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NEW LIGHT ON A ROMAN FORT BASED ON A LIDAR SURVEY IN THE FORESTED LANDSCAPE FROM *POROLISSVM**

Coriolan Horațiu Opreanu¹, Vlad-Andrei Lăzărescu², Anamaria Roman³,
Tudor-Mihai Ursu⁴, Sorina Fărcaș⁵

Abstract: *The aim of this research is to identify and map new archaeological remains from a steep and forested area using information that was acquired by means of high-resolution airborne laser scanning (ALS or LiDAR-Light Detection And Ranging). In order to test the effectiveness of this active remote sensing technique the LiDAR data were collected by a helicopter on an area of 10 km² from the forested landscape at Porolissvm archeological site. The raw LiDAR data were used to create very accurate digital terrain models (DTM with 0.5 m ground resolution). Two visualisation models of the LiDAR-derived DTM were generated in the ArcGIS 10 software: Hill-shading from Multiple Directions and Slope. We particularly analysed a very steep and forested area from the Citera Hill to test if the archaeological features can be identified using this non-invasive method for the surrounding environment. Our results confirm the effectiveness LiDAR-derived DTM visualization techniques for the detection of the unknown and hidden beneath forests archaeological remains. Employing one of the latest non-invasive active remote sensing techniques we have contributed to the database necessary for the enlisting of this sector of the Roman limes on the UNESCO World Heritage List. This would provide the protection of these archaeological monuments and in the same time promote the cultural tourism within Moigrad-Porolissvm area.*

Keywords: *Porolissvm, Citera Hill Roman fort, LiDAR analysis, Digital Terrain Modelling, Landscape modelling*

1. Introduction

The aim of this article is to evaluate the significance of the new archaeological information that can be extracted from LiDAR-derived digital terrain model (DTM) in order to accurately map the fort from the Citera Hill. The spatial information regarding archaeological features is included in the digital GIS database of this area. In this study the archaeological

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structures situated beneath the forests from the Citera Hill are mapped from the helicopter using Light Detection and Ranging, a technique of determining three-dimensional data points by the application of a laser. The LiDAR data were acquired especially for archaeology in 2013 and analysed as part of a wider study that uses remote sensing and other non-invasive archaeological prospection methods applied in the forest of Transylvania (Romania). The final goal is the extension of the existing archaeological dataset in order to prepare the comprehensive knowledge of this site in order to be included in the UNESCO World Heritage List as part of the already nominated “Frontiers of the Roman Empire”. This would ensure the protection of these archaeological monuments and at the same time promote the cultural tourism within this area.

Aerial photography is one of the most frequently used, and best understood, methods of prospection and recording of archaeological sites⁶. More recently, airborne laser scanning (ALS or LiDAR-Light Detection And Ranging) has undoubtedly become the most important and accurate method of generating digital terrain models. Aerial archaeology and other non-destructive archaeological methods are still underestimated in Romania. The first application of aerial photography in Romanian archaeology was in the 1930’s but the technique is still mainly used just as a tool for study site illustration although some studies were published especially during the 1970’s⁷. The lack of a wider perspective for the utility of this remote sensing technique obscured its potential for discovering new sites and monitoring those which are already known and it is only recently that some studies have focused on such problems⁸. Moreover, in Romania LiDAR technology had only been used scarcely and mostly in the field of public awareness at the UNESCO site *Sarmizegetusa Regia*, being commissioned by the BBC for the documentary “Rome – What Lies Beneath” and broadcasted in 2012. Most of the European countries have important archaeological mapping research programmes focusing upon gathering diverse environmental, landscape and archaeological data that have been proven to be helpful in detecting and interpreting archaeological sites. The need for such complex GIS databases is quite obvious in the case of Romanian archaeology and beginning with the year 2010, the team of archaeologists from the Institute of Archaeology and History of Art Cluj-Napoca of the Romanian Academy established the first steps for such an approach at the Roman site of *Porolissvm*.

2. Material and Methods

2.1. Study area

The study area (Figure 1), covers 10 km² within the archaeological site at Moigrad-Porolissvm (Sălaj County, Romania) –47°11’49’’N, 23°08’37’’E, 504 m a.s.l., on the northern frontier of the Roman Empire, also called the Roman *limes*. The remains of the *limes* today consist of defence walls, ditches, forts, watchtowers and civilian settlements⁹. At *Porolissvm*, most of this fortification structures are hidden beneath forests. The area is almost entirely covered with mixed woodland of mainly oak, hornbeam and beech trees with a varying range of understory. The climate is warm and temperate and the average annual temperature is 9.2°C with 647 mm of precipitation that falls annually.

Much work has been done to our better understanding of the Roman frontiers, and systematic research projects are being carried out in most of the countries involved. Comprehensive works, series and monographs and an immense amount of other contributions

⁶ HORNE 2011.

⁷ OBERLÄNDER-TÂRNOVEANU/BEM 2009.

⁸ OLTEAN 2007; OLTEAN/HANSON 2012

⁹ GUDEA 1989; GUDEA 1997; GUDEA 1997a; GUDEA 1997b.

and papers have been published. Since 1949, an international forum has been created in order to enhance the Roman frontier studies. Some sectors of the *limes Romanus* have been already inscribed on the World Heritage List, in the transnational World Heritage Site of the Frontiers of the Roman Empires. At the moment, the file for the Romanian part of the Roman *limes* is only planned being one of the longest segments of Roman frontier. Unfortunately, at the moment, the elaboration of the necessary documentation for enlisting this sector to the UNESCO list is difficult due to the lack of research. The north-western part of the Roman frontier of the Province of Dacia is better known due to systematic archaeological campaigns and field surveys performed starting with the 60's¹⁰. The known archaeological structures allow us to imagine a whole defence system designed by the Roman army in the most dangerous area of the frontier. The core of this system was obviously *Porolissvm* and its surrounding area because of its geographical position that offered numerous strategic advantages. In front of *Porolissvm* it was the only crossway canyon connecting the north-western plains with the inner Transylvanian Plateau. Because of this reason, huge military defence works were performed in the area.

The Roman archaeological complex *Porolissvm* is spreading on more than 500 hectares being situated on several hills between the villages Jac and Moigrad (Sălaj County, Romania) at about 12 km from Zalău. The first archaeological excavations at *Porolissvm* have started at the end of the 19th century¹¹ and were continued (with several gaps) until today¹². Starting with the year 2011 a new strategy of research was necessary and it was implemented by the new research team from the Romanian Academy – Institute of Archaeology and History of Art Cluj-Napoca led by Coriolan H. Opreanu. First of all the entire topographical information was gathered and all the archaeological known structures were mapped. At the moment, the research team is involved in a partnership research project (“Seeing the Unseen. Landscape archaeology on the northern frontier of the Roman Empire at Porolissvm”), financed by the Romanian National Research Authority (UEFISCDI)¹³. The project scheduled large scale geophysical surveys on the entire site, mainly in the less known areas covering the Roman town where unexpected results emerged, many new structures being mapped thus enabling us to elaborate a better and more accurate plan of the entire area¹⁴. Also, during the *PoroLIMES* project the historical environmental conditions and landscape structure are studied in order to achieve a better understanding of the ancient human activities from this frontier area¹⁵.

Nevertheless, the main unknown sector of the site still remains the nearby Roman defence system of the *Dacian* province covering an area of approximately 40 km², most of them being forested and poorly explored. In order to identify and map all the archaeological structures of the defence system hidden beneath the forest, the above mentioned research project proposed and finalized a LiDAR investigation for a limited area of 10 km² (Figure 1) situated in front of the main Roman fort at Pomăt hill (WGS 84: 47°11'49"N, 23°08'37"E, 504 m a.s.l. and STEREO 70: 359477.597E, 634715.004N, 504 m a.s.l.).

From the geographically point of view, the archaeological site is dominated by three prominent hills (in reality three volcanic necks): Pomăt Hill (504 m), Citera Hill (500 m) and Măgura Hill (504 m). From the Citera and Pomăt hills, the area of Agrij Valley can be very well observed, especially the sector that contains the Roman fort at Romita¹⁶. In the centre of the

¹⁰ MACREA/PROTASE/RUSU 1961; GUDEA 1988; GUDEA 1997a; GUDEA 1997b.

¹¹ BUDAY 1908.

¹² OPREANU/LĂZĂRESCU/ȘTEFAN 2013a.

¹³ OPREANU/LĂZĂRESCU 2012.

¹⁴ OPREANU/LĂZĂRESCU/ȘTEFAN 2013a; OPREANU/LĂZĂRESCU/ȘTEFAN 2013b.

¹⁵ GRINDEAN ET ALII 2014; ROMAN ET ALII 2014; ROMAN ET ALII 2015.

¹⁶ GUDEA 1989, 27–28; MATEI 2007, 151–152.

forested area, on the Citera Hill, A. Buday signalled at the beginning of the 20th century the existence of a fortification composed of a turf wall, but unfortunately failed to explain the nature of this structure¹⁷. Later on, S. Ferenczi presumes the Roman character of this fortification that he described as being approximately ellipsoidal but takes also into consideration the possibility that this structure could be a former Dacian citadel to be transformed into a Roman fort¹⁸. The first archaeological excavations started in 1958 under the leadership of M. Macrea and with that occasion the existence of a 101.10 × 66.65 m fort having stone walls was established¹⁹. During its first phase, the fort that had a ditch and turf wall was presumed to have had the following dimensions: 95 × 60 m²⁰. With the same occasion the ellipsoidal fortification (consisting of a turf wall with a width of 4–5 m and being approximately 1–1.5 m height) situated on the Eastern side of Citera Hill was trenched. The structure having a rectangular shape of 190 × 190 m was considered to be contemporary with the first phase of the already mentioned Roman fort, its destination remaining unknown at that time²¹. The archaeological excavations focusing upon this structure have been resumed in 1997 and 2001 when several trenches were opened in order to establish the stratigraphy of the outer fortification. As a result, the hypothesis of an older Dacian fortification that was later transformed into a Roman marching camp has been revisited²².

Due to the inconclusive results previously obtained, we had to explore other types of approaches while focusing upon the detailed topographic study of the entire hill. Such an approach, indispensable for the contextualisation of the archaeological data, was not possible earlier because of the limitations posed by the fact that Citera hill is heavily forested. Therefore, the only solution which is now available due to the advances in airborne remote sensing techniques was to perform a LiDAR scanning of the region.

2.2. Data and Analysis

LiDAR is seen by some as a tool that will record all aspects of the historic environment, making other techniques redundant. This is especially true when it is described as being able to ‘see through trees’. However, this is a misleading statement, and can lead to disappointment if the properties of an airborne scanning system are not properly understood. The key element of this technique is light, and as such it cannot see through trees or anything else. What LiDAR will do is provide accurate locational and height data, enabling the creation of a three-dimensional model of the land surface that can be examined to identify historic features that exhibit some form of surface topographic expression. Like any other tool for archaeological recording LiDAR has its strengths and its weaknesses and it depends to a large extent on the ability of the user to interpret the data effectively. LiDAR will not make other techniques redundant, but will rather provide an additional source of data.

The aerial laser scanning of the 10 km² area was commissioned and processed with a focus on archaeology in early March 2013 during the leaf-off season. LiDAR data (Table 1) were collected by ArcTron GmbH using a D-EBMW/C207 helicopter. The raw data were filtered into terrain and off-terrain points by the provider and delivered as separate xyz files. These were converted to raster format and viewed in ArcGIS 10 (ESRI, 2011) as a very accurate DTM (0.5 m).

¹⁷ BUDAY 1908, 340; BUDAY 1912.

¹⁸ FERENCZI 1941, 192.

¹⁹ MACREA/PROTASE/RUSU 1961, 375.

²⁰ GUDEA 1989, 89.

²¹ MACREA/PROTASE/RUSU 1961, 376.

²² MATEI 2007, 161–165.

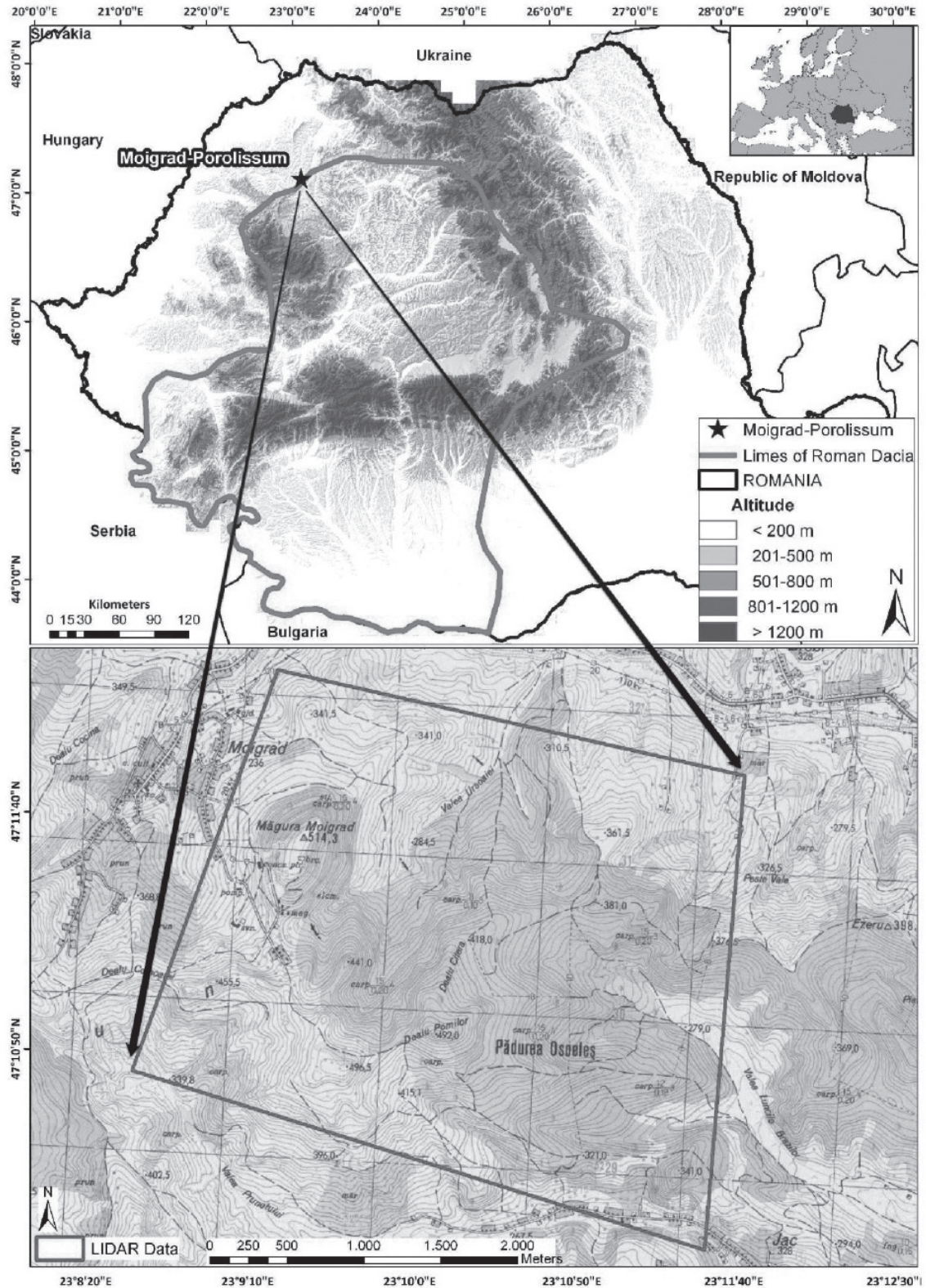


Fig. 1. The research area, located in the north-western part of Romania at Moigrad-Porolissum

Parameter	Performance
Sensor	RIEGL LMS-Q560
Laser pulse frequency	240,000 Hz
Flying altitude	600
Beam divergence	≤ 0.2 mrad = ≤ 20 cm
Scanning angle	60°
Sampling intensity	≈ 40 – 60 returns/m ²
DTM-resolution	0.5 m

Table 1. Parameters of the airborne laser scanning (ALS) flight used in this paper.

For the effective visual interpretation of the DTM we have selected techniques that have proven to be effective for identification of linear archaeological structures like walls, turf walls and ditches. We created two of the most common visualization techniques to ensure that the archaeological features from the Citera Hill can be identified: Hill-shading from Multiple Directions and Slope. The general technical details of each visualization technique are presented elsewhere²³ and the specific parameters used by us are detailed below and in Table 2. **Hill-shading from Multiple Directions** is the most common process used to visualise LiDAR data in archaeological prospection²⁴. This technique takes the elevation model (DTM) and calculates shade from a given solar direction (or azimuth) and altitude (height above the horizon), thus highlighting topographic features²⁵. Shaded relief models provide familiar, photogenic views of the landscape but linear features that align with the direction of illumination will not be easily visible in the shaded relief model, requiring multiple angles of illumination to be calculated and inspected²⁶. These shaded relief models work poorly in areas of substantial macro topographic change, with deep shadows obscuring micro-topography regardless of illumination direction²⁷.

Slope, aspect and curvature maps are commonly used for analysing topographic data in other geographic disciplines. Slope mapping produces a raster that gives slope values for each grid cell, stated in degrees of inclination from the horizontal. Although common for geographical applications, there has been limited application of slope for the detection of micro-topographic change relating to archaeological features, though course resolution aspect and slope terrain maps are well established in predictive models of site location²⁸. It is anticipated that topographic anomalies relating to archaeological features will be identifiable in these images; in particular the slope maps may aid pattern recognition for features such as the lynchets of a field system²⁹.

The visualization models were generated from the same DTM (0.5 m ground resolution) and all calculations were undertaken in ArcGIS 10³⁰ using the *LiDAR DEM Visualization Toolbox*.

²³ DEVEREUX/AMABLE/CROW 2008; HESSE 2010; KOKALJ/ZAKŠEK/OŠTIR 2011; ZAKŠEK/OŠTIR/KOKALJ 2011; DONEUS 2013.

²⁴ BEWLEY/CRUTCHLEY/SHELL 2010.

²⁵ HORN 1981.

²⁶ DEVEREUX/AMABLE/CROW 2008.

²⁷ HESSE 2010.

²⁸ CHALLIS/FORLIN/KINCEY 2011.

²⁹ BENNET 2014.

³⁰ ESRI 2011.

Visualization Techniques	Abbreviation	Parameters
Hill-Shading from multiple direction	HM	Number of direction: 16. Sun elevation angle 35°.
Slope	SP	The method requires no parameter.

Table 2. The visualization techniques applied to the LiDAR data.

In order to map the archaeological features and create a database, the previously known structures were digitized on the basis of existing archaeological field survey data (from the field surveys undertaken during 2012–2014) associated with anomalies on the aerial photography (taken in 2009).

The raster images obtained through the modelling techniques detailed above were explored in ArcGIS 10³¹ and the newly discovered archaeological features were mapped to a shapefile. During this process the potential or uncertain archaeological features are identified in the laser data and mapped accordingly. Archaeological features identified and potentially-identified in the data were extracted and prepared for on-site inspection. Fieldwalks were undertaken for most of the identified archaeological remains.

3. Results and Discussions

3.1. The archaeological interpretation of the newly mapped structures

Previous classical archaeological research has recorded 93 features in the study area, that we have recently mapped using aerial photography. In addition, new archaeological features, previously hidden beneath the forest from the Citera Hill, were visible and mapped from the LiDAR-derived models (Fig. 2).

An area with steep terrain was selected to illustrate (Fig. 3) the performance of different LiDAR-derived models because these conditions are most problematic in attempting to separate archaeological remains from surrounding landscape forms³². The Slope and Hill-Shading from multiple directions enabled the detection of archaeological structures mapped in the wooded area from the Citera Hill. As indicated in Figure 2 both models derived from the LiDAR-derived DTM indicate a fort of 94 m length × 60 m width and defensive structures (wall and ditch) surrounding the Roman fort.

In general terms the Hill-Shading from multiple directions and slope models are the simplest to generate and provide good feature recovery rates of the underground archaeological remains. Also these models provide complementary information for archaeological remains recovery and mapping. The LiDAR-derived models generated an increase in the number of features from the study area and finally made possible the accurate delineation of the Roman Fort from the Citera Hill.

The *Porolissvm* archaeological site is composed of several main sectors such as the big Roman fort on the Pomăt hill (open grassland), the customs point and the military – civilian settlements along the Roman imperial road connecting the Empire with the barbarian world, the small Roman fort on the Citera hill, the Roman *Municipium Septimium Porolissense*, the cemeteries and the advanced defence system elements of the Roman *limes*, situated in the surrounding forested neighbourhood. Beside the two already mentioned forts, the hill-tops were provided with many signalling watchtowers composing a unique surveillance system, other valleys being blocked by stone or turf walls. *Porolissvm* remained the most important military base of the *Dacian* frontier.

³¹ ESRI 2011.

³² HESSE 2010.

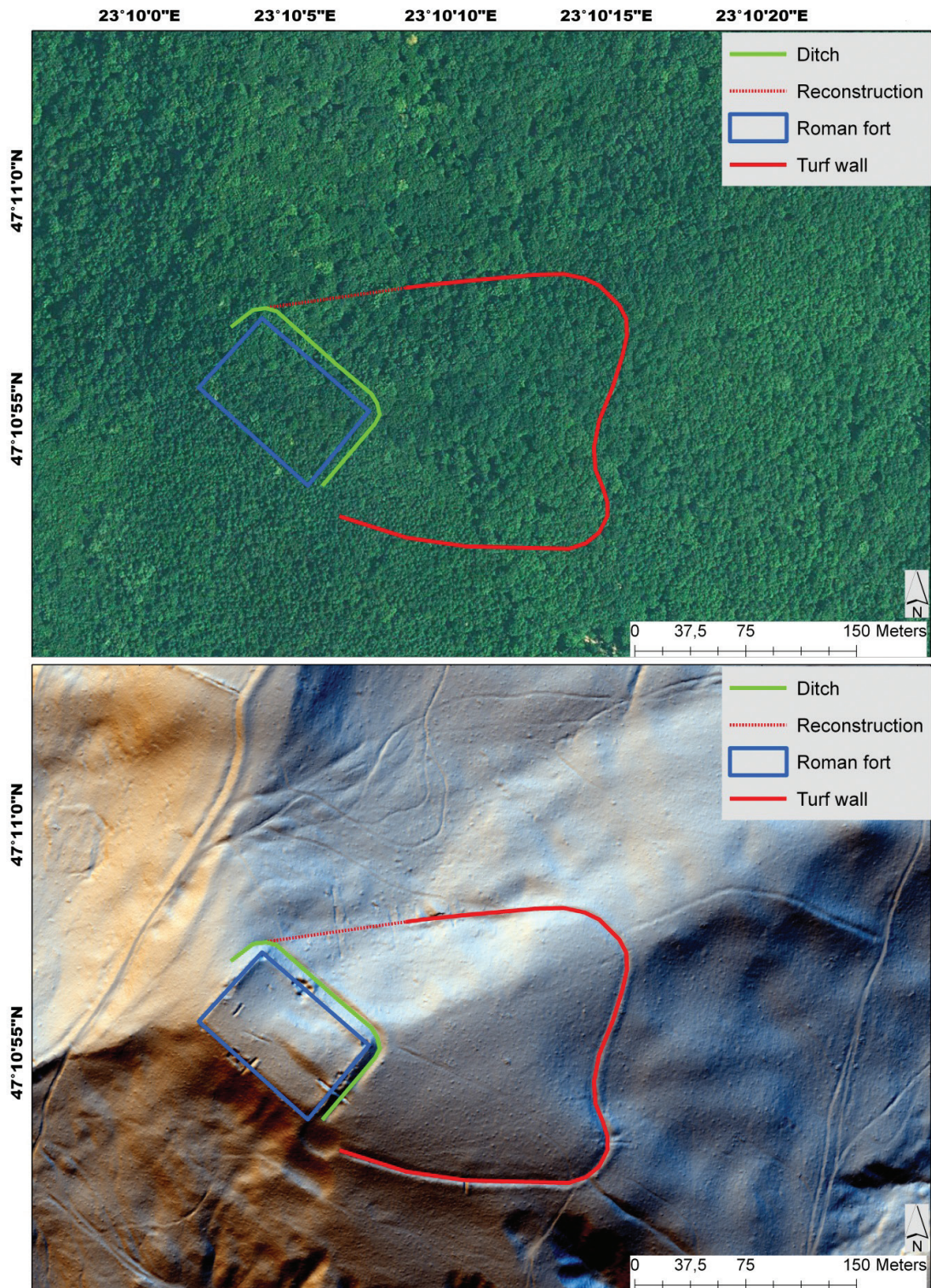
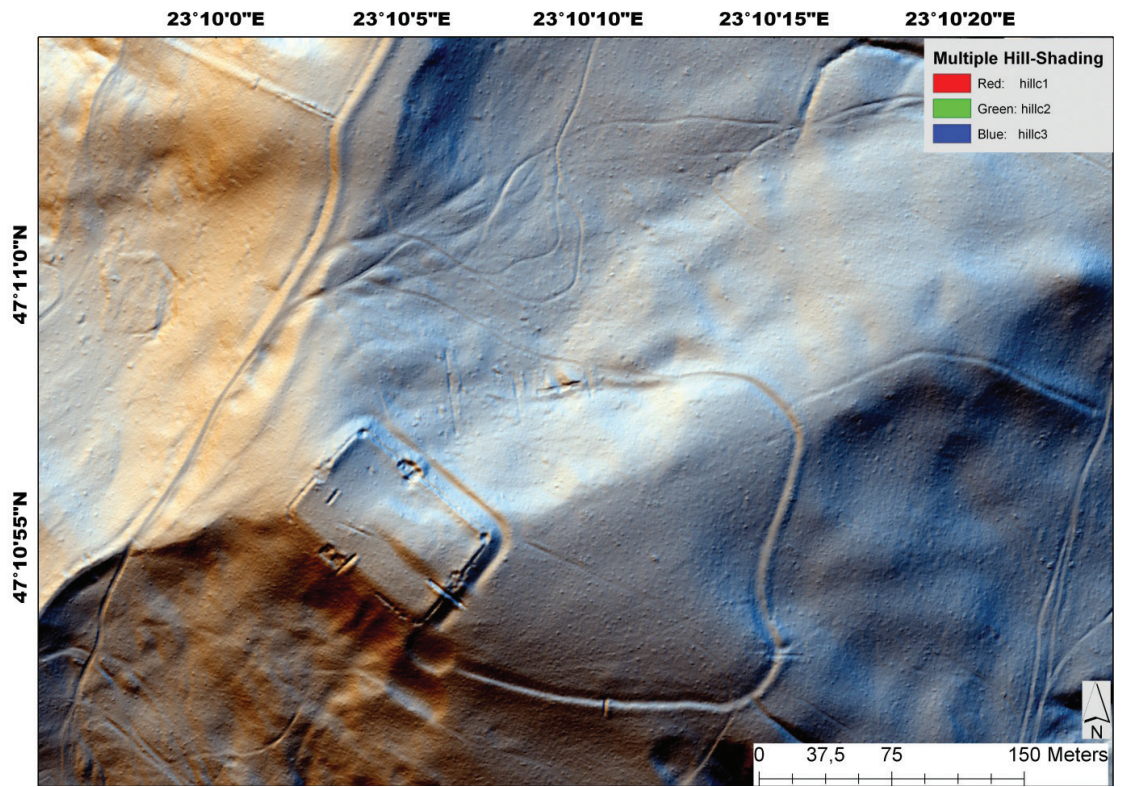
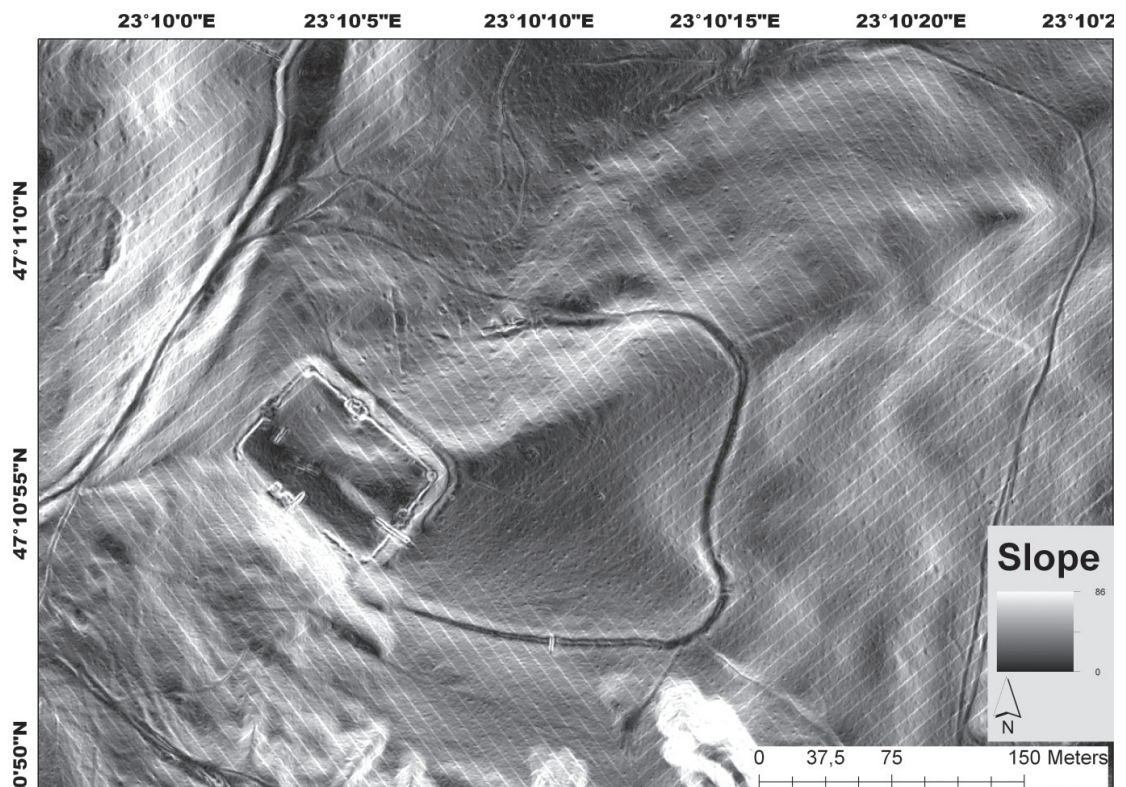


Fig. 2. Mapping archeological features using LiDAR-derived DTM shaded relief model from multiple directions vs. aerial photography.



a.



b.

Fig. 3. LiDAR-derived DTM visualization techniques: a). Hill-Shading from multiple directions; b). Slope

The archaeological artefacts recovered from the excavations at Citera Hill are both poor and inconclusive. Therefore, in the turf wall of the fort only few Roman potsherds and two Dacian handmade pottery fragments have been found. This association certifies the dating of the earthworks during the Roman time. Inside trench SI/1958, at the lower levels of the *agger*, a thin layer of charcoal (about 5cm thick) containing few Dacian handmade pottery have been identified³³, finds used by the archaeologists to presume the existence of a pre-Roman Dacian settlement³⁴. This hypothesis was expressed thoroughly by Al. V. Matei who supposed, without having new archaeological arguments that the enclosure situated next to the fort together with the surface of the fort itself, would have been formerly parts of a larger Dacian fortified settlement that included also a hill fort (the settlement's acropolis), the Romans transforming only this hill fort into a marching camp³⁵. Such a hypothesis is very difficult to accept, the weakness of the archaeological evidence being its main deficiency since no clearly datable structures or contexts were identified that can be related to the Dacian period. A couple of potsherds coming from uncertain archaeological contexts together with an isolated and inconsistent charcoal layer cannot be considered as solid proofs for the existence of a Dacian fortified settlement, suggesting more a temporary and sporadic habitation. On the other hand, there are not known similar situations when the Romans would erect their forts on top of former Dacian fortifications, much less to have reused their structures for military purposes³⁶. Moreover, the existence of another important Dacian fortified settlement in its immediate vicinity, on Măgura hill – perhaps the Dacian *Porolissum*³⁷, makes the presence of another Dacian fortified settlement at just a few hundred meters away extremely improbable³⁸.

The fortifications on Citera Hill certainly belong to Roman time. The first of these, identified through archaeological excavations, is the rectangular fort. The trenches cut over its fortification elements have identified a turf wall leading to the conclusion that initially the fort had a wooden phase. In time, the fort has been raised in stone, thus a 101.10 × 66.65 m fort having massive gates with quadrilateral towers and trapezoidal corner towers resulted. On the NE and SE sides of the fort, a ditch of 7.5 m wide and 3.9 m deep was also identified³⁹. Regarding the chronology of these structures, it is highly probable that the first wooden fort was built shortly after the creation of the Dacian province.

3.2. Historical interpretation

Concerning the dating of the stone phase, we can rely upon few direct clues, the most important being a coin from the reign of Antoninus Pius found in the mortar pavement of the north tower of the NE gate of the fort⁴⁰. Based on this discovery and using the analogies of the fortification's plan we can consider that it has been built during the reign of Antoninus Pius, sometime towards the middle of the 2nd century AD⁴¹. The function period of the fort has raised even more questions. If M. Macrea considered that the abandonment and destruction of the fort took place during the Marcomannic wars⁴², N. Gudea thinks that the duration of this fort has been longer, arguing that the plan of the fort is typical for a 'Numeruskastell' and relating

³³ MACREA/PROTASE/RUSU 1961, 374; GUDEA 1989, 91–92.

³⁴ MACREA/PROTASE/RUSU 1961, 374; GUDEA 1989, 92.

³⁵ POP 2006, 25–27; MATEI 2007, 164–165.

³⁶ GLODARIU 1983.

³⁷ MATEI/POP 2001, 253–257.

³⁸ The dating during the 2nd–1st centuries BC, that means before the appearance of the fortified settlement at Măgura Hill (cf. POP 2006, 25–27, nr. 11), cannot be sustained by absolutely no archaeological argument.

³⁹ MACREA/PROTASE/RUSU 1961, 375.

⁴⁰ MACREA/PROTASE/RUSU 1961, 375–376.

⁴¹ MACREA/PROTASE/RUSU 1961, 375–376; GUDEA 1989, 92; MARCU 2009, 86.

⁴² MACREA/PROTASE/RUSU 1961, 374.

such an assertion with *Numerus Palmyrenorum Porolisensium*, a military detachment confirmed to have been quartered at Porolissvm in the 3rd century AD⁴³.

In our opinion, the stone fort was built in Hadrian – Antoninus Pius time, at the same time with the first stone phase of the fort from the neighbour Pomăt Hill. This phase is recorded by several inscriptions from Hadrian – Antoninus Pius period, such as the construction inscription found in 1943 at *porta principalis sinistra* dating from AD 129 mentioning *cohors I Ulpia Brittonum*⁴⁴ which built the gate and the inscription from *porta praetoria* from AD 140–144⁴⁵. It consisted in a fortification having square shaped towers at the gates similar with the Citera fort ones. The same chronology for the first stone phase of the fort from Pomăt was recently confirmed by the excavation of a *ballistarium* built between AD 140–160⁴⁶. In the fort from Citera was also discovered a tile-stamp *CH III*⁴⁷, considered by N. Gudea from the 3rd century, but which was used during the works for the first stone phase of the fort from Pomăt Hill (Hadrian – Antoninus Pius), as recent research established⁴⁸. More, the tile-stamp comes from the same place as the coin of Antoninus Pius above mentioned. A. Morillo and V. Garcia-Marcos after researching the *porta principalis sinistra* of the legionary fortress of the 7th legion *Gemina* from León (Spain) used as analogies for its plan, among others, the *porta principalis sinistra* of the auxiliary fort from *Aquae Querquennae* (Spain) and the gates of the fort from Citera Hill⁴⁹. It's worth mentioning that recently was demonstrated that the enigmatic tile-stamp *CH III* well-known at *Porolissvm*, belonged to the 3rd cohort of the 7th legion *Gemina Felix* from León, which after building and garrisoned the fort at *Aquae Querquennae* was brought in Hadrian time at *Porolissvm* in *Dacia* where it participated to the building of the stone forts from Pomăt and Citera Hills during Hadrian – Antoninus Pius period⁵⁰. In conclusion we appreciate that if the building period of the fort Citera can be reasonably established, the period of its using remains obscure. We can only show that in comparison with the fort from Pomăt Hill, the Citera fort does not have several reconstruction phases, a situation which can possibly mean it was abandoned at a certain moment, as M. Macrea suggested⁵¹, or it is only a better preservation of the initial building, or the image is the result of a reduced scale archaeological excavation.

Our study shows that LiDAR-derived DTM and topographic analysis can be combined successfully to identify and map the archaeological remains of the Roman *limes* in the forested area from Moigrad-Porolissvm, and can thereby contribute to the spatial reconstruction of the ancient Roman landscape. The use of these models rendered the recovery of archaeological remains significantly more reliable and quick. The key findings of this part of the research are that some DTM visualization techniques, including the most commonly applied technique of shaded relief modelling. As the already existing archaeological data that we can rely upon are scarce and new excavations are almost out of the question due to the fact that the entire area is heavily forested, our only alternative for a better understanding of the chronological relation between the structures already mentioned as well as their function was a detailed topographic analysis conducted employing high tech LiDAR scanning.

The main problem that can be discussed based on the accurate topographical image resulted after the LiDAR scanning is the chronological relation between the Citera fort and the

⁴³ GUDEA 1989, 91–93.

⁴⁴ TÓTH 1978, 7; 17/4a-b.

⁴⁵ TÓTH 1978, 18–19/6.

⁴⁶ OPREANU/LĂZĂRESCU/ȘTEFAN 2013.

⁴⁷ GUDEA 1989, 93; 525, IX.A.11.i., nr. 8.

⁴⁸ OPREANU 2013; OPREANU 2015.

⁴⁹ MORILLO/GARCIA-MARCOS 2005, 574.

⁵⁰ OPREANU 2013; OPREANU 2015.

⁵¹ MACREA/PROTASE/RUSU 1961, 376.

turf wall precinct of 270 × 180 m in size from its very neighbourhood. A first observation is the presence of a defence ditch on three sides of the fort. As these three sides look towards the interior of the annexed turf wall precinct it is obviously they were not contemporaneous, so the fort was not included in the precinct⁵². On the DTM of the area it is visible a pit (probably modern) which cuts the turf wall of the precinct just at the SE corner of the fort. For this reason it is impossible to establish if the precinct was added in a later period to the fort's defence wall as N. Gudea believes⁵³. As the existence of the precinct before the Roman period is highly improbable, it is more reasonable to consider it a temporary fort, very probable from Trajan's Dacian war time, but a later period, as the Marcomannic wars one, cannot be either eliminated from discussion⁵⁴. For the hypothesis of a temporary fort pleads the lack of any building and of archaeological materials inside the precinct area. If the precinct was really a temporary fort from Trajan's Dacian war period it was probably used as an operation base for the conquering of the Dacian fortified settlement from Măgura Hill situated at a few hundred meters distance. Additional support to this conclusion is provided by several examples of temporary forts used by Trajan's Roman army while attacking the Dacian kingdom's royal residence in the Sebeș Mountains. The best analogy among these forts is the temporary fort Comărnicele III⁵⁵. In this situation, immediately after the war ended and the province of Dacia was constituted, on the higher part of the Citera Hill was built a smaller turf and wooden fort for the watching of the Roman frontier under construction. Later, because of the strategic importance of this position, the fort was built in stone as a permanent fortification. Due to the lack of any inscription the military unit which garrisoned the Citera fort remains unknown. As the size of the fort was kept approximately the same in the stone phase we can suppose that the same military unit was camped inside the fort from the beginnings (AD 106) until its end.

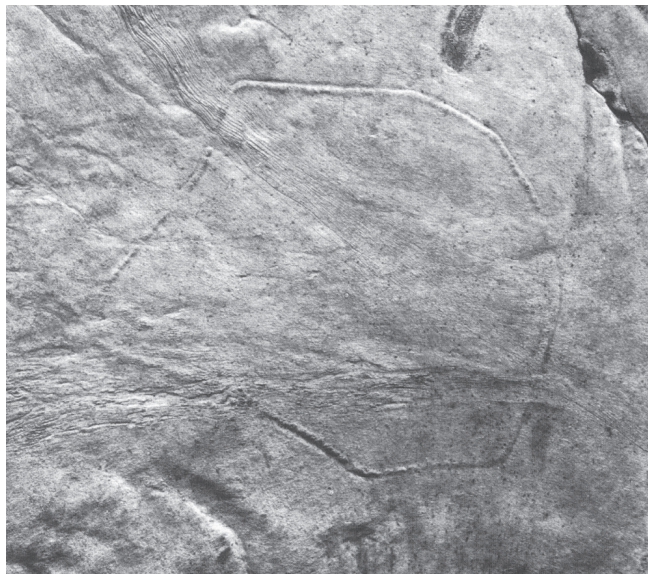


Fig. 4. The temporary fort at Comărnicele III (after ȘTEFAN 2005, 314, Fig. 156).

⁵² N. Gudea presumes that the fortified precinct is added to the fort and that it was used as training ground, that means that both of them were used simultaneously, see GUDEA 1997b, 50, no. 26a. However, such a hypothesis is highly improbable due to the steep terrain that the precinct includes. Equally unlikely seems to be the eventuality in which the precinct can be interpreted as an annexe of the fort because such structures have a totally different planning and aspect including also various buildings, see BAILEY 1994.

⁵³ GUDEA 1997b, 50, no. 26a.

⁵⁴ For examples coming from the Antonine Wall area dated during the middle of the 2nd century AD, see JONES 2005.

⁵⁵ ȘTEFAN 2005, 308–313; 314, Fig. 156; 315, Fig. 157.

The tile-stamp *CH III* indicates only the participation of this unit to the building in stone of the fort and of the interior buildings and cannot be considered as the garrison. That because the same stamp was also found in several buildings from the fort from Pomăt Hill, at the custom building, as well as in the Roman town⁵⁶. Using as a criteria only the small sizes of the fort from Citera, N. Gudea considered as a possible unit which occupied the fort Citera the *numerus Palmyrenorum Porolissensium*⁵⁷. It worth to add that the first record of this unit in Dacia under the name of *Palmyreni Sagitarii ex Syria*⁵⁸ dates from AD 120 and concerning its transformation into a *numerus* there is no written evidence which mentions that. At *Porolissvm* only two tile-stamps of the unit are known, one is coming from the fort at Pomăt Hill and the other from an unknown place⁵⁹. An inscription attests the rebuilding of the temple of *Bel* by the *numerus Palmyrenorum Sagitariorum*⁶⁰, an altar from the temple of *Nemesis* is put by a centurion from *numerus Palmyrenorum*⁶¹, while an altar with unknown place of discovery was dedicated to Herennia Etruscilla, the wife of the emperor Traianus Decius in AD 251, by *numerus Palmyrenorum Porolissensium Sagitariorum civium Romanorum Decianus*⁶². Using these written records it is not possible to support the presence of the unit in the fort Citera, as no inscription was found inside this fortification, nor any other specific artefact related to this unit⁶³.

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⁵⁶ OPREANU 2013; OPREANU 2015.

⁵⁷ GUDEA 1989, 174; PETOLESCU 2002, 141–143, nr. 76.

⁵⁸ IDR I, Dipl. 5.

⁵⁹ GUDEA 1989, 980, Pl. CXXI/17–18; in another paper the author states, without giving other details, that the tile-stamps bearing the NP inscription were discovered also during the excavations at the temple of *Bel*, see GUDEA/TAMBA 2005, 471, nr.2.

⁶⁰ GUDEA 1989, 762, no. 10.

⁶¹ GUDEA/TAMBA 2005, 472, nr. 5.

⁶² TÓTH 1989, 38, no. 50.

⁶³ For example, the spatial distribution of antler bow lath and bone arrowheads shows that they were found only in the military vicus area and inside the fort from Pomăt Hill, see VASS 2014, 102, Fig. 1; 111–112, Pl. I–II.

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