traces of painted decoration made in a reddish-brown color. From the morphological point of view, the majority of determinable vessel shapes is formed by pots with various forms of rims (fig. 8: 1–7), followed by jugs (fig. 8: 12–14), bowls (fig. 8: 15, 16), pot-lids (fig. 8: 17, 18) and plates (fig. 8: 19). In the assemblage, there is a majority of Late Medieval material, which appears in greater intensity north and west of the mound itself. Its spatial association with the geophysical results representing sunken features, such as traces of

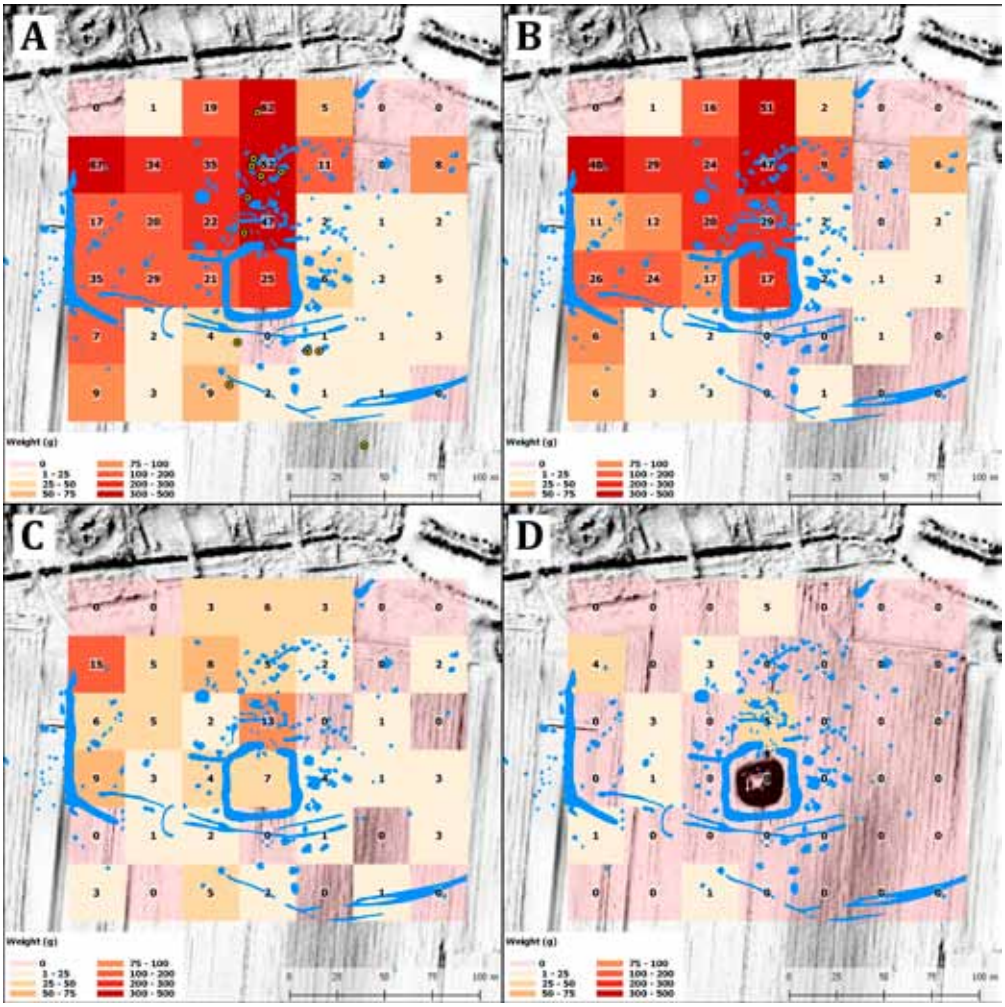

Fig. 7. Krzczonów. Results of analytical field walking data. Archaeological interpretation of geophysical and remote sensing data marked by blue. Color coding represents weight of finds within each grid. Quantity of finds represented by number in center of each grid. A) Full dataset B) Late Medieval C) Early Modern Period D) Modern Period. North at the top

magnetized hypothesized timber constructions, settlement pits and the former moat surrounding the mound, confirm the age of these structures, including the mound, to the 14th–15th centuries with the negligible overlap to the following century.

The 2009 small-scale metal detector survey registered 13 Late-Medieval finds located mostly directly north and south of the mound.

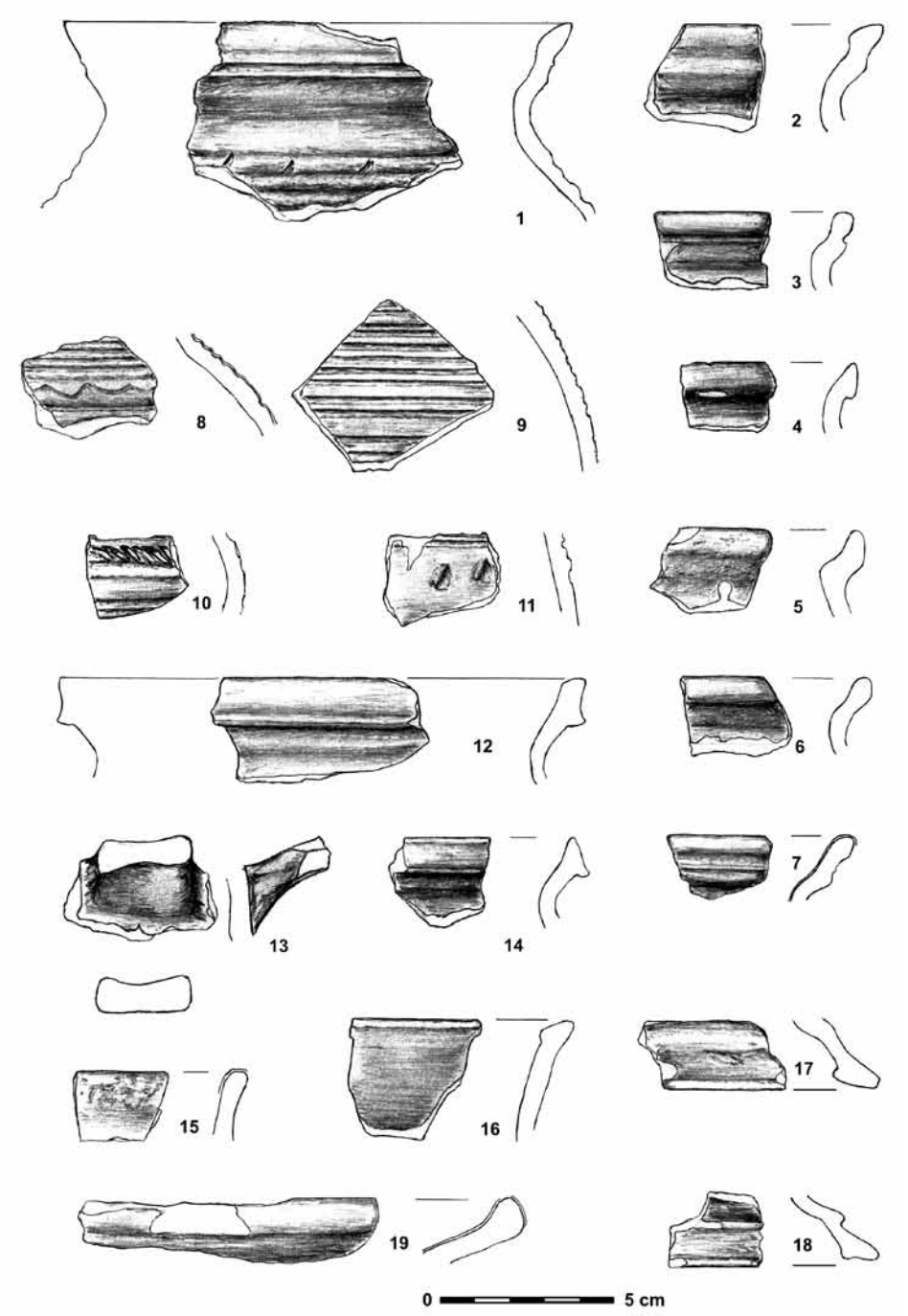

Fig. 8. Late Medieval and Early Modern pottery. A representative sample of 2016 field walking survey assemblage. Drawing and analysis: Agata Sztyber

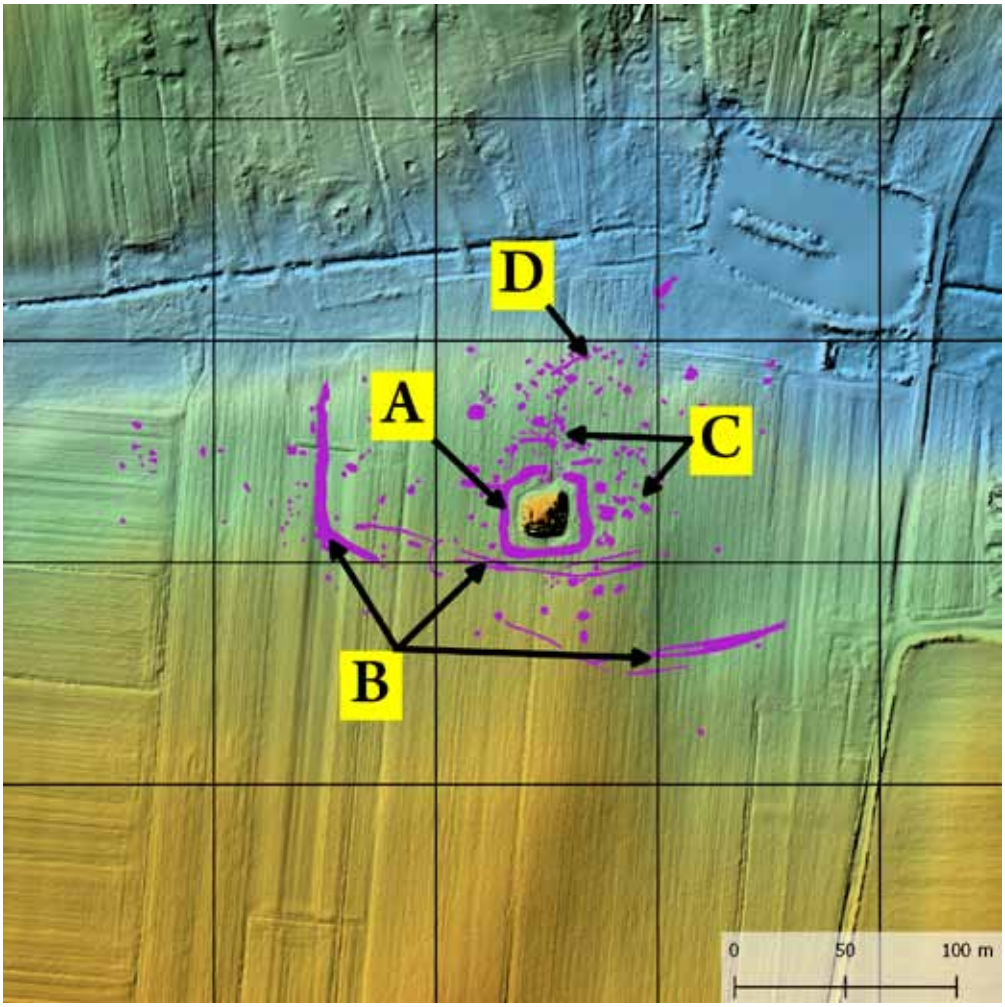

Fig. 9. Krzczonów. Purple) Mapping of remote sensing and geophysical anomalies. A) Fill of possible former moat that surrounded the mound B) Traces of possible road network C) Remains of highly magnetized timber constructions D) Remains of road with traces of settlement pits (?). North at the top

These include 3 Jagiellonian denars, 1 iron belt buckle, 3 bronze coins, 1 silver coin, lead weights and 1 trade seal with a representation of the Fleur-de-lis and Pillars of Giediminas.

The implemented methodology allowed for the collection of archaeologically significant information. Analytical field walking surveys enhance the spatial understanding of past processes taking place in the landscape in different time periods. Aerial remote sensing and

geophysical data revealed the spatial dispersion of archaeological features that, based on comparison of their morphology and signature with the known analogies, also allow estimation of cultural and chronological information.

Archaeological interpretations

The present-day mound has been subject to years of natural and agricultural erosion and was once surrounded by a 5 m wide rectangular moat. The moat can be used in a hypothetical reconstruction of the initial size of the mound. It was originally about 35 metres in width. The regular rectangular shape and width of the surrounding moat are crucial data for the archaeological interpretation of the Krzczonów earthwork. Most probably it is not a barrow or of prehistoric chronology. Rectangular barrows are known from the Early Medieval period from extensive areas of Southern Poland, Podlasie and Pomerania, but most of them are much smaller, with dimensions no more than few metres to about 10 metres (Zoll-Adamikowa 1975; 1988; Łosiński 1996). Its morphology is more related to the mound of a Late Medieval motte-type castle. We cannot exclude a later, Post-Medieval chronology but based on the available data this may be a less likely interpretation even though Polish nobles still used this type of mound residence up to the second half of 16th and even later in 17th and 18th century (Kajzer 1996). In these later periods a horizontal layout timber building which required more area than a vertical keep (typical for Late Medieval and Early Modern periods – first half of 16th century) was preferred. A Modern period structure would require a larger area on the top of the mound than which can be observed in the reconstructed topography of Krzczonów.

A. Marciniak-Kajzer in her publication on private residences doubted in rectangular-shaped medieval mottes (2011, 68–69) assuming that this form appeared in the Early Modern period. The chronology of the possible motte in Krzczonów based on surface finds, dimensions and morphology tends to favour a Late Medieval interpretation. Several comparisons to such structures from this time period can be recognized.

In Bebelno a rectangular mound 25 m wide was surrounded by 4 m wide moat. During excavations in 2002–2003 two phases of medieval residence were uncovered. The older one from the 13th–14th

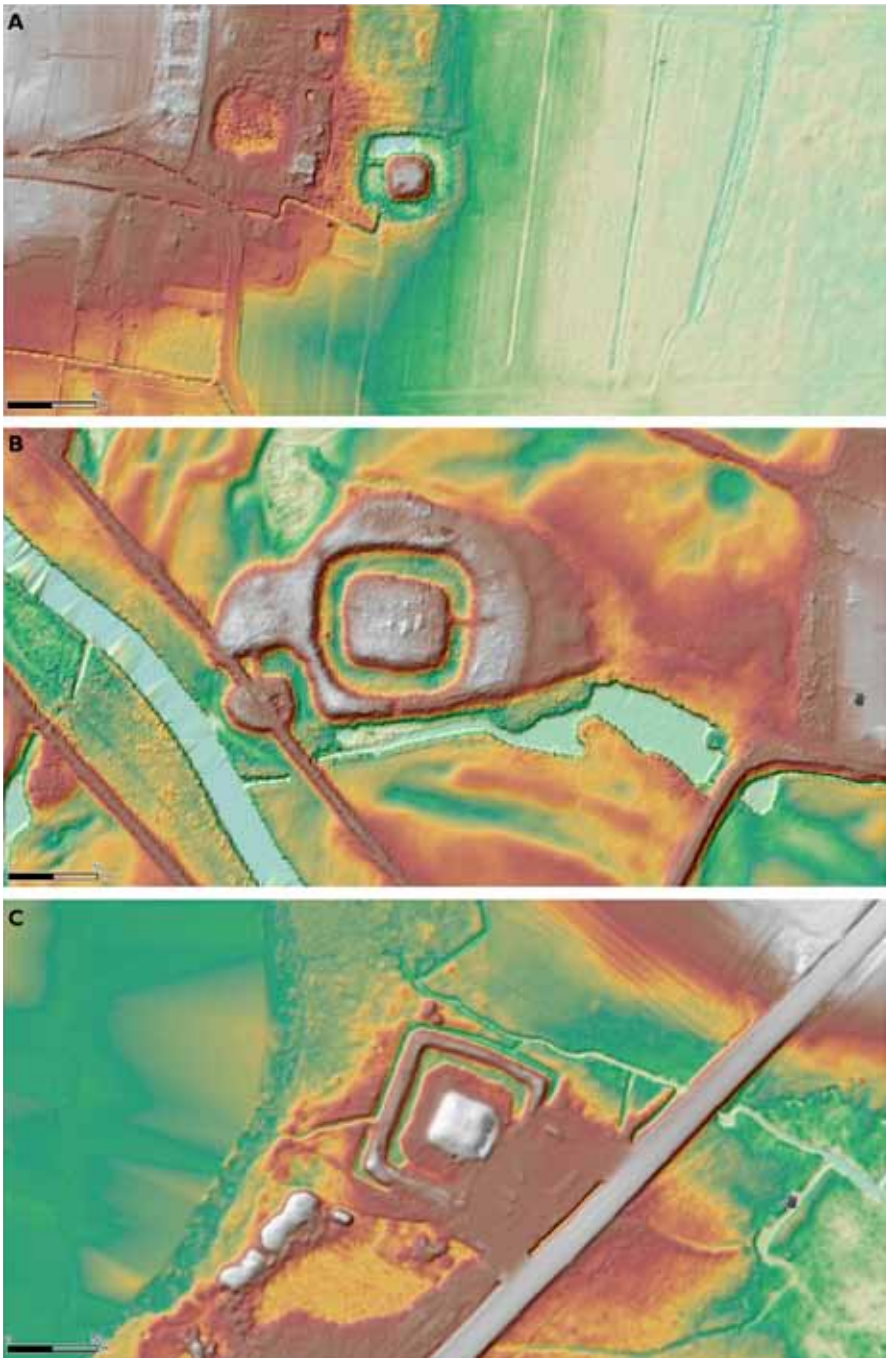

Fig. 10. Hillshaded DEMs of rectangular mottes from Poland. A) Chróścina, gm. Góra, B) Bełcz Mały, gm. Wąsosz, C) Wityń, gm. Świebodzin. North at the top

century constituted a timber building with palisade, the younger period from the 15th century was a masonry tower with dimensions of 6.8×7.5 m (Hadamik 2004). Thoroughly researched remains of a rectangular motte were uncovered during rescue excavations preceding the construction of a motorway in 2003–2005 in Pomorzany. It was a quadrilateral platform of a levelled mound with dimensions of 16×19 m originally surrounded by a moat. Both the mound and the moat were dated (with dendrochronology) to 1385–1386 AD (Świętosławski 2013). According to the excavations of F. Biermann *et al.* (2011) a motte-and-bailey castle in Bełcz Mały (fig. 10: B) was a seat of a castellanus (a ducal official), built around 1400 AD. The remains of the central part of the castle are currently an almost rectangular mound with dimensions 50×54 m on which masonry features were discovered (remains of a residential tower) surrounded by a moat 16 m to 19 m wide. Remains of a bailey adjoin it to the west (28×32 m). In Chróścina (fig. 10: A) another rectangular motte is known, about 26 m wide with a moat 10 m wide. During small scale excavation it was dated to 14th–15th century (Lodowski 2001). In Wityń (fig. 10: C) we can observe a rectangular mound about 30 m wide surrounded with about 20 m wide moat and small rampart (Nowakowski 2008, 566–567). This overview indicates that rectangular forms of motte were not exceptional, especially in the Late Middle Ages (14th and 15th centuries) although most of them are known from Silesia and only some from Late Medieval territory of the Kingdom of Poland.

Magnetic anomalies mostly to the north, west and directly east of the moat may be interpreted as remains of sunken parts of timber buildings, possibly contemporary to the hypothesised motte. Large, regular, and heavily magnetized anomalies are characteristic of burnt daub walls, typical in Late Medieval Polish architecture. To the north is a rectilinear positive anomaly that is adjacent to the moat feature. These structures can be interpreted as remains of a settlement connected with the residence or most probably as traces of residential, economic or service buildings of the outer bailey that maybe enclosed by a palisade (?). Magnetic gradiometry shows a 5 m wide linear feature that implies the existence of a hollow way road leading from the small river valley, south of the mound, going further in the eastern direction. This group of curvilinear anomalies can be tied to past human activities such as traces of sunken roads (more sunken and infilled hence higher

anomalies in parts closer to the valley, higher parts less eroded and narrower anomalies), an important landscape feature.

Based on the available data we would like to hypothesize that the Krzczonów earthwork could be related to the end of 14th up to the beginning of the 16th century. This period fits both to the pottery analysis and is documented by metal finds as Jagiellonian silver denars, buckle and lead textile seal. In this case the whole complex in Krzczonów could be understood as motte-type castle (cf. Sikora, Kittel 2017).

Conclusions

The Krzczonów Mound is one of relatively few archaeological sites in Poland included within the protected monument list[4]. The earthwork itself does not objectively present a high aesthetic value, nor is it well preserved, looking out of place in the contemporary rural landscape. Despite data pointing to other interpretations it is recorded in documentation as a prehistoric barrow. These points altogether form a certain dissonant and contradictory picture of the area's past. Until recently this situation with unclear and missing data presented a seemingly impossible task to properly interpret the site without the use of destructive excavations. The research carried out intermittently since 2008 with multi-method and integrated use of non-invasive techniques has however managed to break the cognitive impasse and propose a more precise interpretation of the function, chronology and range of past cultural activities in the area. The acquired non-invasive data has provided answers to heritage management questions. The applied techniques and methodology are capable of providing significant scientific data. They also facilitate a more precise view of the archaeological landscape of the study area and traces of long forgotten human activities in various chronological periods and spatial contexts. At the foundation of this approach lies the crucial appreciation of the value of integration of methods. Finally, what may seem obvious but is often forgotten when evaluating various methodologies – despite various flaws it is non-destructive, thus the research on certain sites can be repeated many times without damaging unique and irreplaceable archaeological resources.

[4] According to the AZP there are over half a million known archaeological sites but only around 7700 are actually listed as protected monuments (cf. footnote 1).

Acknowledgements

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