Achim Lichtenberger – Cornelius Meyer – Mkrtich H. Zardaryan

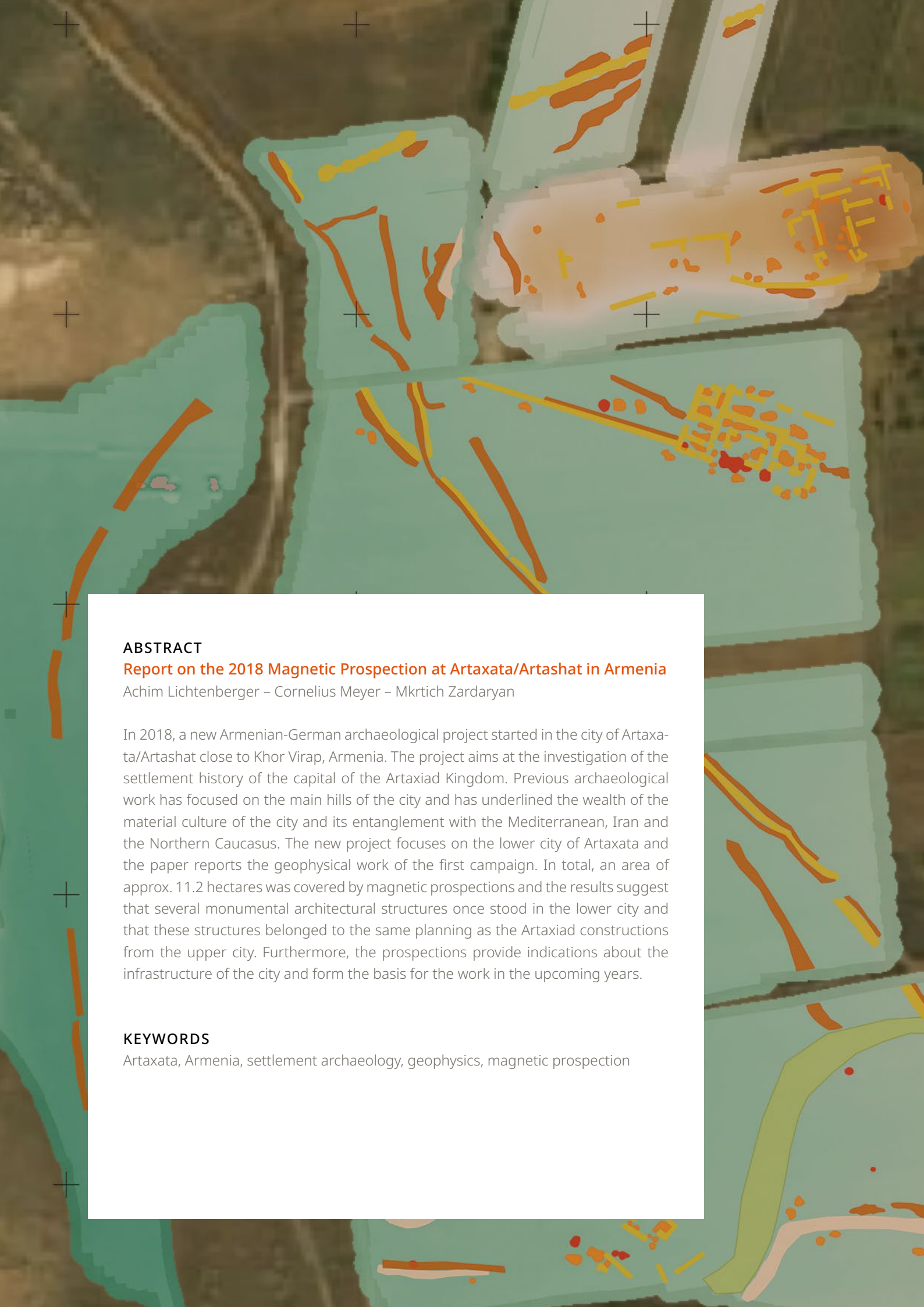
Report on the 2018 Magnetic Prospection at Artaxata/Artashat in Armenia

aus / from

Archäologischer Anzeiger

Ausgabe / Issue **2 • 2019**
Umfang / Length **§ 1–41**
DOI: https://doi.org/10.34780/aa.v0i2.1004 • URN: https://nbn-resolving.org/urn:nbn:de:0048-aa.v0i2.1004.1

Verantwortliche Redaktion / Publishing editor
Redaktion der Zentralen Wissenschaftlichen Dienste | Deutsches Archäologisches Institut
Weitere Informationen unter / For further information see **https://publications.dainst.org/journals/index.php/aa/about**
ISSN der Online-Ausgabe / ISSN of the online edition **2510-4713**



ABSTRACT

Report on the 2018 Magnetic Prospection at Artaxata/Artashat in Armenia

Achim Lichtenberger – Cornelius Meyer – Mkrtich Zardaryan

In 2018, a new Armenian-German archaeological project started in the city of Artaxata/Artashat close to Khor Virap, Armenia. The project aims at the investigation of the settlement history of the capital of the Artaxiad Kingdom. Previous archaeological work has focused on the main hills of the city and has underlined the wealth of the material culture of the city and its entanglement with the Mediterranean, Iran and the Northern Caucasus. The new project focuses on the lower city of Artaxata and the paper reports the geophysical work of the first campaign. In total, an area of approx. 11.2 hectares was covered by magnetic prospections and the results suggest that several monumental architectural structures once stood in the lower city and that these structures belonged to the same planning as the Artaxiad constructions from the upper city. Furthermore, the prospections provide indications about the infrastructure of the city and form the basis for the work in the upcoming years.

KEYWORDS

Artaxata, Armenia, settlement archaeology, geophysics, magnetic prospection

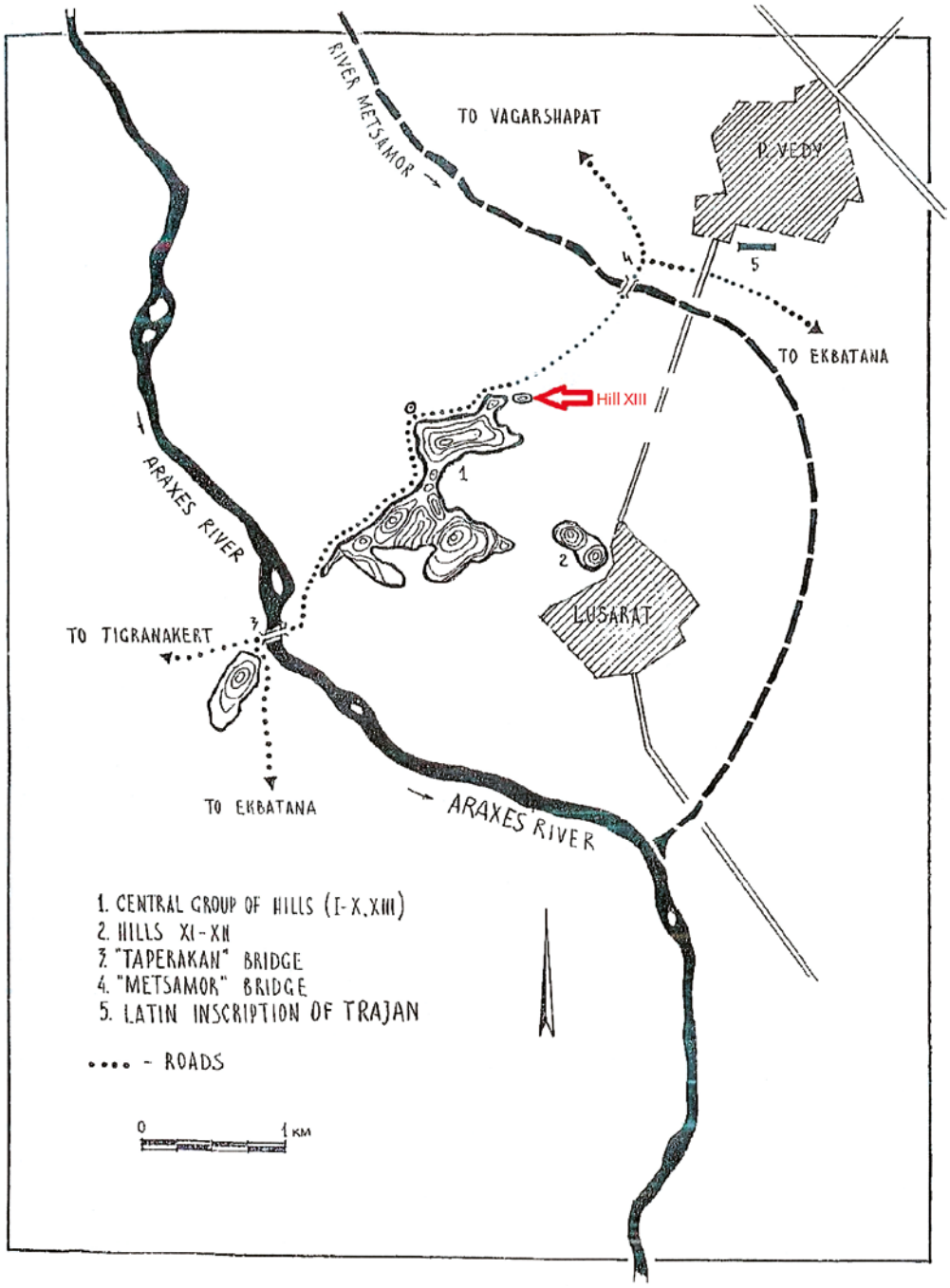
Report on the 2018 Magnetic Prospection at Artaxata/Artashat in Armenia

Introduction

1 In the framework of the Armenian-German Artaxata project led by the Institute of Archaeology and Ethnography of the National Academy of Sciences in Armenia (Mkrtich Zardaryan) and the Institute of Classical Archaeology and Christian Archaeology/Archaeological Museum of Münster University (Achim Lichtenberger), the Berlin-based company Eastern Atlas carried out a geophysical survey in the ancient city of Artashat/Artaxata in the Ararat plain in Armenia. The survey took place from September 18th to 23rd 2018 and covered approx. 11.2 hectares. The ancient city of Artaxata occupied a system of 11 interconnected hillocks, some smaller adjacent hillocks, and the surrounding plain (Fig. 1. 2)[1]. Since 1970, Artaxata has been a target of systematic archaeological excavations on the hillocks and exploratory work at the surrounding plain, which have revealed a rich picture of Artaxata's development. The areas surveyed during the 2018 magnetic prospection campaign are located on the top and on the intermediate terraces of Hill II (being the citadel of the city), on the plain to the east of Hills I and II, and on Hill XIII (where also a trial trench was excavated during the 2018 campaign). The Armenian-German Artaxata Project initiated in 2018 aims at the investigation of the hitherto unexplored Hill XIII in the Lower City and the areas south and southwest of it in the area of the Lower City of Artaxata.

2 The aims of the magnetic prospections were twofold: On the one hand, as previous archaeological excavations have revealed indications of fortifications, dwellings and other urban structures on the hills, the magnetic prospection was intended to confirm the existence of such constructions beyond the hills. On the other hand, at the surrounding plain, chance finds and earlier works have suggested that the city expanded to these areas, and so, the magnetic prospection was intended to check the possible

1 For the archaeological exploration of Artaxata, cf. Khachatryan 1981; Arakelyan 1982; Arakeljan 1984; Tonikian 1992; Tonikyan 1996; Zardarian – Akopian 1994, 175–180; Invernizzi 1998; Khachatryan 2005; Zardaryan 2018, 105–145.



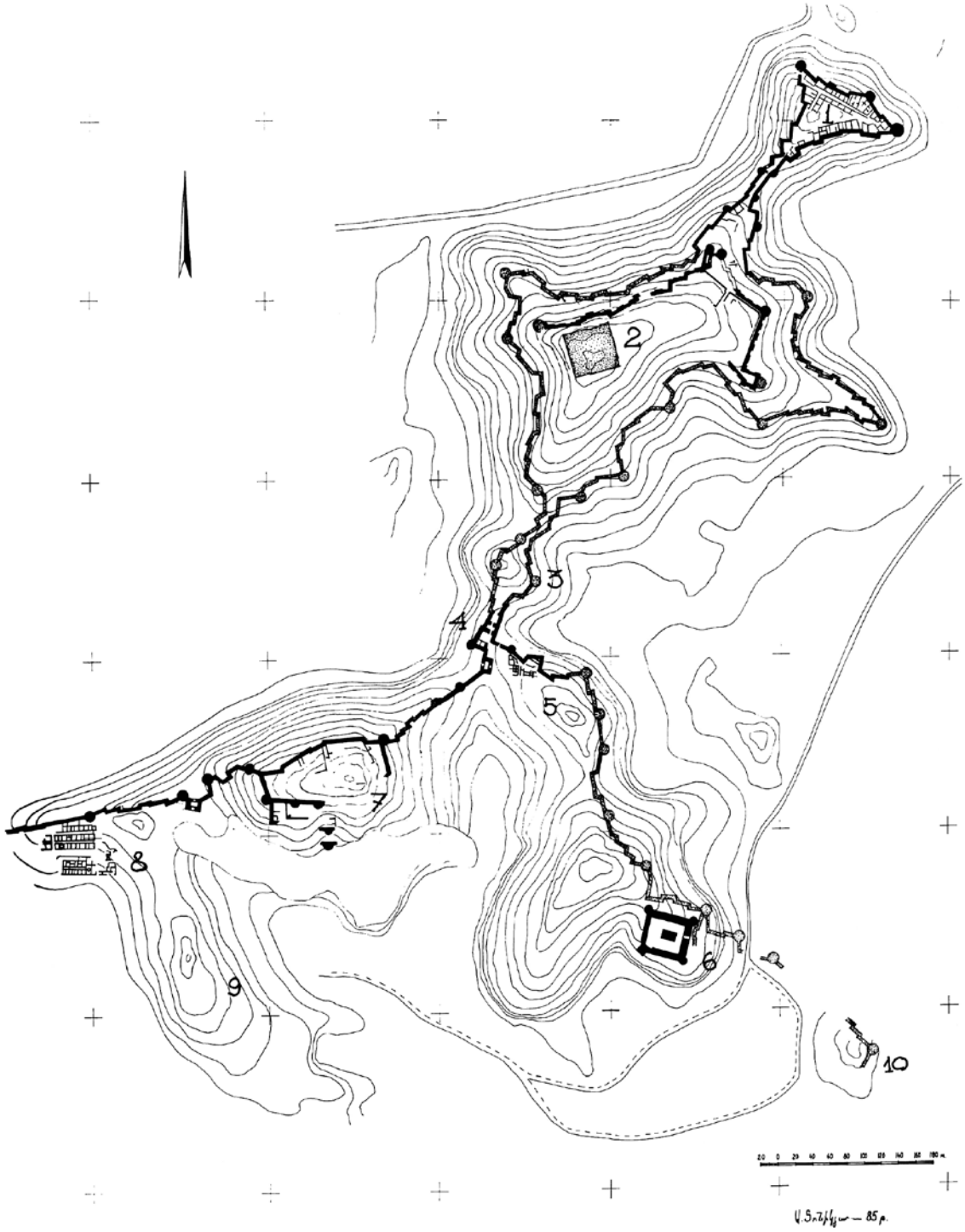
1

Fig. 1: Map of Artaxata and vicinity, red arrow marks the position of Hill XIII (scale 1 : 50 000)

existence of buried structures on these areas. Finally, the measurements on Hill XIII, a small hillock much altered by land improvement works during the 1950s and 1960s, had the aim of checking the existence of building remains, and confirming that this mound was part of the urban structure of Artaxata. At all sites, magnetic measurements were realised using the LEA MAX system carrying seven fluxgate gradiometer probes.

3 It is the aim of this report to present the magnetic data. The authors are fully aware that any conclusions drawn from the magnetograms are preliminary and subject to subsequent revision, as archaeological excavations are planned in the area[2]. Still, we deem it appropriate to provide other researchers with the data from the magnetic survey.

2 A limited test excavation was undertaken in 2018 on the northern slope of Hill XIII. Cf. for that Lichtenberger – Zardaryan (forthcoming).



2

Fig. 2: Plan of Artaxata (scale 1 : 7500)

Geology and Landscape

4 The ancient city of Artashat – Artaxata of Greek and Roman sources – is located in the heart of the Ararat plain (also referred to as Ararat valley or Ararat basin), to the northeast of Mount Ararat. This fertile plain, Armenia's largest agricultural zone, is an intermountain depression at a height of about 800 to 900 m above sea level divided by the Arax (river, situated in the central area of the Armenian plateau/or Armenian highlands). Artaxata was built on a group of at least fourteen hillocks located near the left margin of the river Arax in the northern part of the Ararat plain, only 1 km to the northwest of the modern village of Lusarat. Known as the Khor Virap hills (from the name of the Medieval monastery), these conspicuous hillocks crop out from the flat

alluvial plain being formed by tectonised Late Devonian–Early Carboniferous shallow marine carbonate and siliciclastic deposits developed in neritic facies (Famennian bioclastic limestones intercalating with thinner deposits of sandstones and quartzites and Tournaisian, slightly metamorphosed coral limestones). Several thick igneous rock (dolerites or altered basalts) sills, which most probably result from volcanic activity in the region during the Late Devonian regional volcanic period, are also present[3]. These stones were used for the constructions of the ancient city, but in most cases the stones only formed the foundations with mud brick architecture on top[4]. The surrounding plain is intensively used for agricultural production, and it is geologically generically characterised by fluvial-lacustrine and alluvial-prolluvial formations (loam, clay, and sandy loam) topped by cambisols, fluvial-lacustrine light brown alluvial soils poor in humus, and sandy lake deposits in the lower parts[5].

5 The strategic advantages of this site were superb. Ten of the hillocks, where the central part of the city developed, form a single system with a total area of about 1 km^2 and heights above the plain between 20 and 70 m. Other hillocks and smaller elevated areas most probably existed in the past, some possibly directly adjoining the main system, but they are today much altered or destroyed as a result of intensive quarrying and of large-scale earthworks for land improvement activities, particularly during the 1950s and 1960s. The main group of hillocks, impressively prominent on the surrounding plain, provided prime conditions for fortification; it was located at the crossroads of important long-distance and trans-regional trade routes, and dominated the extensive fertile and densely populated valley. The Arax and the Metsamor rivers formed natural defensive borders. The Arax river, flowing in the northwest–southeast direction, passed the western side of the city[6]. Artaxata was also bordered by the Metsamor river on the northern, northeastern and eastern side of the hillocks (its course has not been exactly determined), and the Metsamor joined the Arax river just a couple of kilometres to the south of the hillocks (today these two rivers meet c. 30 km upstream from Artaxata).

6 Artaxata was the capital of the Armenian Kingdom of the Artaxiads, which had renounced from the Seleucids[7]. Earlier settlements already existed at the site, namely considerable settlement structures from the Urartian period[8]. The Artaxiad city was founded in the eighties of the 2nd century B.C., by the time of King Artashes/Artaxias I (189–160 B.C.). It quickly became an important metropolis of Armenia. According to the legend, Hannibal gave the suggestion to establish the city at this point because of the favorable natural location between two rivers (Strab. 11, 14, 6; Plut. Lucullus 31). According to Strab. 11, 14, 6, Artaxata was a royal residence. Under King Tigranes II (96–55 B.C.), the kingdom of Armenia expanded and even reached into the southern Levant. An Armenian campaign of the Roman commander Lucullus brought him in 69 B.C. also to Artaxata (Plut. Lucullus 32). In this context, Plutarch calls Artaxata »Armenian Carthage«, emphasizing not only Hannibal's alleged involvement in the founding, but also the importance of the city and its antagonism to Rome. Lucullus was beaten by Tigranes II and driven out of the country. However, Armenia remained contested between Rome and the Parthians. In A.D. 58, the inhabitants of Artaxata opened the gates to the Romans under Corbulo. Since the conquered city was too large and too difficult to defend, Corbulo destroyed Artaxata (Tac. Ann. 14, 23, 1; Cass. Dio 62, 19–20). The Romans were then defeated by the Parthians in Armenia and a new dynasty was

3 Ginter et al. 2011.

4 Kanetsian 1998, 55–63.

5 Valder et al. 2018.

6 On the Arax river, cf. now Traina 2018.

7 On the history of Artaxata, see in general Arakelyan 1982; Kanetsian 1998; Khachatrian 1998; Traina 1999/2000.

8 See now Zardaryan 2018.

3

Fig. 3: Artaxata, magnetic prospections in the lower city with Khor Virap Monastery in the background

established in Armenia, the Arsacids, whose first king Tiridates I went to Rome, was confirmed there by Nero as king and received a large compensation for the destruction of Corbulo with simultaneous recognition of the formal dependence of the Armenian kingship of Rome (Cass. Dio 63, 6). Subsequently, the city remained the royal residence. Under Trajan (A.D. 114–116) and under Marcus Aurelius (A.D. 163) Artaxata was short-lived conquered by the Romans, resulting in Roman military occupation. But already in A.D. 186, the Romans definitively left the country again. Artaxata remained a metropolis, and only in the 3rd/4th century A.D., ponding and swampification led to a general decline of the area. In A.D. 368, the Sassanid king Shapur II destroyed Artaxata (Faustus Byz. 4, 55), but the city, which is mentioned on the Tabula Peutingeriana (XI 4), remained a trading hub also in the 5th century A.D. (Cod. Ex. 4, 63, 4).

7 Today, the only standing construction on the hillocks is the monastery of Khor Virap (Fig. 3). The existence of this monastery led to the development of a cemetery that has grown exponentially during the last few decades, today almost entirely occupying the plain indentation between the Hills II, III, V and VI.

Methodology

General

8 Magnetic anomalies are caused by changes in the complex magnetic properties of the soil. The amplitude of the magnetic anomalies is determined by the contrast between the different magnetic susceptibilities of archaeological structures and surrounding uninfluenced soil, as well as by the volume and depth of the magnetic structures. Two types of magnetisation can be observed during magnetic measurements: the induced and the remanent magnetisation. The induced magnetisation is ascribed to the effect that the elementary magnets of a matter are enhanced by external magnetic fields (e. g. the Earth's magnetic field), and, consequently, partly align with it. The propensity for this alignment and the enhancement's strength is determined and described by the magnetic susceptibility. In soils, the highest magnetic susceptibility values are observed at ferromagnetic or ferrimagnetic minerals like the iron oxides magnetite and maghaemite. These minerals occur ubiquitously in the soil, forming microscopically small grains. There are several possibilities to explain their origin and concentration in soils:

- a) Heating: In soils with rich organic content and in reducing conditions, iron oxides of low magnetisation can be transformed into magnetite and maghaemite under the influence of fire[9].
- b) Microbial mediation: Microbes populating rich organic deposits can change the soil conditions sufficiently to favour the conversion of weakly magnetised iron oxides into more magnetic forms[10].
- c) Magnetotactic bacteria: These bacteria are able to produce intracellular crystalline magnetite which allows them to navigate using the Earth's magnetic field. These magnetite crystals remain in the soil after the death of the bacteria[11].
- d) Pedogenetic origin: The magnetic susceptibility can increase during soil formation processes in which organic material is absent[12].
- e) Incorporation of magnetic material: Increased magnetisation of the topsoil can be a result of anthropogenic accumulations of magnetic materials.

9 Rocks and soil materials rich in ferromagnetic iron oxides are the carriers of induced magnetisation. Therefore, volcanic rocks, in particular, are characterized by strong magnetic field amplitudes that can be traced back to their induced magnetization. While induced magnetisation requires an external magnetic field for its development, remanent magnetisation stays fixed in a material after its creation. The most important type of magnetic remanence is caused by the heating of a material over its specific Curie temperature. When this happens, the elementary magnets become mobile and align with the external Earth's magnetic field. During the subsequent cooling, the alignment of the magnets is conserved, and, consequently, the burnt material becomes a strong magnet. Since the average Curie temperature of soil components is around 650°C, fireplaces, kilns, layers of burnt daub, accumulations of pottery, and other burnt materials can be detected on the base of this effect[13].

10 In addition, other types of remanent magnetisation can occur in soils. For example, small grains of magnetic minerals tend to align with the external magnetic field during sedimentary processes, producing the so-called detrital or depositional remanent magnetisation (DRM). This effect can also be observed in anthropological deposits, and thus remanent magnetisation can be registered in filling materials of human-made pits or ditches[14].

11 Another important magnetic phenomenon is the diamagnetism. Structures mainly composed of diamagnetic materials, like quartz or calcite, cause noticeable negative anomalies. Diamagnetic materials literally repel the external magnetic field and form a strong magnetic field in the opposite direction, so that the resulting anomaly field has negative amplitudes. Based on this effect, buried constructions of limestone and quartzite as well as fills of sand and calcareous sediments can be identified in the magnetic data as anomalies with negative amplitudes of the magnetic gradient. The same effect occurs at unfired mud brick structures, even though the causal physical effect is not completely clear yet.

Technical Application

12 For the magnetic measurements, an array of seven Förster fluxgate gradiometer probes was used. The probes were mounted on a light and foldable cart. This gradiometer array is a component of the convertible LEA MAX system.

9 Le Borgne 1955.
10 Linford 2004.
11 Fassbinder et al. 1990.
12 Maher – Taylor 1988.
13 Schmidt 2009.
14 Fassbinder – Becker 2003.

13 The Förster FEREX CON650 fluxgate gradiometer probes register the vertical gradient of the vertical component of the Earth's magnetic field with an accuracy of 0.1 nT (Nanotesla). The measured gradient (the difference between two vertically arranged sensors in the gradiometer probe) is insensitive to the typically large fluctuations of the Earth's magnetic field, and is determined only by the magnetisation of local subsurface objects. The technical details concerning the measurements are specified in the Table. The greyscale images of the investigated sites are presented in dynamic scales from ±10 nT to ±5 nT.

14 The data positioning for the magnetic survey was realised by means of differential GPS, using two GNSS receivers SMART V1G (NovAtel) in RTK mode (Real-Time Kinematic) to achieve a relative accuracy of 2 cm. The coordinate system used during the magnetic measurements was WGS84 UTM Zone 38N (EPSG: 32638). The base position was corrected by means of the post-processing of the GPS raw data (RINEX), using the position data provided by the IGS station Aruch-Yerevan (ARUC00ARM), located 30 km to the northwest of Yerevan. Thus, the absolute accuracy of the data positioning is in the range of 2 to 10 cm. As a result, the magnetic data and their interpretation are presented in the coordinate system WGS84 UTM Zone 38N (EPSG: 32638).

Results

15 The data shown on the maps are generally successful in reflecting the archaeological situation and the surface conditions at the investigated areas. Some parts of the investigation area could not be covered by magnetic measurements due to the presence of crops, fruit plantations, bushes, and other constraints.

16 The general approach to classify the magnetic anomalies is to distinguish them respectively by means of their amplitudes, polarization, and shape. As part of the first step, anomalies of unambiguously modern human origin were separated and marked

Colour	Magnetic anomaly type	Amplitudes	Type of magnetisation	Related structures
	Distinct circular and oval positive anomalies	+1 to +5 nT	Induced and remanent	Fillings of pits and post holes, fillings that may contain pottery fragments, burnt daub and pottery fragments
	Linear but partly irregularly shaped zones of positive anomalies	+1 to +5 nT	Induced and remanent	Organically enriched fillings of ditches, fillings of construction debris enriched with burnt daub and pottery fragments
	Distinct dipole anomalies of moderate to high amplitudes	±5 to ±20 nT	Predominantly remanent	Remains of kilns and fire places, accumulations of burnt material and ashes
	Linear anomalies of moderate amplitudes	-2 to -10 nT	Diamagnetism	Remains of walls and foundations made of limestone and unfired mud bricks
	Linear patterns of weak dipole anomalies	±1 to ±5 nT	Unclear	Magnetic anomalies caused by ploughing marks and field boundaries
	Extended zones of weak positive and negative anomalies	±1 to ±5 nT	Induced and remanent	Geomorphological structures, e.g., bedrock rises and silted up water courses
	Clearly defined dipole anomalies	>±20 nT	Induced	Modern disturbances caused by scrap metal, fences and other ferromagnetic sources

Fig. 4: Artaxata, colour scheme of magnetic data interpretation

4

in blue colour. The second step was to sort the remaining anomalies that were assumed to have an archaeological or geomorphological background. In order to structure these anomalies, several classes were introduced with corresponding causal physical structures. The specific characteristics of the anomalies, the related archaeological structures, and the color scheme, as used in the interpretation maps, are set out in Fig. 4.

Lower Town and Hill XIII

17 The investigated area of the Eastern Lower Town of Artaxata extends over approximately 14 ha on the lowlands to the east of the hillocks. Due to the fertile soils and the favorable humidity conditions, the zone is intensively used for agricultural purposes. At the time of the measurements the majority of the areas were easily accessible, because only low crops existed on the fields. However, the areas with vineyards had to be left out. The area to the west of the dirt road was overgrown by dry shrubs and bushes, which had to be mowed with heavy machinery before magnetic measurements could be carried out. Fig. 5 shows an overview of the investigation area after this western sector has been cleaned of the dry shrubs and bushes.

Fig. 5: Artaxata, eastern lower city, view from the northwest

5

18 The results of the magnetic survey of the Artaxata's Eastern Lower City are displayed on the overview maps Fig. 6 (grey scale values of ±10 nT) and Fig. 7 (grey scale values of ±5 nT). Based on the GPS data collected during the magnetic measurements a digital terrain model was created. The superimposition of magnetic data and terrain model is shown on the map Fig. 8. The interpretation can be found on map Fig. 9. Map Fig. 10 shows a superimposition of the digital terrain model and the interpretation of the magnetic data.

19 The magnetic data displays a great variety of features. Areas with low magnetic contrast alternate with zones of strong magnetic anomalies over relatively short distances. The modern impact is especially visible along the field boundaries. Strong dipole anomalies indicate the positions of reinforced concrete posts, water pipelines, and pieces of scrap metal. All magnetic anomalies clearly classifiable as modern ones are marked in blue and summarized on the overview map Fig. 11. Additionally, all linear features that can be correlated with plough marks are displayed in light blue.

20 In addition to the anomalies of modern origin, there are numerous other anomalies of various forms, obviously reflecting parts of the ancient underground structures. These anomalies and the related archaeological structures are discussed below, starting from the ones to the north and towards the south.

6 Fig. 6: Artaxata, magnetogram of the eastern city at greyscale values of ±10 nT

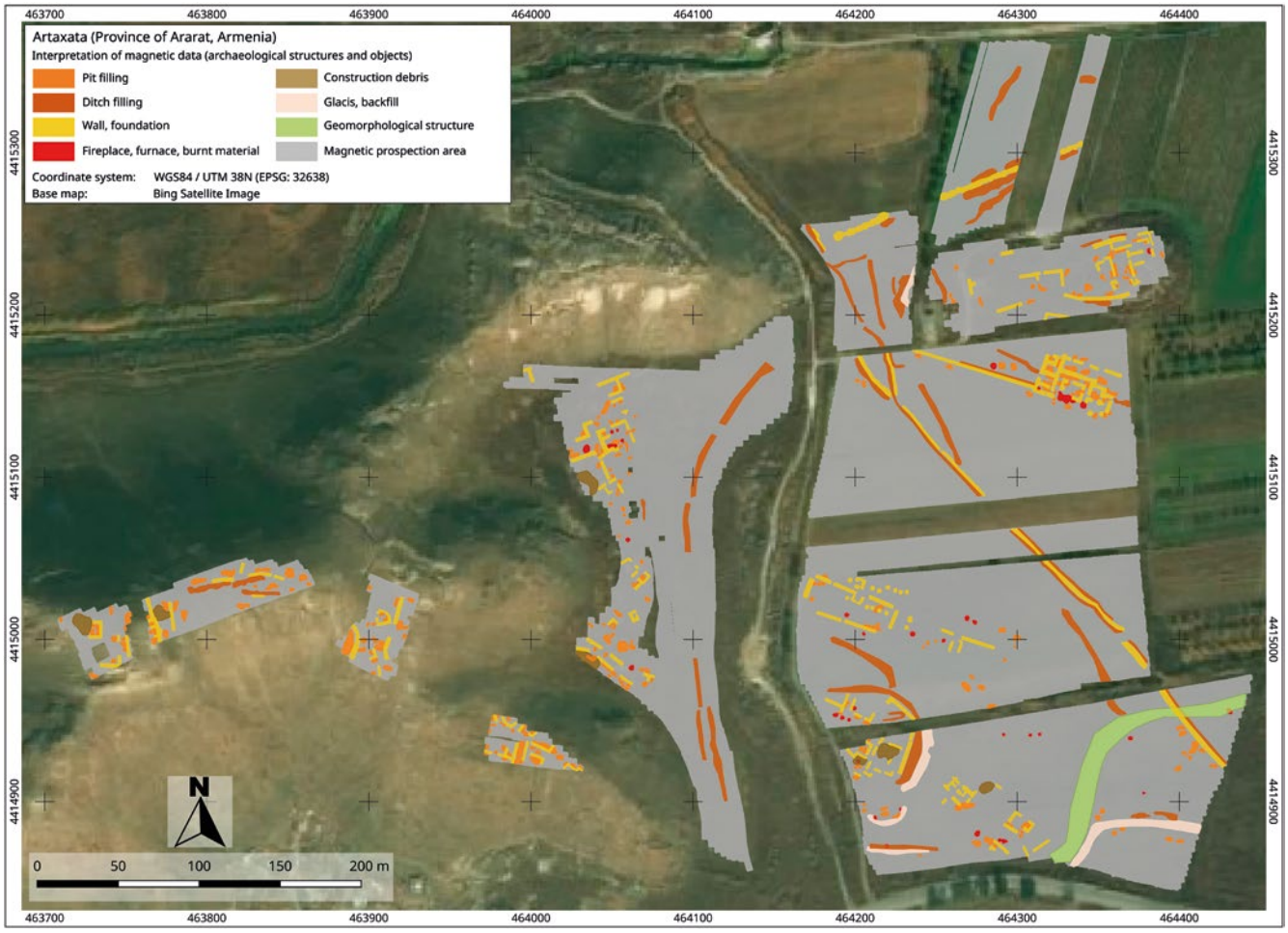
7 Fig. 7: Artaxata, magnetogram of the eastern city at greyscale values of ±5 nT

Fig. 8: Artaxata, superimposition of magnetic data and terrain model

8

The Linear Northwestern Anomaly

21 In the field to the north and northwest of Hill XIII some linear structures with different orientations can be observed. The most striking structure is composed by an ENE-WSW running row of single anomalies of high negative amplitudes. These single spots have a regular distance between themselves of approximately 4 m and can be traced along a distance of at least 160 m. Their amplitudes and regular order clearly indicate a human-made structure, directed at the northeastern foot of Hill I. Towards the west, the amplitudes decrease and its regular shape fades out. Therefore, it can be assumed that the depth of the structure increases towards the west. However, it must be left open whether these very conspicuous anomalies are caused by an antique or a modern construction. Further positive anomalies with a linear character most probably show the fillings of ditches. A clear classification of the anomaly is not possible at the moment.



9

Fig. 9: Artaxata, interpretation of magnetic data

Hill XIII

22 The magnetic data on Hill XIII clearly fall out of the dominant pattern. As the hill itself cannot be used for agriculture, garbage and scrap metal of recent decades have accumulated on it. In addition, a meteorological station has been recently moved from the northern edge of the hill to its western edge. All these interventions are clearly reflected in the high amplitudes of the magnetic data. Despite these limitations, indications of archaeological structures can be found in the data. Especially at the eastern side of the hill, its highest part, several linear negative anomalies can be observed. They indicate the presence of a rectangular building on a surface of approximately 30 m × 40 m, probably with limestone foundations and remains of unfired mud brick walls. Further to the west only some fragments of linear structures can be distinguished in the data, though indicating the continuation of the rectangular building structures. Along the northern and the southern edges of the hill more linear structures appeared, being probably related to thicker walls and filled ditches, which suggest a sort of fortification or terrace walls around the hill.

23 During the 2018 investigation of the Armenian-German Artaxata project a test trench was excavated at the northern slope of Hill XIII[15]. Although no built in-situ structures were encountered, material from the 1st/2nd centuries A.D. was retrieved, among them extensive remains of mud brick architecture. If this test trench is representative of the structures on top of Hill XIII, it might give an indication of the date of the structures. But this conclusion must be regarded as preliminary.

15 Lichtenberger – Zardaryan (forthcoming).

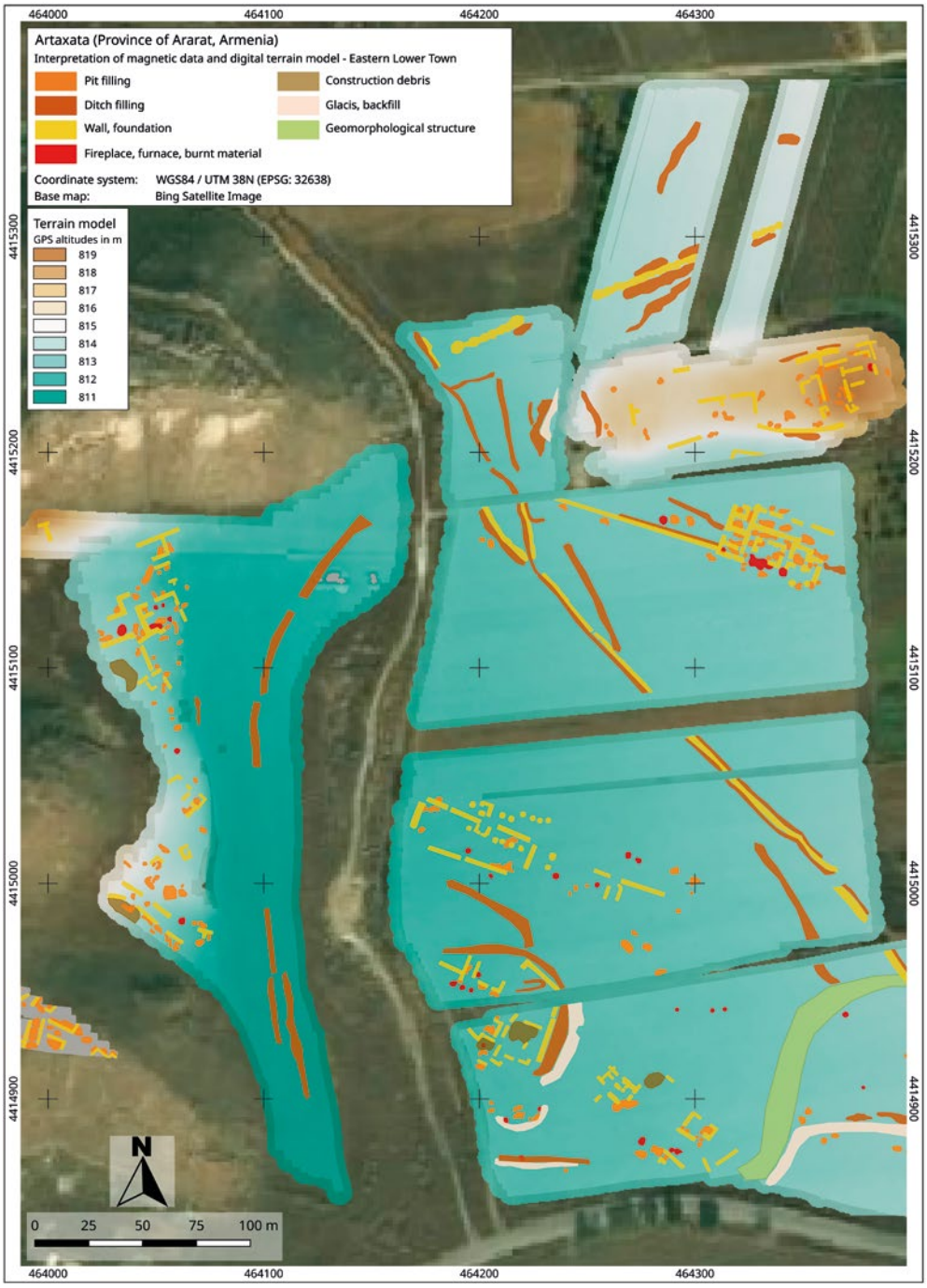
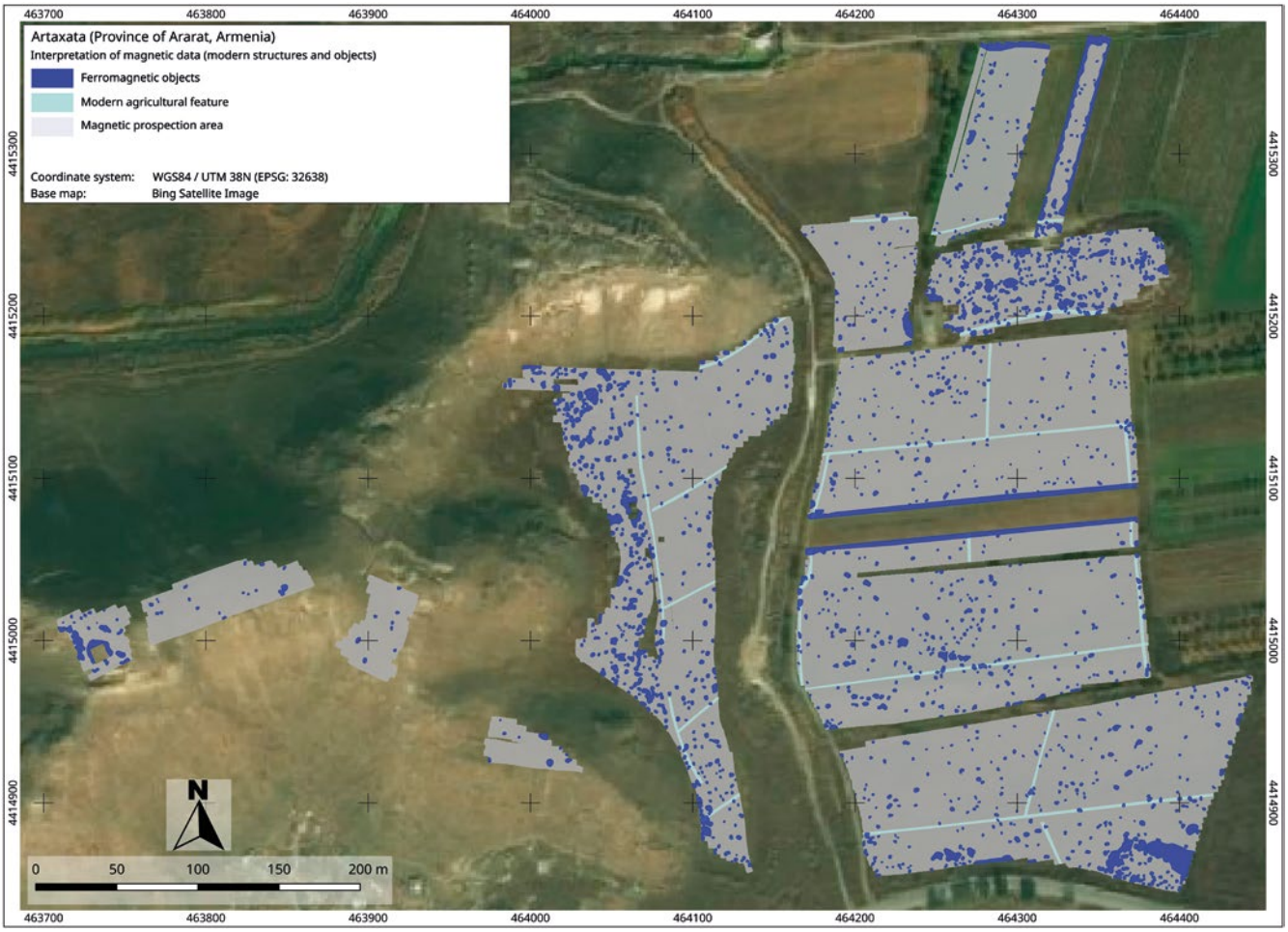


Fig. 10: Artaxata, superimposition of the digital terrain model and the interpretation of the magnetic data

10

The Rectangular Building

24 Further to the south, at a distance of around 50 m from the southern foothill, a clear anomaly pattern of negative magnetisation can be identified. It seems very likely that their cause lies in the existence of remains from a rectangular and regular built complex. Its dimensions of at least 50 m × 28 m and the clearly defined 1 to 1.5 m thick walls suggest an ancient building complex of representative character. It can also be assumed that the top of the preserved foundations is found at depths of only a few decimeters from the surface. The located constructions probably had foundations of limestone blocks on which mud brick walls were built. At the southern edge of the complex, an area of dipole anomalies of slightly increased amplitudes indicates the presence of remains of ovens or accumulations of combustion residues. From the southwestern edge of the complex a linear structure, expressed in negative and positive magnetic anomalies, runs in the WNW direction over a distance of 75 m, before disappearing



11

Fig. 11: Artaxata, modern magnetic anomalies

below the modern dirt road. The characteristics of the anomaly may be related to an approx. 2 m wide road plastered with limestone, and a parallel ditch[16].

25 Since we have no pottery data related to the rectangular building, a chronological discussion is not possible. Regularly built monumental houses are attested from the Urartian to the late Classical (›Roman‹) periods, and also a typological comparison does not contribute to a dating of the structure. Only an excavation will clarify this.

A Street?

26 According to the magnetic data, to the south and southwest of the prominent building complex, an area of about 3 hectares seems to be free of any archaeological structures, except for an almost 400 m long cluster of linear structures running from the NW to the SE. They show changing anomaly characteristics: partly they are negatively magnetized, while, in other areas, stripes with positive and negative magnetization run parallel and next to each other. At their northern section, several bifurcations can be observed. However, only based on the magnetic data, their archaeological interpretation remains unclear. It cannot be decided whether the magnetic anomalies are related to a road or to another type of ancient construction.

A Hall?

27 In the southwest of the supposedly empty area, another larger building complex can be recognised in the data. Here the magnetic anomalies are more fragmented

16 Sahinyan 1988, 41–45; Kanetsian 1998, 37–42; Ter-Martirosov 2008, 89–101. But, see also Khachatrian 1998, 109 for Artaxata.

and extend over an area of 140 m × 30 m. However, it is obvious that this complex has the same orientation as the rectangular building identified south of Hill XIII. The distance between these two parallel building structures is about 150 m. The weak negative anomalies reveal some linear structures running in the NW-SE direction and some single spots of negative magnetisation in more or less regular rows. The distance between these spots varies between 3 and 4.5 m. They may indicate the preserved bases of columns. The magnetic anomalies of limestone foundations are accompanied by positive anomalies indicating fillings of pits and either accumulations of combustion residues or remains of ovens. The fragmented character and the low amplitudes of the magnetic anomalies suggest either a poorer preservation status compared to the complex further north or a thicker topsoil layer, and thus deeper building remains.

28 Again, a precise architectural interpretation of the structure is not possible prior to excavation. It is however relevant, that the hall-like structure runs parallel to the rectangular building, and, therefore, probably belongs to the same building or at least to a related planning phase[17]. Colonnades are known from Artaxata from the 1st–4th century A.D. so-called Riverside Palace[18], but, without a chronological indication and archaeological confirmation, this comparison remains hypothetical.

Miscellaneous Structures

29 South of the ›hall‹, further smaller building complexes can be identified by means of the magnetic data. Partly, the magnetic data indicate the existence of ramparts and ditches around them. Since the southern part of the surveyed area is the one with the lowest ground level of the alluvial plain, it is conceivable that the buildings were erected on artificial elevations in order to protect them from flooding. The orientation of the smaller building complexes roughly is similar to the one of the larger complexes further north.

A River Bed?

30 In the southeastern corner of the area, a curved stripe of slightly increased positive magnetization suggests a silted up water course. Since this course is cut by the prominent linear anomalies crossing this area from the NW to the SE, it is likely that the water course was already silted up in ancient times. It cannot be ruled out that this was an ancient branch of the Metsamor river heading west, but this remains to be investigated.

Modern Disturbances?

31 The origin of the anomaly group in the extreme southeastern corner of the measured area, extending on an area of more than 2,000 m^2, cannot be clarified unambiguously. The high amplitudes as well as the proximity to the modern road rather suggest a modern origin.

The Western Area

32 The measuring area at the foot of the hills of Artaxata is separated from the previously mentioned area by an inaccessible strip, which probably corresponds to the course of a Hellenistic fortification line. In this area, a clear division in two parts is discernible. While the magnetic data on a 20 to 40 m wide strip along the hill foot indicate the existence of dense building remains, the lower area to the east of it seems

17 It is roughly the same orientation as the Hellenistic northern street on Hill I. But, since the urban layout of Hill I is strongly influenced by the natural topography, we cannot necessarily conclude that the orientation relates to the buildings in the plain.

18 Cf. the preliminary report by Khachatryan 2005.

to be free of archaeological structures, except for a N-S running ditch system. Since the boundary between the areas is clearly recognizable in the terrain by an approx. 1 m high terrain step, the probable reason for this distinction is the extensive leveling of the site for agricultural purposes during the past decades, which has led to a widespread destruction of ancient remains in the ground.

33 Of the detected building remains, a complex of about 37 m × 20 m in the northern part stands out in particular. Here, the magnetic anomalies suggest preserved foundations and accumulations of combustion residues. In the central part, at the foot of Hill II, a group of parallel structures of negative magnetisation indicates the existence of an ancient access to the hill. However, the significance of the magnetic data in this area is limited, due not only to the assumed mechanical levelling but also to waste deposits and remains of reinforced concrete scattered over the more elevated part of this area. Clearly controlled and regulated access of different parts of the Upper City of Artaxata is also encountered elsewhere, and seems to be a characteristic of the urbanism and the fortifications of the royal residence city[19].

Terraces on Hill II

34 The investigation of the terraces at Hill II included magnetic measurements on four individual areas with a total surface of approx. 7,300 m^2. It is assumed that on Hill II the basileia of Artaxiad Artaxata was situated[20]. The total envelope area extends to 1.4 hectares. The measuring conditions differ considerably from those found on the survey areas in the Eastern Lower City. The rocky terrain, partly with open excavation trenches, limits the information value of the magnetic data.

35 The lowest of the investigated terraces shows clear indications of buildings. Despite the small dimensions of the survey area, a pattern of E-W and N-S running foundations and walls can be recognised. While the foundations, mainly made of limestone blocks and blocks of low-magnetised metamorphic rock, show negative magnetic anomalies, likewise to the observations in the Eastern Lower Town, here positive anomalies indicate the fillings of rooms between the foundations. These fillings may be composed of construction debris, burnt material such as tegulae and fragments of pottery as well as of combustion residues from hearths and ovens. Due to the absence of a topsoil layer, it can be assumed that the detected archaeological structures are only under a debris layer a few centimetres or decimetres thick, if they are not even visible directly on the surface.

36 The magnetic data from the upper second terrace, located about 100 m to the northwest, are less significant when compared to the first one. However, some indications of the existence of building structures can be derived from the data. The lower data quality is probably due to soil movements related to archaeological excavations at the fortification walls. In some areas, the material on the surface seems to consist of spoiled material from these excavations.

37 Further to the west, at a distance of about 60 m, a third terrace was investigated. There, the magnetic data show linear positive and negative anomalies running along the E-W orientated ridge in the direction of the hilltop. At the western end of the terrace, the data suggest the existence of massive walls belonging to a larger building complex or to a sort of fortification of the hilltop.

38 On the hilltop itself less favourable measuring conditions were found. The large steel tube frame of a trigonometric point, several modern fireplaces, and waste deposits limit the significance of the magnetic data. Nevertheless, traces of rectangular building remains with a N-S orientation can be observed, which confirm the basic assumptions regarding the structure of the hill of a built-up area.

19 Kanetsian 1998, 15–26.

20 Tonikian 1992, 172.

39 In general, the terraces offered less favourable conditions for magnetic measurements compared with the plains in the Eastern Lower Town. Moreover, the rough surface does not allow georadar measurements to be carried out as an alternative, therefore, the magnetic prospection remains the only available method to obtain information about the archaeological structures hidden underground.

Summary

40 In the perspective of the stated survey objective, the magnetic survey provided good results that, by all means, contribute to the overall understanding of the ancient settlement structure of Artaxata. Based on the results of the magnetic measurements carried out in 2018, the following conclusions are made:

- Several large building complexes in the Eastern Lower City were identified. In general, the buildings follow a NW-SE orientation. The probably best preserved remains are expected to exist in an area about 50 m to the south of Hill XIII. The negative magnetic anomalies suggest the existence of limestone foundations with remains of mud brick walls. Further to the south, other, less clearly definable building complexes were found.
- Despite the modern transformations and waste deposits, the existence of preserved building structures was confirmed on Hill XIII. In particular, on its eastern end, i. e. on its most elevated part, an enclosing structure and a rectangular building complex were localised. Since the linear structures indicating building structures show a negative magnetisation, it can be assumed that the building material was limestone and unfired mud-bricks.
- Furthermore, the area of the Eastern Lower City is crisscrossed by linear structures of unclear characteristics. To the north of Hill XIII, a longer than 150 m long linear structure running from the ENE to the WSW and probably ending at the foot of Hill I was observed. Another linear structure crosses the area from the NW to the SE over a distance of more than 400 m. The observed varying anomaly characteristics make difficult their clear assignment to ancient structures. However, a modern origin can be excluded with a high level of probability.
- Another built-up area was identified at the feet of Hill I and Hill II. The investigated area, located to the west of the assumed course of the Hellenistic city wall, showed a clear division between its western part, where ancient structures are preserved, and its eastern part, which most likely has been levelled in modern times, probably resulting in a profound destruction of possible ancient features.
- The results obtained at the terraces of Hill II confirm the assumption of a dense ancient development on the hills. Due to the rough surface conditions and the limited dimensions of the surveyed areas, the data quality is lower than the one achieved in the plains of the Eastern Lower City. Thus, the conclusions based on the magnetic survey must remain fragmentary.
- In order to refine the archaeological interpretation of the magnetic data and to contribute to the archaeological contextualization, in the coming years the Armenian-German Artaxta Project will investigate features of unclear origin by means of direct interventions such as drilling and test trenching.
- More information on the geomorphological formation of the Eastern Lower City area maybe obtained by means of geoelectrical measurements (Electrical Resistivity Tomography). Electrical 2D and 3D data can help to identify silted up river arms and human-made elevations. GPR is not recommended as a convenient survey method, because in the plains of the Eastern Lower City the clay-rich and well saturated soils offer unfavourable conditions to obtain a sufficient investigation depth and an acceptable spatial resolution.

Acknowledgements

41 The authors are listed alphabetically. The authors would like to thank the team members of the 2018 campaign for their excellent contribution to the project, namely the archaeologists Syuzanna Muradyan (Yerevan), Hayk Gyulamiryan (Yerevan), Saskia Erhardt (Münster) and the geophysical team of Eastern Atlas Berlin, Henning Zöllner and Pedro Manuel Lourenço Gonçalves. Special thanks to our driver Ashot Khachatryan. Thanks are also due to Torben Schreiber (Istanbul) who helped with the preparation of the campaign. The first campaign was undertaken with the financial support of the Armenian Academy of Science and the Westfälische Wilhelms-University Münster, to whom we are grateful.

References

Arakelyan 1982 B. N. Arakelyan, Artashat I (Yerevan 1982)

Arakeljan 1984 B. V. Arakeljan, Les fouilles d'Artaxata. Bilan provisoire, REtArm 18, 1984, 367–381

Fassbinder – Becker 2003 J. W. E. Fassbinder – H. Becker, Magnetometerprospektion des großen Kurgans 1 von Bajkara, Kasachstan, Archäologie in Eurasien 16, 2003, 131–136

Fassbinder et al. 1990 J. W. E. Fassbinder – H. Stanjek – H. Vali, Occurrence of Magnetic Bacteria in Soil, Nature 343, 1990, 161–163

Ginter et al. 2011 M. Ginter – V. Hairapetian – A. Grigoryan, Chondrichthyan Microfossils from the Famennian and Tournaisian of Armenia, Acta Geologica Polonica 61, 2011, 153–173

Invernizzi 1998 A. Invernizzi (ed.), Ai piedi dell'Ararat. Artaxata e l'Armenia ellenistico-romana (Florence 1998)

Kanetsian 1998 A. Kanetsian, Città e insediamenti nell'Armenia di età classica, in: Invernizzi 1998, 1–94

Khachatrian 1998 Z. Khachatrian, Artaxata, capitale dell'Armenia antica (II sec. A.C.– IV sec. D.C.), in: Invernizzi 1998, 97–158

Khachatryan 1981 Z. D. Khachatryan, Artashat II. Antik dambaranadashter (1971–1977 tt. peghumnere) = Artashat II. Classical Necropolises (Excavations of 1971–1977) (Yerevan 1981)

Khachatryan 2005 Z. D. Khachatryan, Archaeological Research in Artaxata. Preliminary Report 2003–2004, Parthica 7, 2005, 19–28

Le Borgne 1955 E. Le Borgne, Susceptibilité magnétique anormale du sol superficiel, Annales de Géophysique 11, 1955, 399–419

Lichtenberger – Zardaryan (forthcoming) A. Lichtenberger – M. Zardaryan, Preliminary Report of the 2018 Campaign of the Armenian-German Artaxata Project, Boreas (forthcoming)

Linford 2004 N. T. Linford, Magnetic Ghosts: Mineral Magnetic Measurements on Roman and Anglo-Saxon Graves, Archaeological Prospection 11, 2004, 167–180; DOI: 10.1002/arp.232

Maher – Taylor 1988 B. A. Maher – R. M. Taylor, Formation of Ultrafine-Grained Magnetite in Soils, Nature 336, 1988, 368–370; DOI: 10.1038/336368a0

Sahinyan 1988 A. A. Sahinyan, Arkhitektura Antichnikh sooruzhenii Garni = Architecture of the Classical Constructions of Garni (Yerevan 1988)

Schmidt 2009 A. Schmidt, Electrical and Magnetic Methods in Archaeological Prospection, in: S. Campana – S. Piro (eds.), Seeing the Unseen. Geophysics and Landscape Archaeology (London 2009) 67–81

Ter-Martirosov 2008 F. Ter-Martirosov, Yervandashat, Patma-banasirakan handes 1, 2008, 89–101

Tonikian 1992 A. Tonikian, The Layout of Artashat and Its Historical Development, Mesopotamia 27, 1992, 161–187

Tonikyan 1996 A. V. Tonikyan, Architecture of Dwelling Houses of Artashat, Capital of Ancient Armenia, Ancient Civilizations 3/1, 1996, 15–37

Traina 1999/2000 G. Traina, Épisodes de la rencontre avec Rome (II^{e} siècle av. J.-C. – III^{e} siècle ap. J.-C.), Iran & the Caucasus 3, 1999/2000, 59–78

Traina 2018 G. Traina, La »découverte« de l'Araxe, in: A. Dan – S. Lebreton (eds.), Étude des fleuves d'Asie Mineure dans l'Antiquité II (Arras 2018) 235–244

Valder et al. 2018 J. F. Valder – J. M. Carter – C. J. Medler – R. F. Thompson – M. T. Anderson, Hydrogeologic Framework and Groundwater Conditions of the Ararat Basin in Armenia, U.S. Geological Survey Scientific Investigations Report 2017–5163, 2018; DOI: 10.3133/sir20175163

Zardarian – Akopian 1994 M. Zardarian – H. Akopian, Archaeological Excavations of Ancient Monuments in Armenia 1985–1990, Ancient Civilizations 1, 1994, 169–195

Zardaryan 2018 M. H. Zardaryan, The Early Iron Settlement of Artashat and Problems of Chrono-Topography of the Site (pre-Classical Period), Aramazd 12, 2018, 105–145

SOURCES OF ILLUSTRATIONS

Title Page: © The Armenian-German Artaxata Project
Fig. 1: Modification of Tonikian 1992, 167 Fig. B
Fig. 2: © Institute of Archaeology and Ethnography of the National Academy of Sciences of the Republic of Armenia, Jerewan
Fig. 3: © The Armenian-German Artaxata Project
Fig. 4: © The Armenian-German Artaxata Project
Fig. 5: © The Armenian-German Artaxata Project
Fig. 6: © The Armenian-German Artaxata Project
Fig. 7: © The Armenian-German Artaxata Project
Fig. 8: © The Armenian-German Artaxata Project
Fig. 9: © The Armenian-German Artaxata Project
Fig. 10: © The Armenian-German Artaxata Project
Fig. 11: © The Armenian-German Artaxata Project

ADDRESSES

Prof. Dr. Achim Lichtenberger
Institut für Klassische Archäologie und Christliche Archäologie/Archäologisches Museum
Westfälische Wilhelms-Universität Münster
Domplatz 20–22
48143 Münster
Deutschland
lichtenb@uni-muenster.de
ORCID-iD: https://orcid.org/0000-0003-2653-9859
GND: http://d-nb.info/gnd/2061969-8

Dipl.-Geophys. Cornelius Meyer
CMP Cornelius Meyer Prospection
Prenzlauer Allee 181
10405 Berlin
Deutschland
cmp@cmprospection.com

Dr. Mkrtich H. Zardaryan
Institute of Archaeology and Ethnography
National Academy of Sciences
15 Charents str.
Yerevan, 0025
Republic of Armenia
mhzardar@gmail.com

METADATA

Titel/*Title*: Report on the 2018 Magnetic Prospection at Artaxata/Artashat in Armenia
Band/*Issue*: AA 2019/2

Bitte zitieren Sie diesen Beitrag folgenderweise/*Please cite the article as follows*: A. Lichtenberger – C. Meyer – M. H. Zardaryan, Report on the 2018 Magnetic Prospection at Artaxata/Artashat in Armenia, AA 2019/2, § 1–41, https://doi.org/10.34780/aa.v0i2.1004

Online veröffentlicht am/*Online published on:* 11.05.2020
DOI: https://doi.org/10.34780/aa.v0i2.1004
URN: https://nbn-resolving.org/urn:nbn:de:0048-aa.v0i2.1004.1

Schlagworte/*Keywords*: Artaxata, Armenia, settlement archaeology, geophysics, magnetic prospection

Bibliographischer Datensatz/*Bibliographic reference*: https://zenon.dainst.org/Record/001603698