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AERIAL ARCHAEOLOGICAL INVESTIGATION OF HALLSTATT TUMULUS NECROPOLISES IN TRANSDANUBIA AND IN ADJACENT AREAS. AN OVERVIEW

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Abstract: The long-known, spectacular tumulus fields have been popular destinations for aerial archeological research since its beginnings. Similarly, the well-preserved groups of burial mounds in the forests seemed to be excellent test areas for the ALS-based explorations launched in the late 2000s, too. The aerial photography not only expands our knowledge about the topography of known tumulus fields, but it also increases the number of registered remains belonging to previously not detected mounds. Although both the identification of their structure and the dating of the latter features are highly questionable, it can be stated, that the extent and the number of the tumulus necropolises of the Eastern Hallstatt culture are significantly larger than it was previously assumed.

Keywords: burial mounds, aerial photography, ring ditches, Eastern Hallstatt culture, Transdanubia

INTRODUCTION

This study is the continuation of our article about the aerial photography research of the burial mounds in northwestern Hungary and southwestern Slovakia (Winkler, Czajlik 2018). We used orthophotos and oblique aerial photos in order to identify the traces of new archaeological sites and other mounds at already known sites. As the research area expanded, it was necessary to gather all information available, including the records of the burial mounds from eastern Austria and Eastern Slovenia documented through aerial archaeology and rescue excavation, besides western Hungary and western Slovakia. In addition to the above, we tried to include the data revealed by other non-destructive methods (geophysics and ALS) in the study. The relatively large amount of information creates several interpretation problems, however it is important in terms of further analyses to present these issues in detail. Despite the difficulties in analysis, it is necessary to include the larger amount of new, mainly non-destructive records in later studies.

PREVIOUS RESEARCH

The aerial archaeological research of Early Iron Age tumulus groups and fields in Hungary dates back to the period between the two world wars. From this era we have aerial photographs of the burial mounds at Tihany (August 1929; Neogrády 1948–1950, 302–303), at Nagyberki-Szalacska (July 1929; Neogrády 1948–1950, 296–298 cf. Holl, Czajlik 2013, 26) and at Érd/Százhalombatta (1934; Holl, Czajlik 2013, 27). The latter site is unique, because its second topographic survey, published in 1986, was based on an archival aerial photograph from 1953. From the same year we have a high-quality photograph taken for the purpose of mapping the territory around the tumulus field at Nagyberki–Szalacska as well, and it depicts groups of mounds south of the region photographed in 1929, i.e. in a much larger area (Holl, Czajlik 2013, 28).

Regular aerial archaeological research has begun in Austria before the 1980s. Among the few aerial photographs reported on Early Iron Age necropolises, the images picturing the mounds at Unterparschenbrunn (Lauermann 1997, 156), Bernharndstahl (Lauermann 2020, 49) and Grossmugl – Hintern Gärten (Trnka 1982, Abb. 42) can be mentioned here.

According to our information, Ivan Kuzma was the first one in the entire region, who started systematic aerial archaeological prospection at Early Iron Age tumulus fields in Slovakia. This is demonstrated by his photographs taken on the 3rd March 1987 at Dolné Janíky (Kuzma 2012, 84) and on the 15th December 1988 at the same site (Fig. 1, cf. Kuzma 2007, 22), further by the recordings at Reca (Winkler, Czajlik 2018, 327).

Due to its proximity to the Budapest airports, the first images of the Hungarian-French aerial archaeological program (1993–2000) were taken of the tumulus field and the Iron Age fortified settlement at Érd/Százhalombatta in 1993 (Goguey, Szabó 1995, 71, Czajlik *et al.* 2016, 60). We have from the same period the first aerial photographs of already published sites, where the burial mounds or the necropolises were previously unknown or just partly known, but on these pictures they were detectable (at Svodin, in 1994, Kuzma 2007, 21; Écs – Petkevár, photographed by Otto Braasch in 1994, Bálek *et al.* 1997, 147; Jedespeigen in 1998, Doneus 2000, 30; Nové Žámky in 1999, Kuzma 2007, 21; Biely Kostol in 2000, Kuzma 2010, fig. 114; Tápszentmiklós, photographed by Otto Braasch in 2000, Visy 2003, 117).

Fig. 1. Dolné Janíky (Slovakia). Early Iron Age tumulus and traces of several other tumuli (Ivan Kuzma, 15. 12. 1988, L130)

Branko Kerman discovered many new sites in the region Prekmurje, Slovenia (at Krog in 1996, 1998 and 2000, Kerman 2001, 129; Kerman 2002, 19–20; Murska Sobota in 1998, Kerman 2001, 130; Kerman 2002, 19; Petanjci in 2000, Kerman 2002, 19).

In the 2000's Ivan Kuzma has continued his prospections in Southwest Slovakia and he discovered a new tumulus field (?) at Dunajská Lužná (earlier Nové Košariská in 2006, Kuzma 2007, 22), he took photographs at Dunajská Lužná – Jánošiková in 2008 (Kuzma 2013, 202); Kostolné Kračany in 2006 (Kuzma 2012, 85); and Vel`ka Paka-Čukárska Paka in 2009 (Kuzma 2012, 80).

Researchers from Pécs provided new aerial photographs of the burial mounds at Kővágótöttös Gábor Bertók and Csilla Gáti (2005, Bertók-Gáti 2014, 132). Máté Szabó served further pictures of the tumulus field at Nagyberki-Szalacska (2011, Szabó 2016a, 168–169; Szabó 2016b, 338) and of the remains of burial mounds (?) at Jánossomorja, detected by himself (2007, Szabó 2016a, 164, cf. 44).

Our systematic research was launched in the 2000s as part of larger aerial archaeological topographical projects. For a long time we tried to take advantage of the early summer periods, mainly in line with the ripening of the winter wheat. At long-known sites such as Érd/Százhalombatta (Czajlik 2008, 96–97), Süttő-Sáncföldek (Czajlik *et al.* 2015), the area of Sághegy (Czajlik 2008, 99), Nagyberki-Szalacska (Fig. 2, cf. Czajlik 2008, 97–98; Holl, Czajlik 2013; Czajlik, Holl 2015, 63–65), Győrújbarát/Nagybaráti (Winkler, Czajlik 2018, 327–330) and Zalaszántó (Czajlik 2008, 99–100; Czajlik, Holl 2015, 62–63), phenomena related to previously unknown or perished tumuli (encircling ditch and/or the mound itself, in some cases the remains of the burial chamber) were observed. In Tihany only the snowy winter period assured success for the aerial prospection (Soós 2017, 114). Despite our systematic research, there are also known sites, where the aerial investigation has so far unsuccessfully failed (e.g. Vaszar, Vaskeresztes). Documentation of previously

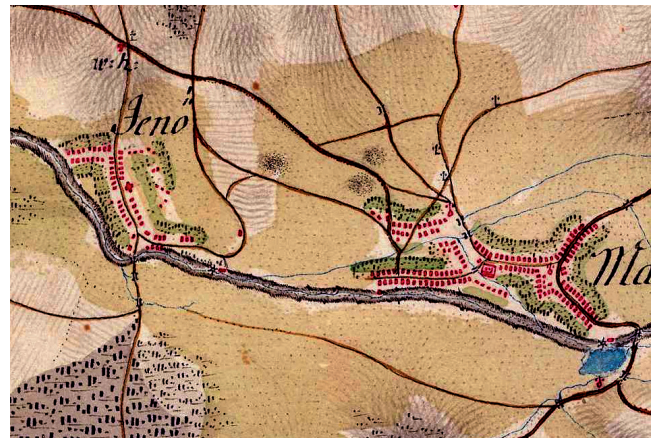

Fig. 2. Nagyberki-Szalacska (Hungary). Traces of tumuli (Zoltán Czajlik, 15. 06. 2017)

unknown ring shaped structures (burials/graveyards?) was fruitful mainly in the Little Hungarian Plain (at Veszkény – Keleti-csapásra-dűlő, 2003; Szárföld – Felső-tag; Gyirmót, Mérges–Kurdipuszta, 2015 (Winkler, Czajlik 2018, 331–333).

MATERIALS AND METHODS

The traditional aerial archaeological photography dates back almost 100 years, and we have recently summarized its methodological possibilities (Czajlik, Doneus 2019). Thanks to GPS-based digital navigation, we can perform high-precision flights, allowing us to capture uncertainly identifiable mounds not only during periods more favorable for cropmarks, but also outside of the vegetation period. This does not always result in the observation of previously unknown tumuli or parts of them, but blurred soilmarks can help to identify areas suitable for geophysical research and/or field walking survey. Aerial archaeology has not reached its limits in the investigation of these necropolises, but provides more and more information for further field research.

In addition to oblique aerial photography, Ivan Kuzma has effectively used the historical military survey maps for studying the western part of the Žitný ostrov (Rye Island) (Kuzma 2012). The importance of the digitized maps of historical military surveys for our entire region (Fig. 3), the new amount of data they provide, was highlighted also by András Bödőcs and László Rupnik apropos the sites of Érd/Százhalombatta and Süttő (Bödőcs, Rupnik 2019). Ivan Kuzma was one of the first to use satellite imagery available on Google Earth (e.g. Dvorniky, 2010; Šoporňa, 2010, cf. Kuzma 2013, 201). High-quality orthophotos can also offer relevant data, as for instance they were analyzed to detect new tumuli groups around Strettweg in 2015 (Tiefengraber, Tiefengraber 2019, 86). The key to use both of these digitalized resources is the easy access to the web, which became available during the last decade. The digitalized and online archives of aerial photographs taken for cartographical purposes also yield a major help. E.g. it was an orthophoto from 1958, which helped to identify a tumulus field at Schandorf, at the Hungarian-Austrian border (Bödőcs *et al.* 2019, 86), while

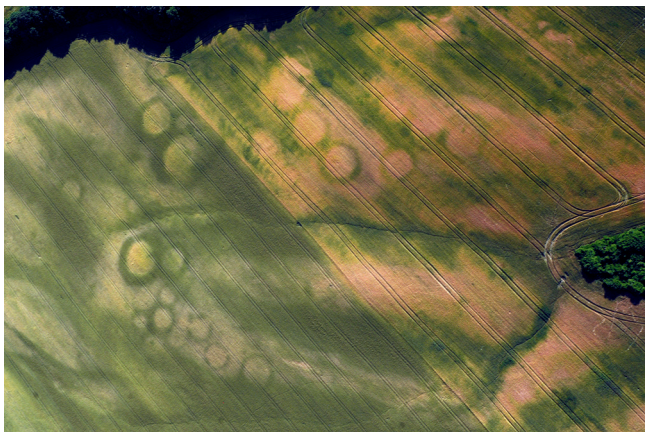

Fig. 3. Depiction of burial mounds between Somlójenő and Somlóvásárhely on the map of the First Military Survey (1766-1785). (©Arcanum, cf. Molnár – Tímár 2015 and Molnár *et al.* 2014)

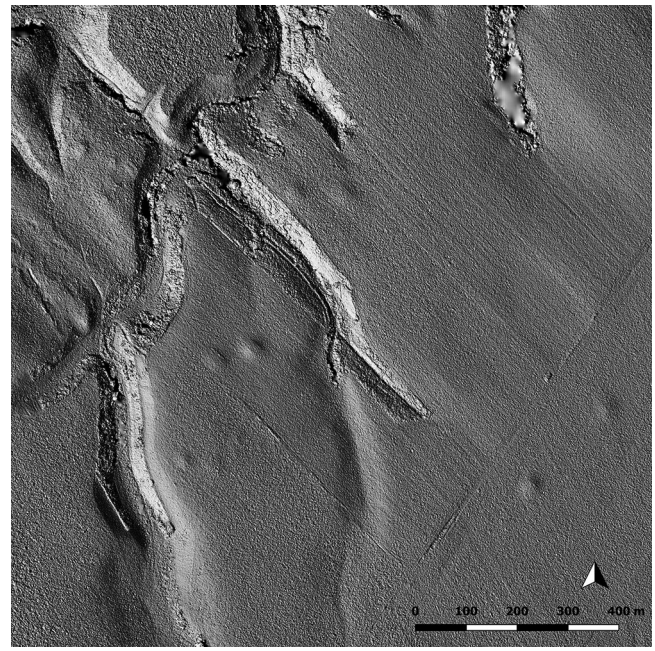

Fig. 4. The tumulus groups of the Süttő site complex (Hungary) on the DSM, generated on the basis of archive aerial photographs from 1975 (fentrol.hu, László Rupnik)

the already forested territory can nowadays investigated only by adapting ALS technology (see below). Aerial photographs, archival orthophotos (Fig. 4, cf. Czajlik *et al.* 2019b, 193), or UAV pictures (Czajlik *et al.* 2019b, 197) can be used for preparing terrain models, as it was presented in case of the research at Süttő.

ALS technology appearing in the 2000s brought very significant changes also in the processes of mapping and detecting Early Iron Age burial mounds. Due to their relatively small extent they were excellent areas for testing the new technology for archaeological purposes (Doneus, Briese 2006, 159–160). The number of known mounds at the Iron Age fortified settlement in Purbach has doubled (Doneus *et al.* 2008), and a new survey was carried out on the mounds of Mannersdorf and Donnerskirchen, too, within the framework of the Leitha Project (Doneus *et al.* 2015, 56–57). With the rapid spread of the method, ALS-based terrain models are prepared and become available in more and more countries, which provide a more accurate base to map the Early Iron Age tumulus fields and tumulus groups. Take for example the tumulus field at Schandorf (Doneus, Fera 2019, 145), the area of Stoob (Klammer *et al.* 2017, 57) Nikitsch (Klammer *et al.* 2017, 60), the Early Iron Age sites of the Sulm Valley (Hellmuth-Kramberger *et al.* 2019) from Austria; the tumuli around the hillfort at Poštela (Habakuk and Pivola), the area of the hillfort at Čreta and Novine/Bubenberg (Črešnar *et al.* 2019), furthermore the region of the hillfort at Cvinger from Slovenia (Mlekuž, Črešnar 2019, 231); the site at Kagovac in Northern Croatia (Potrebica, Rakvin 2019, 154). In Hungary the first ALS survey was conducted in 2007, we published the terrain model of the tumulus field at Sopron-Várhely in 2012 (Czajlik *et al.* 2012, 75–76). At the same time was released the ALS-based terrain model of Bakonytamási – Hathalom as well (Stibrányi 2012, 10). The ALS survey of the fortified settlement and of the Early Iron Age tumulus field at Pécs – Jakabhegy was completed in 2013, the detailed analysis was published in 2017 by Csilla Gáti. ALS-based model was prepared also about the nearby tumuli at Kővágótöttös (Bertók, Gáti 2014, 133). The ALS surveys carried out in 2013 and 2017 for flood protection along the Danube opened an opportunity to set up the terrain model of the tumulus fields at Érd/Százhalombatta and Süttő (Czajlik *et al.* 2019a, 173; Czajlik et al 2019b, 206). A lower resolution ALS model is also available for the burial mounds at Tihany (Soós 2017, 115).

ALS technology and aerial photography can be applied complementary at the boundaries of wooded areas and agricultural lands. There is an excellent example for this at the burial mounds of Siegendorf (Klammer *et al.* 2017, 55). Based on ALS data, even more often on aerial photography, good results are expected by additional magnetic surveys, as it was shown at Poštela-Habakuk (Medarić *et al.* 2019, 117), Kővágótöttös (Bertók, Gáti 2014, 134), Érd/Százhalombatta (Czajlik *et al.* 2016, 61), Süttő-Sáncföldek (Czajlik *et al.* 2019b, 195; Czajlik *et al.* 2019c, 347–351) and Strettweg (Czajlik *et al.* 2017, 353–355; Tiefengraber, Tiefengraber 2019, 88).

RESULTS: PROBLEMS OF INTERPRETATION

We have previously pointed out that there are two types of marks on aerial photographs of arable lands which indicate burial mounds: circular features that have lighter color than their surroundings and are often bordered by darker rings and dark rings with an inner part which has the same color as the outer territories. In the case of the former ones we can assume, that the inner, lighter discoloration is caused by the remains of the mound itself, while the latter case appears if the mound was encircled by a ditch and the constructing material of the mound has completely disappeared by this time (Winkler, Czajlik 2018, 326–327).

We can notice already in the interpretation of Sándor Neogrády, that analyzing the early aerial photograph of the tumulus field at Szalacska (Neogrády 1948–1950, 298) he has not described only the clearly identifiable mounds,

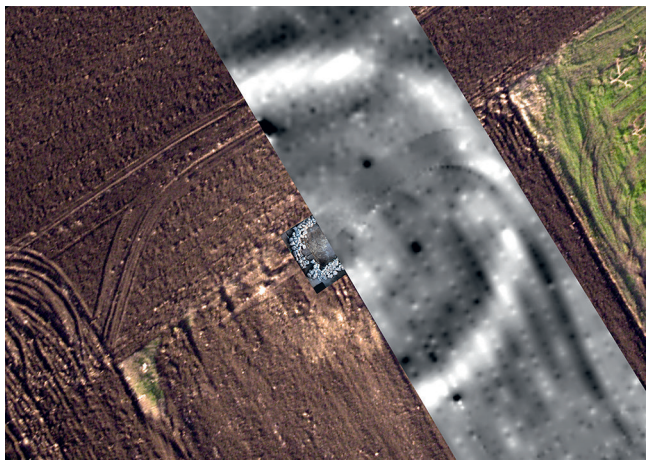

Fig. 5. Érd/Százhalombatta (Hungary). Early Iron Age tumulus field, the excavation of tumulus nr. 49 (excavation director: Gabriella T. Németh). Composite picture of aerial photograph, magnetometer survey map and UAV image to demonstrate the stone burial chamber, the mound (yellow discoloration) and the position of the ring ditch (Zoltán Czajlik – Sándor Puszta – László Rupnik, 2018)

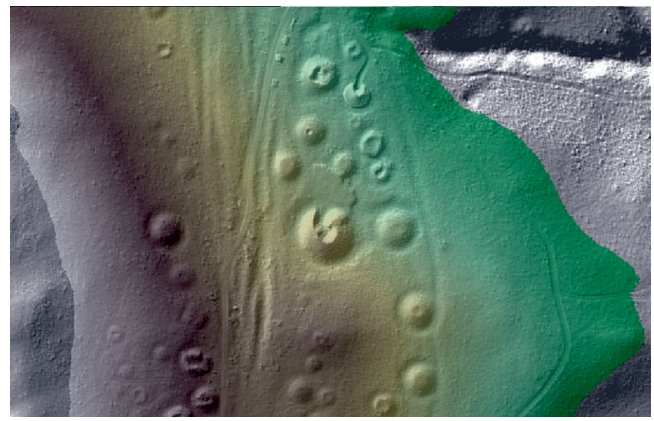

Fig. 6. Sopron (Hungary). ALS image (detail) of the Early Iron Age tumulus field. Ring ditches are detectable around several mounds (Géza Király, 2007)

but all circular phenomena (with or without a ring) as mounds. Apparently, his hypothesis was, that the circular structures are remains of once standing and at the moment of capturing the pictures completely destroyed or strongly demolished mounds. István Torma and Dénes Virágh had the same assumption when they prepared the map of the tumulus field of Érd/Százhalombatta on the basis of archival aerial photographs (Dinnyés *et al.* 1986, 229, cf. tab. 57; cf. Czajlik *et al.* 2016, 59). For their project they also had field prospections, and they could identify 91 discoloration out of the 123 mapped structure based on their different elevation (min. hight difference of 0.2 m). Regarding the other structures they only had aerial photographic data, but the number and the position of all the mounds corresponded to the 122 tumuli known from the first map of the site, made by János Varsányi in 1847. It should be noted, that on the aerial photographs they observed 23 other phenomena, which can be interpreted as remains of vanished barrows. (Dinnyés *et al.* 1986, 228).

Among the aerial archaeological prospections, Ivan Kuzma's flights outside the vegetation period should be highlighted. On the images he took in different periods at Dolné Janíky (Kuzma 2007, 22; 2012, 84), both the remains of the mounds and the surrounding ditches are visible as soil discolorations. At the same time, on the aerial photographs of the 1990s and 2000s which were taken during grain ripening (listed above), researchers could mainly capture only circular, more precisely ring-shaped phenomena. This difference may root not only in the preservation or destruction of the mounds, but it can be caused by the fact that archaeological aerial photographs aiming to detect cropmarks can often reveal only the ditches enclosing the mounds due to the vegetation cover. During geophysical (magnetometer) surveys these ring ditches are the features which can be detected around the rarely observed burial chambers (cf. Grossmugl-Flur Hintern Gärten: Lindinger 2020, 192). In Százhalombatta, Százhalom (Czajlik *et al.* 2016, 61) the burial chamber, detected by geophysical prospection, was confirmed with excavations as well (Fig. 5, cf. Németh *et al.* 2016). Contrarily, the ALS surveys show mainly the mound itself, traces of ditches appear only exceptionally, for example, at the larger mounds in Sopron–Várhely (Fig. 6, cf. Czajlik *et al.* 2012, 76).

In line with the above described observations, during the last 6–8 years we have been studying Early Iron Age necropolises not only on the basis of oblique photographs which were taken in the cropmark period and that has helped us to gain more complex data about the sites. In case of tumulus group "D" at Süttő – Sáncföldek, low angle sunlight and poorly grown vegetation can make it possible to identify the mounds; however, despite intensive aerial archaeological research on the site, the surrounding ring ditches which were clearly observable on the magnetometer surveys (Czajlik *et al.* 2019b, 195; 2019c, 348) have not been detected from the air with the exception of a thin outline around one of the tumuli (Fig. 7). The stone circles around the mounds – detected in Süttő-Sáncföldek (Vadász 1983, 22) as well – may raise further problems of interpretation, as Michael Doneus pointed it out in the case of an Austrian mound (2013, 203).

Processing archival photographs and taking aerial photographs regularly, increased the number of discovered circular ditches within the territory of already recorded tumulus fields (cf. Nagyberki-Szalacska, Dolné Janíky, Győrújbarát/Nagybaráti, Érd/Százhalombatta and Süttő). At the latter mentioned two sites the magnetometer surveys have added also significant number of new discoveries. However, as we pointed out earlier (Czajlik *et al.* 2016, 65), circular ditches alone do not necessarily refer to former mounds, it is possible that they bordered a graveyard, or that a mound much smaller than the size of the ringditch stood in the middle of the yard. The hypothesis about functional variability of the newly identified circular ditches in the Hallstatt necropolises may be supported by the fact that, the map of the Érd/Százhalombatta tumulus field from 1847 (Fig. 8), which was drawn on the basis of precise topographic observations, marked "only" 122 mounds on an area, which is still free from large-scale agricultural cultivation. Thanks to modern aerial photographs and geophysical (magnetometer) surveys, in addition to the ditches surrounding the mounds, we can

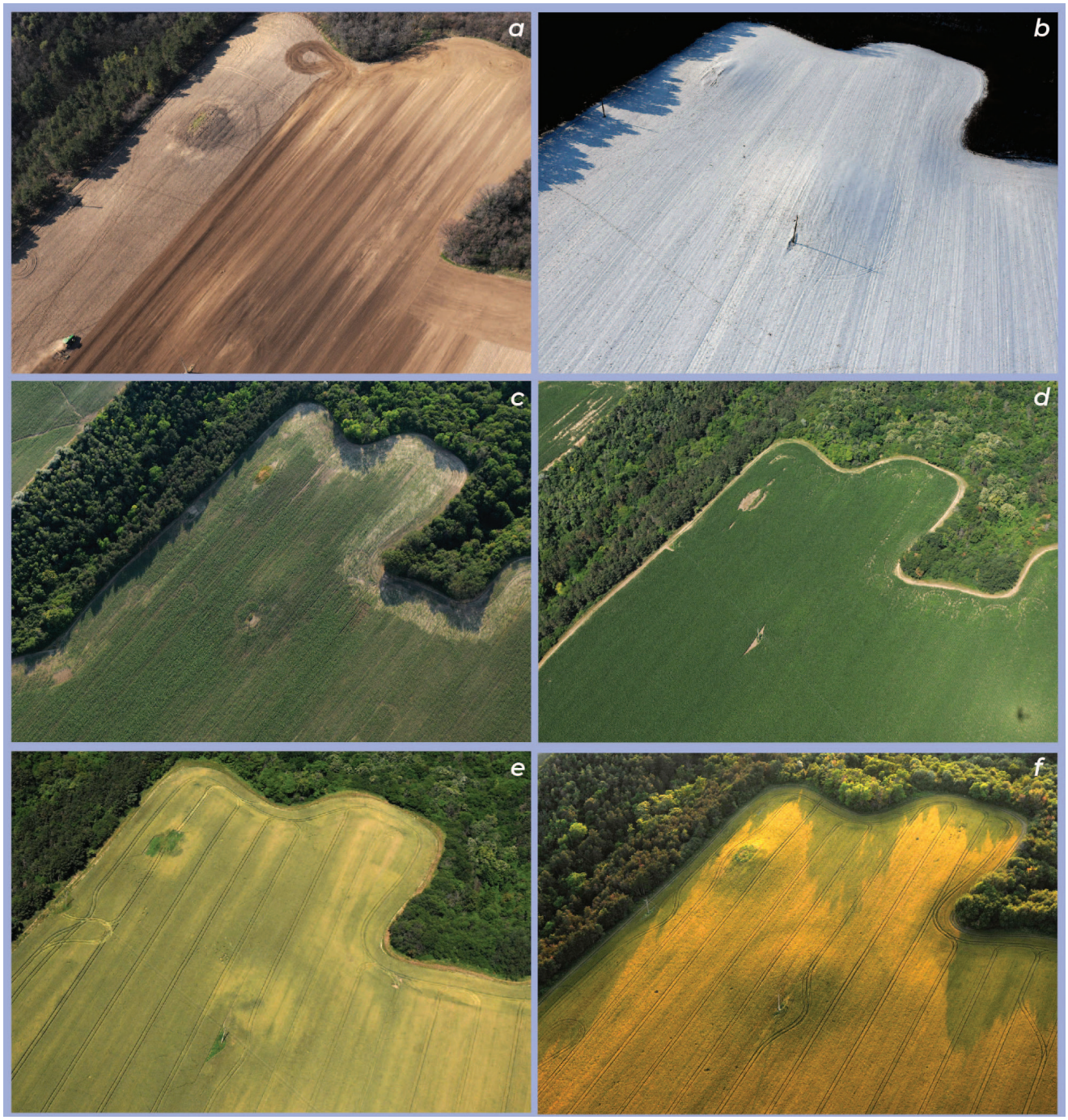

Fig. 7. Süttő-Sáncföldek, tumulus group „D" (Hungary). The six images show not only different covers on the ground (soil, snow, corn, wheat) and the unique observation possibilities typical of the given year, but also the „mosaic" nature of the information gathering: the analysis method of putting together the details from a long-term aerial archaeological research in the same area (Zoltán Czajlik, a, 13 March 2014; b, 28 February 2018; c, 30 June 2015; d, 18 June 2014; e, 21 June 2016; f, 19 June 2013)

now count more than 250 ringditches here, where a mound was not visible even 170 years ago; therefore it is possible that these rings belonged to another type of burials.

Detailed topographic survey at long-known sites, studied earlier by aerial photographs as well, has also shown, that while in Érd/Százhalombatta there is a densely-built necropolis like in Sopron–Várhely or in Schandorf, in Süttő–Sáncföldek for sure and in Nagyberki-Szalacska presumably we have to deal with large-scale tumulus fields organized into smaller groups. The widespread opinion that the mounds lined up along the roads leading to the fortified settlements is also confirmed by the new topographic results, in the region of Purbach (Doneus, Briese 2011, 70–71), Sopron–Várhely (Czajlik *et al.* 2012, 76) and Érd/Százhalombatta (Czajlik *et al.* 2019a, 176) it even seems to be possible to reconstruct the road systems (Fig. 9).

The interpretation of structures with ring ditches (tumuli?) recently detected far from known sites raise new questions. In their case there are no excavated mounds with exact dating, which could provide assisting information

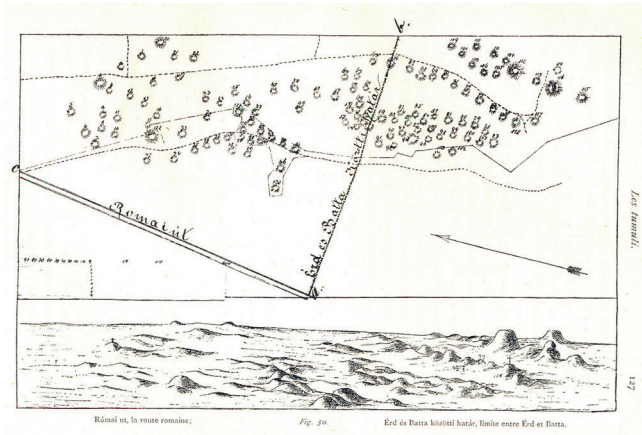

Fig. 8. Map of the Érd-Százhalombatta (Hungary) tumulus cemetery from 1847 (J. Varsányi). After Luczenbacher 1847, Pl. 5; Rómer 1878, Fig. 50.

to connect them to an archaeological period. Thus, we have already assumed in our previous reports that circular ditches identified in aerial photographs refer to destroyed mounds if their diameter, the width of the ditches and their distance from each other correspond to the topographic data known from Hallstatt tumulus fields, possibly if old maps, vineyard names, etc. also hint at former mounds. Other scholars had similar preconceptions, according to the publications, the aerial photographic images of the circular ditches in western Slovakia, eastern Austria and eastern Slovenia referring to previously unknown mounds, do not show any significant differences from the ones in Transdanubia (western Hungary).

While we can be more or less certain of the date of the new tombs belonging to long-known necropolises, the dating of new structures with ring ditches is mostly still in question. The sites with features smaller than the known Iron Age tumuli and containing only a few ring ditches (Bronze Age?) – which are known in large quantity from aerial prospections – were disrespected from the study. At the same time, distinguishing Iron Age and Roman Age phenomena does not seem feasible yet. This can be seen very clearly from the excavation at Murska Sobota–Nova tabla (Tiefengraber 2004, 132; 2019, 429), where the smaller or larger ring ditches (tumuli?) of both periods formed groups. We also received important data from the excavation of Attila Molnár at Bezi–Faluhely-dűlő (Molnár 2014), where further some Celtic graveyards were placed between the Hallstatt burials enclosed with ring ditches (destroyed burial mounds?).

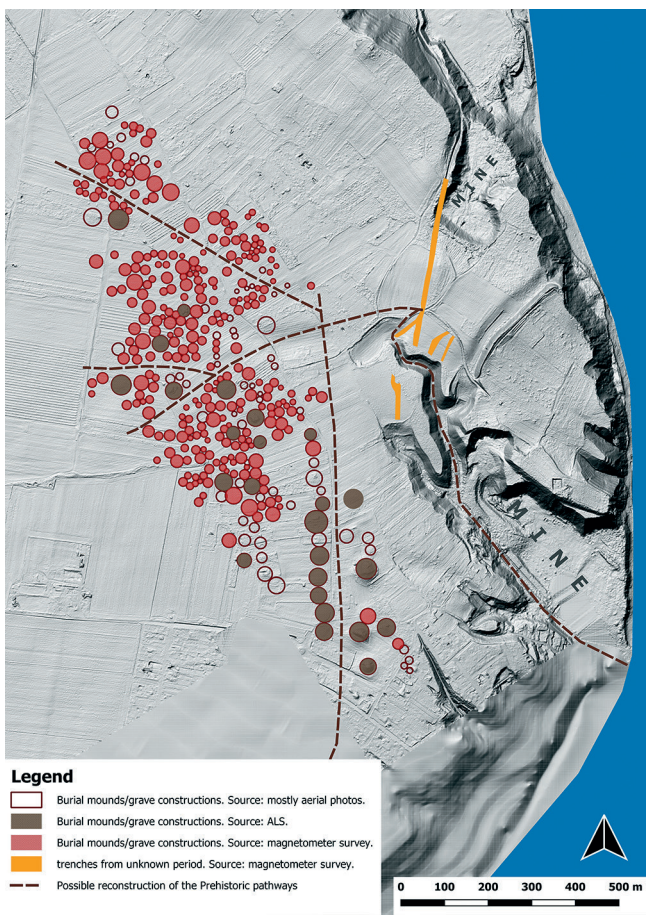

Fig. 9. Probable prehistoric paths of the Érd/Százhalombatta plateau (Zoltán Czajlik – László Rupnik) Sources: ALS, Géza Király; archival (Balázs Holl) and oblique (Zoltán Czajlik) aerial photos; magnetometer survey (Sándor Puszta)

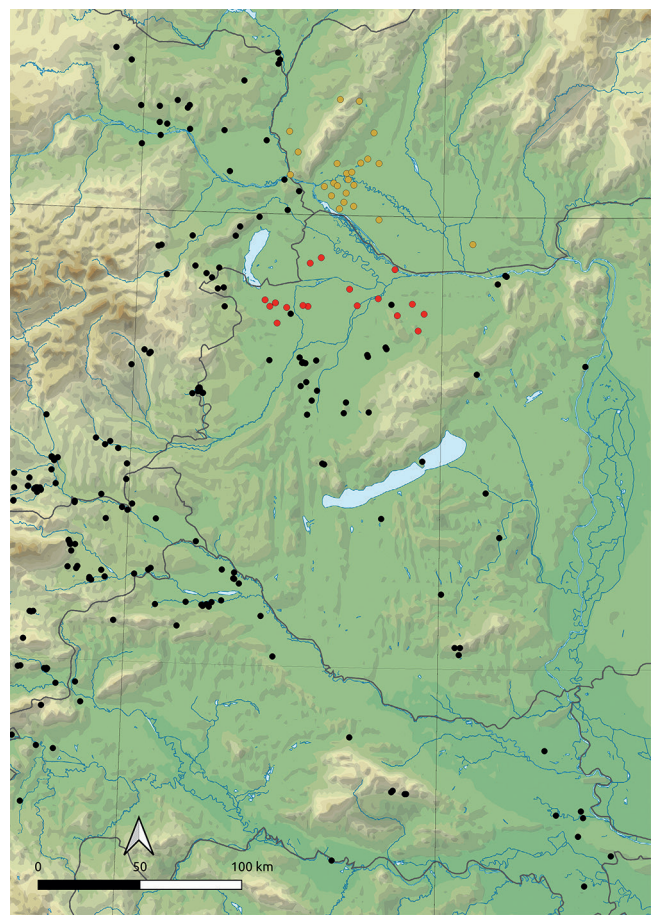

Fig. 10. Hallstatt tumulus necropolises in Transdanubia and in adjacent areas. Using the Iron-Age-Danube database (https://www.iron-age-danube.eu/about, black dots), completed with aerial archaeological and topographical data from Slovakia (orange dots) and Hungary (red dots; Zoltán Czajlik – Bence Soós – Ádám Marton, 2021)

CONCLUSION

Depicting the burial mounds of the Eastern Hallstatt culture, in Transdanubia and in the adjacent areas we can record – in terms of the topography – several significant changes (Fig. 10). Some of them are related to large scale excavations (e.g. Murska Sobota – Nova tabla, Bezi – Faluhely-dűlő). However, the vast majority of the new information originates in the aerial archaeological prospections starting in the late 1980s, and more recently in the processing of archival and modern orthophotos, in airborne laser scanning and in geophysical research conducted on the basis of the former methods. Using new methods have changed our previous topographic picture or its elements in case of many well-known sites (e.g. Dolné Janíky, Strettweg, Győrújbarát/Nagybaráti, Süttő–Sáncföldek, Nagyberki–Szalacska, Érd/Százhalombatta). Based on aerial photographic research of known tumulus fields and using analogies for others, new sites can also be discovered in large quantity, mainly in the Little Hungarian Plain (Hungary)/ Žitný ostrov (Rye island, Slovakia) and in the Prekmurje region (Slovenia).

It should be emphasized, that in the case of both aerial photographic and geophysical (magnetometer) surveys and even partly in modern, large-scale excavations, the most commonly observed structures beside the burial pits – are the ring ditches, which – in our opinion – cannot always be undoubtedly identified as burial mounds. Regarding the new sites detected only on aerial photographs, questions about the date may also arise. While the latter problem seems to be solved after field walking and test excavations, the graveyards around the graves possibly maintained in the Hallstatt tumulus fields, the appearance of the necropolises, to gain information about the structures around the mounds require a much more complex approach. An important part of it is to continue the systematic aerial photographic research, not only during cropmark periods, but throughout the whole vegetation cycle.

Acknowledgements

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